Earth in Sight: Evidence-Based Urban Governance for Healthy Cities

Accelerated urbanization is the thread that simultaneously stitches together agricultural territory and urban habitat. When city growth bites into the productive hinterland, it alters ecological and economic flows—water, energy, carbon, and mobility—that sustain both food security and the quality of life in already established neighborhoods (Seto, Güneralp & Hutyra, 2012; Grimm et al., 2008). Comparative projections warn that, if current trends continue, a significant fraction of cropland could be lost by 2030 due to urban expansion, with heterogeneous impacts depending on the region and crop (Bren d'Amour et al., 2017). In other words, metropolitan planning tacitly becomes an agrarian policy: deciding where and how the city grows is also deciding what and how much can be cultivated nearby.

Our approach starts from this dual equation: managing urbanization to reduce urban risks while, at the same time, safeguarding the regional food base. The path is to turn Earth observation into concrete public decisions that avoid externalities by omission: extreme heat, recurrent flooding, and the loss of soils with high productive potential (Foley et al., 2011; IPCC, 2022).

The evidence on "solutions for a cultivated planet" is clear: without expanding the agricultural frontier, it is possible to increase production by closing yield gaps, improving water efficiency, and reducing post-harvest losses (Foley et al., 2011). Territorializing these strategies requires using data to locate where favorable climatic windows exist and where stress threatens yields.

In the urban context, contemporary resilience does not seek "fail-proof" systems, but rather "safe-to-fail" ones: infrastructures that anticipate disturbances and are redesigned to fail small, not big (Ahern, 2011; Meerow & Newell, 2016). This vision connects with green-blue infrastructure—retention parks, shade corridors, permeable pavements—that buffers heat, captures runoff, and improves daily livability (Kabisch, Qureshi & Haase, 2016).

We also assume that the city is a complex ecosystem where land-use changes, urban metabolism, and climate interact and provide feedback to each other (Grimm et al., 2008). Integrating satellite data, climate series, and socio-spatial layers is not a technocratic luxury, but the sensible way to govern urban complexity (IPCC, 2022).

With this compass, we built a multi-source database at the municipal and neighborhood scale with a climate calendar from 2003 to the present, energy and atmospheric variables, and agricultural and infrastructural layers. The database is living and is updated with open services (NASA Langley Research Center, n.d.; NASA GPM, n.d.).

To characterize the climate and energy balance, we adopted NASA POWER as the backbone: a set of solar and meteorological parameters derived from CERES and MERRA-2 that allow for the description of radiation, cloud cover, and temperature at 2 m, among other critical inputs for agriculture and urban comfort (NASA Langley Research Center, n.d.).

For intense rains and stormwater drainage design, we integrated GPM IMERG, with estimates every 30 minutes in research and near-real-time versions, useful for mapping extreme events and defining operational thresholds for cleaning and dredging (NASA GPM, n.d.).

For soil moisture—key in both agriculture and the risk of waterlogging—we use SMAP, which observes the top layer of the soil every 2–3 days and distinguishes between frozen/thawed states, strengthening phenological and runoff forecasts (NASA Jet Propulsion Laboratory, n.d.-a).

Fine topography and its derivatives (slope, curvature, flow directions) come from SRTM/NASADEM, a reprocessing with improvements in voids and control that offers a 30m base to delineate micro-watersheds, identify stream lines, and locate critical waterlogging points (NASA MEaSUREs, n.d.).

For urban heat and crop thermal stress, we added ECOSTRESS, which maps surface temperature and evapotranspiration at high resolution, useful for locating urban heat island "hotspots" and estimating irrigation efficiency and water demand (NASA Jet Propulsion Laboratory, n.d.-b).

With these foundations, we took three analytical steps. First, an agricultural reading that crosses thermal windows, radiation, and soil moisture to identify "prime conditions" and "closing conditions" per crop. The practical objective is to schedule plantings, irrigation, and living covers where the climate cooperates, and to buffer stress where it does not (Foley et al., 2011).

Second, an urban reading of composite risk: precipitation (IMERG) + topographic convergence (NASADEM) + soil water state (SMAP). The result is polygons of preferential attention and operational thresholds (for example, triggering brigades when the combination of rain intensity-duration-frequency and soil saturation exceeds specific levels per neighborhood) (NASA GPM, n.d.; NASA MEaSUREs, n.d.; NASA Jet Propulsion Laboratory, n.d.-a).

Third, a public health reading that recognizes something evident and proves it with data: the climate creates the "possibility" of arbovirus transmission, but urban infrastructure (intermittent water supply, container storage, sanitation) modulates the real risk at the block level (Schmidt et al., 2011; Gibb et al., 2023).

Temperature non-linearly affects the vector competence of Aedes and the transmission potential; therefore, we combine thermal calendars with indicators of water supply and container management to anticipate critical weeks and guide campaigns (Mordecai et al., 2017; WHO, 2025).

From this analysis, clear criteria for decision-making emerge. At the urban-agricultural frontier, the city should only grow towards soils with low productive aptitude and high water resilience; near urban cores, crops with robust "prime" windows are prioritized, and investment is made in efficient irrigation where the climatic signal justifies it (Bren d'Amour et al., 2017; Foley et al., 2011).

In the urban grid, planning prioritizes shade corridors and retention parks in neighborhoods with higher thermal loads and greater modeled runoff; these investments have sustained social and environmental co-benefits (Kabisch et al., 2016; Ahern, 2011).

For urban health, we convert the thermal calendar into a prevention calendar: eliminating breeding sites one or two weeks before optimal conditions for Aedes, reinforced in neighborhoods with intermittent water supply and mandatory storage; Latin American evidence associates uncovered containers with a higher larval presence (Schmidt et al., 2011; WHO, 2025).

In public safety, we intervene in the environment with maintenance, lighting, visibility, and social programming of public spaces in polygons that today coincide with extreme heat or frequent waterlogging; the goal is to break the spiral of "physical deterioration → less social use → higher perception/occurrence of crime," while reducing exposure to environmental hazards (Grimm et al., 2008).

Governance is the muscle of the plan. We propose a Technical-Political Committee with Public Works and Territorial Planning, Potable Water and Sanitation, Parks and Gardens, Municipal Health, Economic Development, and universities. This committee validates thresholds, approves annual investment polygons, and agrees on verifiable goals (IPCC, 2022).

City leaderships participate not only by approving works but by committing to "safe-to-fail" protocols: if the pluvial-hydric thresholds are exceeded, crews and temporary closures of sponge-roadways are activated; if a thermal threshold in schools is surpassed, schedules are adjusted and neighborhood climate shelters are enabled; if the Aedes calendar approaches its peak, breeding site control and community communication are intensified (Ahern, 2011; WHO, 2025).

The citizenry is a co-producer of knowledge. With a light application (web-mobile), residents report waterlogging, perceived heat points, risk containers, and shade deficits. This flow feeds the decision-making dashboard and enables micro-actions: covering, draining, planting, and shading (WHO, 2025).

To present the project, we propose a public dashboard and a toolbox. The dashboard integrates layers for agriculture ("prime" windows and crop stress), pluvial risk (IMERG accumulations + NASADEM slopes + SMAP saturation), and vector health (weekly probability of suitable conditions), with action sheets by agency and tracking metrics (NASA Langley Research Center, n.d.; NASA GPM, n.d.; NASA MEaSUREs, n.d.; NASA Jet Propulsion Laboratory, n.d.-a).

The toolbox includes: design guides for permeable streets and retention parks; a quick manual for tree planting and shade structures; a protocol for preventive cleaning based on thresholds; and a community kit for breeding site control (Ahern, 2011; Kabisch et al., 2016; WHO, 2025).

In the agricultural dimension, development paths consider insurance and credit instruments linked to objective climatic conditions (indices based on "prime" windows and water stress signals) to stabilize incomes and prices, with continuous phenological and energy monitoring (Foley et al., 2011; NASA Langley Research Center, n.d.).

In the urban dimension, investment routes prioritize infrastructure with co-benefits: where a retention park mitigates floods, it also reduces heat, enhances urban biodiversity, and enables social space. Performance evaluation is done with ex-ante and ex-post indicators and a quarterly public audit (Kabisch et al., 2016; IPCC, 2022).

The approach aligns with the IPCC's proposal: measurable adaptation, based on local evidence, and with social safeguards. In coastal and tropical contexts—where warming and urbanization converge—acting with data simultaneously reduces multiple vulnerabilities (IPCC, 2022).

In parallel, we propose an applied research agenda with local universities: calibrating yield models with demonstration plots; validating hydrometeorological indices with low-cost sensors; testing green infrastructure and measuring its thermal and hydrological effects; evaluating Aedes control interventions with community trials (Grimm et al., 2008; Mordecai et al., 2017).

As a narrative product for decision-makers, we will develop an executive presentation that translates layers and algorithms into three questions: where to intervene first?, what package of actions to apply?, and what goal will we verify in 6–12 months? The story is told with before/after maps and neighborhood testimonials (Meerow & Newell, 2016).

For the community and media, we will prepare short audiovisual pieces that show how satellites "see" our city: where it heats up, where water runs off, and how that translates into trees, shade structures, clean grates, and covered containers (NASA Jet Propulsion Laboratory, n.d.-b; NASA GPM, n.d.).

The proposal is explicitly public: to manage urban expansion so as not to sacrifice the local food supply and to improve existing neighborhoods to make them cooler, safer, and healthier. Earth observation does not replace democratic deliberation; it makes it fairer by putting open evidence on the table (Seto et al., 2012; IPCC, 2022).

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