UN-HABITAT

Weitzman SCHOOL OF DESIGN
UNIVERSITY of PENNSYLVANIA

HOTSPOT STOPLIGHT

What is it?

Co-created by UN-Habitat, the University of Pennsylvania, and One Architecture, the Hotspot Stoplight geospatially projects the risk of land use change, biodiversity loss, and climate change to 2050 and provides a robust evidence base for decision making about where and how to develop with least harm to planet and people. UN-Habitat and the Uinversity of Pennsylvania share the values of helping cities grow in ways that not just restore but also prevent environmental destruction.

How does it work?

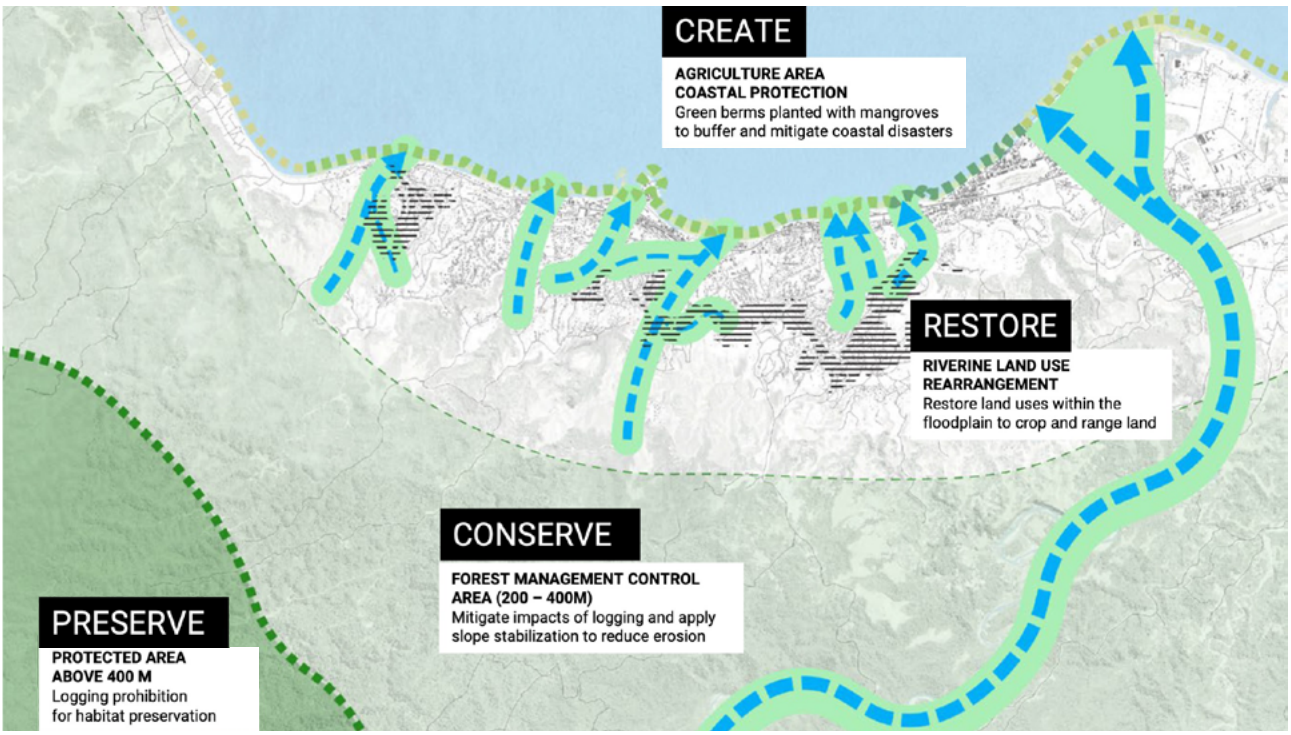
Based on open-source data, the Hotspot Stoplight uses a unique workflow based on artificial intelligence (AI) and deep learning algorithms to estimate the probabilities of (1) land use change, (2) biodiversity loss, and (3) risk of effects of climate change across space, and map these for any metropolitan area at a resolution of 30m^2. All three overlayed form a gradated 'stoplight' map that indicates combined risks of development in a particular area. The red end of the gradient indicates land likely to develop that also faces high risk of biodiversity loss and/or the effects of climate change (i.e. currently undeveloped land with a high probability of conversion that also has high biodiversity intactness and/or faces increased flooding and heat events). Such areas caution strongly against development, promoting instead preservation, conservation, and/or restoration measures. At the other end, the 'green light' indicates areas within the existing built footprint well-suited for densification or infill. In the middle, the 'yellow light' promotes caution in extending the city into areas of lower intactness and higher accessibility.

How is it unique?

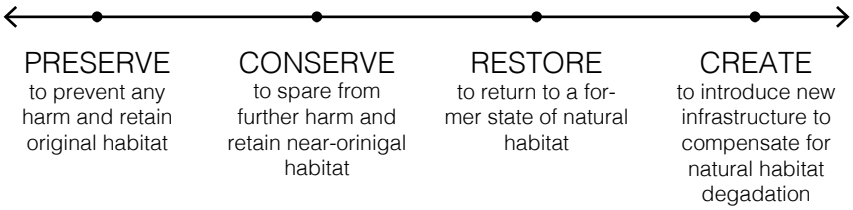
It offers multidimensionality at a fine scale. The Stoplight is the first and only tool that projects land use change and biodiversity loss (along with climate change risk). It is also the only tool that projects biodiversity loss due to any cause at such a fine scale (30m2). Existing biodiversity-oriented tools tend either to map intactness at a medium scale or to project loss at a very crude scale, but not both, making it difficult for local decision makers to make informed neighbourhood and/or site-based decisions about where and how to develop with least risk to nature, dramatically broadening the scope of urban planning.

It twins the global and the local. Our pairing of top-down (Landsat-based projections) and bottom-up (site-based ground-truthing with municipalities) approaches also has the potential to twin global impact with local access to funding. The battle for sustainable development (including achievement of the Paris Agreement and Global Biodiversity Framework) will be won or lost in cities. Largely this is because site-scale land use conversion locks in infrastructure, which in turn predetermines material flows and wider globally-experienced consequences. There are major synergies to be tapped by twinning national policies on the preservation of biodiversity and numerous local decisions made every day around our expanding cities, and correspondingly higher cumulative impact.

It offers foresight and savings. Instead of only providing a picture of the present, the Stoplight projects into the future. It transforms raw data into visualizations that help municipalities envision possible paths of action and catalyze conversations about which strategies might be most future proof. Ultimately the Stoplight promotes preventative decision making, which is cheaper and more efficient than remediation.



It illustrates tradeoffs. The Stoplight indicates not just where not to develop but also where to develop, and where development might be pursued with caution. It offers indications of most appropriate approaches along the preserve-conserve-restore-create spectrum (in terms of promoting green open space) with further suggestions about which sites might be more appropriate for extension, infill, or densification (in terms of promoting least-risk land conversion and development).



What is its potential impact?

Accelerating achievement of the SDGs

SDG-11: 11.3 on reducing sprawl, 11.5 on reducing infrastructural damage, 11.7 on increasing green public space

SDG-13: 13.1 on local disaster risk reduction strategies

SDG-15: 15.1 on increasing protected area, 15.3 on decreasing degraded land, and 15.9 on national biodiversity strategies and action plans.

Supporting the Global Biodiversity Framework

Target 1: all areas under spatial planning processes by 2030

Target 2: 30% of degraded eco-systems under restoration by 2030

Target 3: 30% of earth's area protected by 2030

Target 12: increase the area, quality, connectivity, access to, and benefits of urban green space

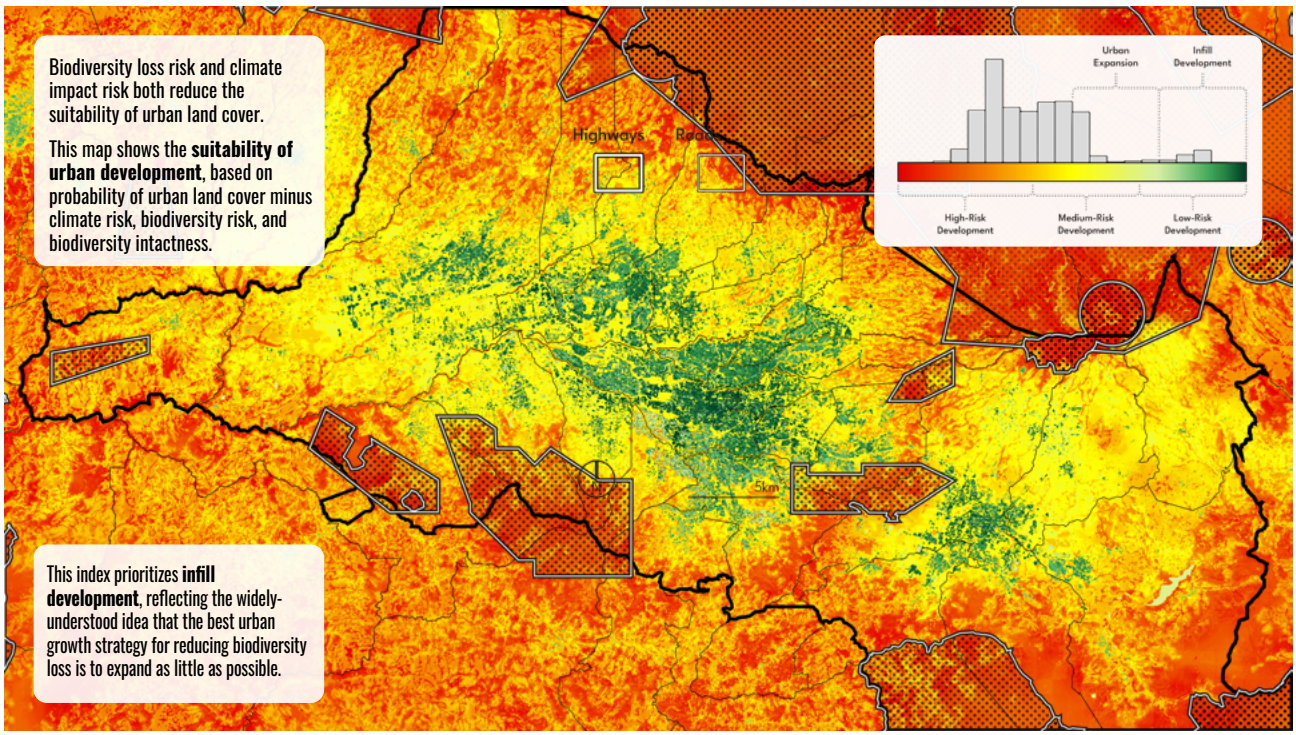
Catalyzing sustainable, local development action

Environmental impact assessment for wider-scale initiatives (e.g. hosting of major global events)

Future-proofing and revising existing plans for cities/metros

Impetus/catalyst for new spatial plans where none currently exist

Strengthening networks for supramunicipal collaboration and territorial management strategies



LEGEND

Urban Development Suitability
Hybrid Suitability-Risk Index
low
high

Protected Area by Category
IUCN
2
4
6

Municipal Boundaries
GAM
Municipality

Highways
Roads

N

5km

How was it produced?

Based on funding from the Swedish International Development Cooperation Agency, UN-Habitat, the McHarg Center for Urbanism and Ecology at the Weitzman School of Design at the University of Pennsylvania, and One Architecture \collaborated to produce two versions, tested remotely in cities in three LDCs, then remotely with ground-truthing in metropolitan San José, Costa Rica. The ground-truthing process tested the accuracy of the algorithm's classifications and engaged multiple levels and sectors (e.g. Ministries of Housing and Environment, mayors and directors of planning of constituent municipalities, and community representatives) to discuss the validity of projections and brainstorm responses.

One of the lessons learned were that challenges and opportunities are not equally distributed. Many climate change-related risks are highest in existing urban centres because of the high proportion of imperviously paved ground (and its effects on flooding and heat). These accelerating effects obviate the need to respond, but limited green space yields limited response options. In contrast, many peripheral municipalities still have relatively high proportions of green space which carry higher risk of biodiversity loss due to future land use conversion; a risk that for many local residents is less evident. Such municipalities cannot afford to forfeit investment opportunities, so it is especially important that the 'green light' (i.e. where development carries minimal risk) complement the 'red light'. There are potential benefits of collaboration between neighbouring municipalities, e.g. by payment for transferrable development rights that, by preserving intact habitat, mitigates climate risk downstream and biodiversity loss upstream.

Connection to other tools?

The UN's first resolution on biodiverse and resilient cities was adopted by the UN Habitat Assembly in 2022 with the mandate for a global toolkit. With the Hotspot Stoplight as its centrepiece, UN-Habitat is applying this modularly to other tools such as the City-Wide Open Space Assessment, and Our City Plans.

We also presented the Stoplight at the 24th Understanding Risk conference and discussed with the Interamerican Development Bank (IDB), World Bank, and Global Facility for Disaster Reduction and Recovery, the potential for pairing Risk-informed Land Use Planning (RILUP) and Nature-based Solutions Opportunity Scan (NBSOS) with the Stoplight given its projection of land use change and biodiversity loss and suggestion of planning responses (i.e. protective measures such as preservation or restoration, or development measures such as expansion or infill).

Which paths of opportunity lie ahead?

1. Broadening the Stoplight

The next step is to broaden the Stoplight to test its validity in a diverse set of circumstances (i.e. a respresentative sample of cities).

Scope: scale-up and final refinement of process and product.

Time: 18 months

Cost: US $2 million from governments and/or organizations.

Activities: scale-up the testing of the tool in a representative sample of cities (e.g. 100) in other circumstances (e.g. two to three each in other biomes in different regions) and with other attributes (e.g. size and economy).

Output: stoplight maps generated would be continued to be shared publicly along with shape files, data sets, and source codes, along with formal peer learning on robustness of algorithms.

Opportunities: the sample could include additional partner cities of UN-Habitat and others.

2a. Deepening the Stoplight

Scope: on-demand advisory service that could be deployed in any city on a case-by-case basis

Time: Two months per city

Cost: US $5K per city for an initial assessment (remote projections and mapping); US $20K for a deeper assessment (i.e. ground truthing and local engagement); US $25K for add-on services (e.g. review of existing plans)

Activities technical assistance to use algorithm to run projections and produce high-resolution maps; ground-truthing findings through site visits and engagement of local experts and and decision makers to improve accuracy; review of existing plans, quantitative analysis of ecosystem services, cost-benefit analyses, and design workshops.

Output: maps and shape files, review of existing plans, design of new plan/project.

2b. Automating the Stoplight

Scope: light version via automation of process and hosting of service for self-use

Time: open-ended, ongoing

Cost: US $50-100K for website design, TBD/yr for management

Activities: design of 'draw a box' functionality and institution of back-of-house management and hosting that allow selection of geographic parameters.

Output: automated projection and mapping with source codes in the public domain.

Contact Information

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