

# PLANNING FOR GREENER SUBURBS USING MULTIPLE ECOSYSTEM SERVICES MODELLING

## MOTIVATION

Urban ecosystem services refer to the benefits, such as microclimate regulation, stormwater retention and recreation opportunities, derived from natural infrastructures in an urban environment. As demands for liveable, sustainable and resilient cities rise, the role of urban ecosystem services in alleviating the environmental repercussions of urbanisation, in addition to climate change, will become increasingly important.

**Our aim** was to identify areas where natural infrastructures should be targeted to improve the provision of urban ecosystem services in peri-urban Greater Kuala Lumpur, Malaysia.

## Overview of Methods

Urban (InVEST) Ecosystem Service Models

Data Normalization

Getis-Ord Gi\* Hotspot Analysis

Sum Of Hotspots

Indicators of Physical & Land Use Constraints

Suitability Analysis (Geometric Mean)

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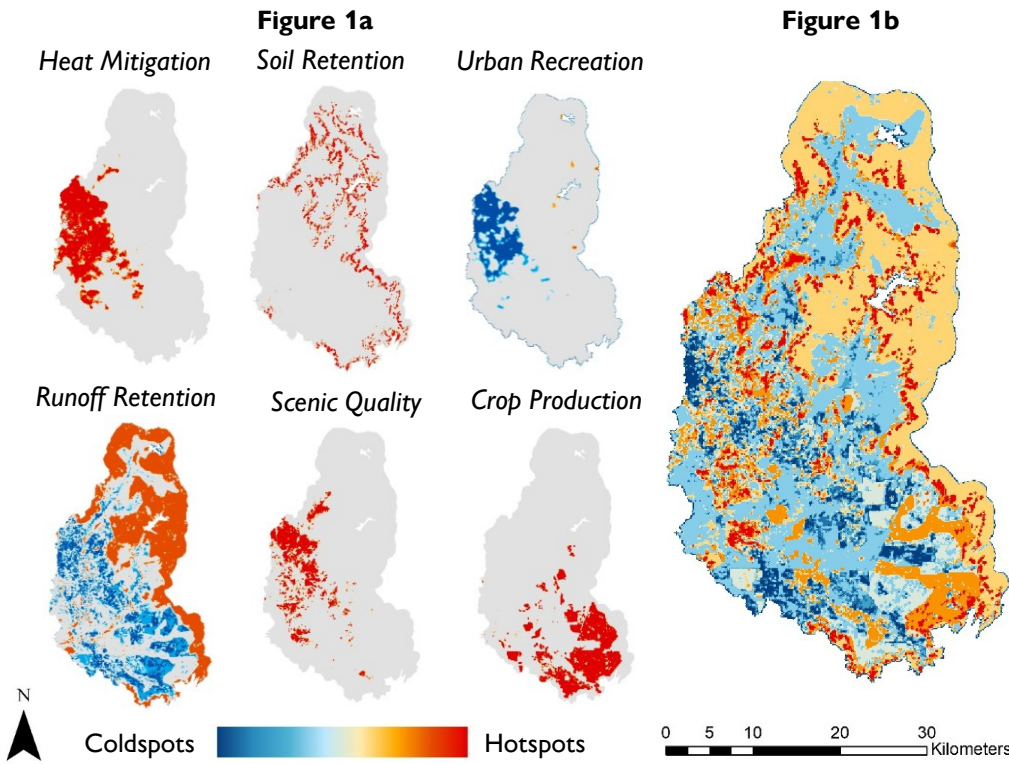
## METHODS

We used transferrable, process-based ecosystem service models (InVEST) to conduct a multiple ecosystem service assessment in the upper Langat catchment. We conducted a hotspot analysis and used the sum of the six hotspot maps as an indicator for the suitability analysis. The indicators were supported by physical and land use constraints specific to each natural infrastructure strategy (see table below). The indicator was positive (+) when higher values correspond to higher suitability, and negative (-) when higher values correspond to lower suitability. All indicators and constraints were standardized to values between 0 and 1.

## Suitability Indicators

Natural Infrastructure Strategy	Land Use and Physical Constraints	Indicators
Implementation of green roofs and walls – <b>urban greens</b>	Built areas	Sum of hotspots (-)
Development of new <b>urban parks</b>	Non-forest vegetation, bare soil, agricultural land, 500m distance from built areas	Sum of all hotspots except crop production (-)
<b>Reforestation</b> of agricultural land and vegetated areas	Vegetation + areas > 10ha	Sum of hotspots (+)
<b>Conservation of headwater areas</b>	Vegetation, agricultural land, bare soil	Sum of hotspots (+)

## Ecosystem Services Hotspots



## Sum Of Hotspots

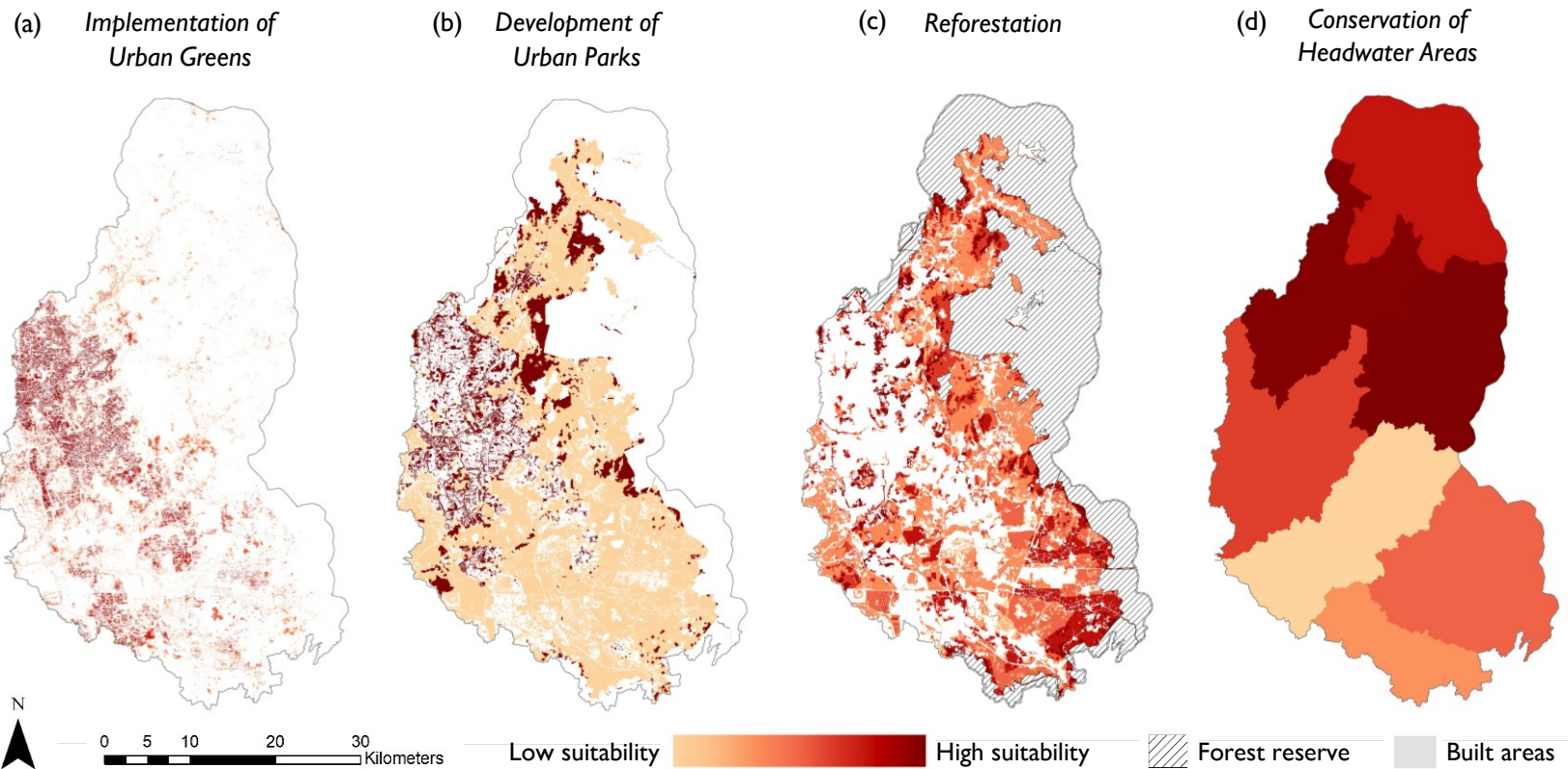
## RESULTS

- The distribution of hotspots of the six services were spatially heterogenous (Figure 1a).
- Planning efforts should be focused on areas where multiple hotspots overlap, to preserve and improve the provision of multiple services (Figure 1b).
- The suitability maps (100m x 100m) highlight parts of the catchment that are most suitable for each natural infrastructure strategy (Figure 2). Results for headwater area conservation were aggregated by mean suitability per subcatchment.
- Overlaps between the suitability maps suggest that some areas may be suitable for more than one natural infrastructure strategy (see close-up images in Figure 2).

## APPLICATION

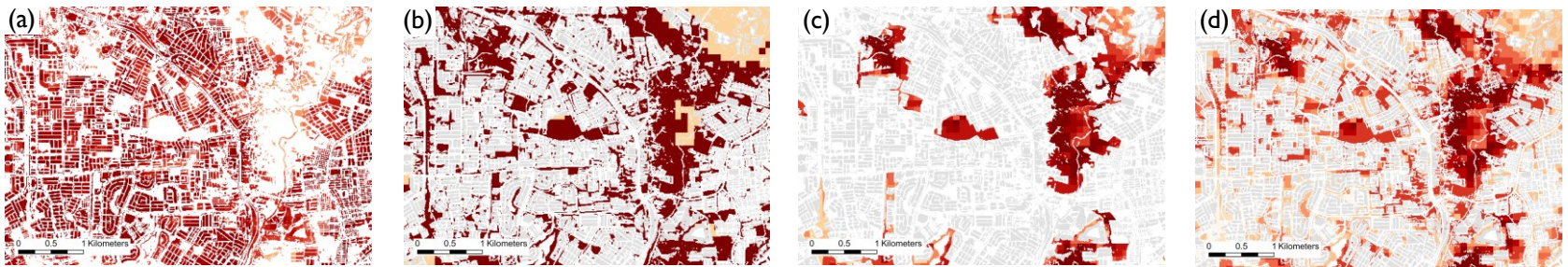
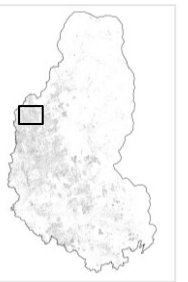
This novel approach combines process-based ecosystem service models with suitability analyses to support decision-making. The urban InVEST models parameterized in this study can be adapted for other urbanizing areas with similar climatic characteristics, while the methods applied are relevant to data poor regions globally.

## Suitability Maps For Planning Natural Infrastructures In The Upper Langat Catchment



**Figure 2**

The top row shows the four suitability maps at catchment-scale. The panel below showcases close-up images of the suitability maps above. The images highlight planning opportunities for a densely built area of the catchment (see inset below).



Note: The close-up image for headwater area conservation is shown at pixel scale (100m x 100m) derived prior to aggregation by subcatchment.