Nature-Based Solutions to Adapt to Local Climate Change: Political Strategies in Brazilian Cities

Procedures used to generate results

To understand how Nature-Based Solutions (NBS) are integrated into Brazilian cities' urban agenda, we conducted an in-depth analysis of the Campinas and Santos cases, in the state of São Paulo.

The procedures used to generate results involved:

1. **Data collection:**

We identified and selected official government documents about NBS strategies adopted in Santos and Campinas, including: municipal plans, master plans, and related legislation, as shown in Table 1.

Table 1—Government documents analyzed

Cities	Government documents analyzed
Campinas	• CAMPINAS. (2016a). Decree No. 19,167 of June 6, 2016. Establishes the Municipal Green Plan. Available at: https://www.campinas.sp.gov.br/arquivos/meio-ambiente /decreto_19_167_2016.pdf, accessed on Sep/15/2022. • CAMPINAS. (2016b). Campinas. Municipal Green Plan: Forecast. Available at: https://www.campinas.sp.gov.br/arquivos/meio-ambiente/vol-3-prognostico.pdf, accessed on Sep/15/2022. • CAMPINAS (2018). Complementary Law No. 189 of January 8, 2018. Sets forth the Strategic Master Plan of the municipality of Campinas. Available at: https://suplementos.campinas.sp.gov.br/admin/download/suplemento_2018-01-09_cod473_1.pdf, accessed on Sep/15/2022. • CAMPINAS. (2021a). Campinas. The city. Available at: https://portal.campinas.sp.gov.br/secretaria/planejamento-e-urbanismo/pagina/a-cidade, accessed on Sep/15/2022. • CAMPINAS. (2021b). Linear Parks. Available at: https://portal.campinas.sp.gov.br/secretaria/verde-meio-ambiente-e-desenvolvimento-sustentavel/pagina/parques-lineares, accessed on Sep/15/2022. • CAMPINAS. (2021c). Campinas. Municipal Green Plan. Available at: https://portal.campinas.sp.gov.br/secretaria/verde-meio-ambiente- e-desenvolvimento-sustentavel/pagina/plano-municipal-do-verde, accessed on Sep/15/2022. • CAMPINAS. (2021d). Ecological Corridors. Available at: https://portal.campinas.sp.gov.br/secretaria/verde-meio-ambiente-e-desenvolvimento-sustentavel/pagina/corredores-ecologicos, accessed on Sep/15/2022. • Interact-Bio. (2021). Action Plan for the Implementation of the Area of

Cities	Government documents analyzed
	Connectivity of the Campinas Metropolitan Area. Available at: https://americadosul.iclei.org/wp-content/uploads/sites/78/2021/04/60-ly-plano-de-acao-campinas-digital-3.pdf, last accessed on Sep/15/2022.
Santos	• MOREIRA, P. F., CARVALHO, D. A. E COFFANI, J. V. (2022). Panel III: Ecosystem-Based Adaptation (EBA): Measure on Mount Serrat. Available at: https://www.santos.sp.gov.br/static/files_www/files/portal_files/hotsites/pacs/abe_-_monte_serrat_joaovicentecoffani_daniellecarvalho_paulamoreira.pdf, last accessed on Sep/15/2022. • SANTOS. (2021). Municipal Plan for the Conservation and Recovery of the Atlantic Forest (PMMA) of Santos. Available at: https://www.santos.sp.gov.br/?q=hotsite/plano-municipal-de-conservacao-e-recuperacao-da-mata-atlantica-pmma, accessed on Sep/15/2022. • SANTOS. (2022). Santos Climate Action Plan. Executive Summary Available at: https://www.santos.sp.gov.br/static/files_www/files/portal_files/hotsites/pacs/plano_de_acao_climatica_de_santos_pacs_sumario_executivo.pdf, last accessed on Sep/15/2022.

Additionally, the events and meetings held by local governments and partner institutions regarding the analyzed NBS strategies were also followed by some of the authors between 2019 and 2022, as shown in Table 2.

Table 2—List of events followed by the first author

Activity	Event	Date
NBS in Santos, SP	Adaptation and Urban Resilience Day	Jan/13/2022
	3rd participatory workshop for Discussion and Validation of the Guidelines for the Santos-SP Climate Action Plan	Sep/30/2021
	Pocket Training—Inclusive and Non-Sexist Language, ProAdapta Project	Sep/08/2021
	2nd Critical Areas Assessment Workshop in Santos/SP	Aug/6/2021
	1st Future Risk Impact Assessment Workshop	Jul/6/2021

Activity	Event	Date
	Santos Climate	
	Meeting of the Municipal Commission on Climate Change Adaptation	Nov/19/2020
	Webinar on the Experience of the Santos ProAdapta GIZ/SIMA Adaptation Plan	Jul/10/2020
	II Seminar of the Santos Municipal Commission on Climate Change Adaptation	Nov/4/2019
NBS in Campinas-SP	How to mobilize resources for water security in Campinas and surrounding areas: the role of forests	Sep/15/2022
	V Webinar on Protected Areas and Green Areas as Connectivity Strategies	Jul/15/2021
	Launch of the Action Plan for the Implementation of the Connectivity Area of the Campinas Metropolitan Area	Apr/8/2021
	III Webinar on the Subnetwork of Local Protected Areas	Feb/25/2021
	Session "Nature-based solutions for cities—What they are and how they can be expanded"	Nov/12/2020
	IV Conference on Local Protected Areas	Sep/14/2020

2. Definition of keywords:

Identification of the key variables to be analyzed in the selected documents, including: nature-based solutions, ecosystem services, nature-based adaptation, green infrastructure, ecosystem-based disaster risk reduction, nature-based infrastructure, and engineering with nature, based on

GADDA et al., 2019.

3. Data analysis:

We broke down the analysis of the data into four key topics: (i) urban and climate challenges, (ii) NBS co-benefits, (iii) NBS facilitators, and (iv) NBS potential and limitations. These topics of interest for analysis were inspired by the research methodology adopted in the project "Naturvation*: Nature-based Urban Innovation*"[1] (ALMASSY et al., 2018), which conducted a survey into a thousand NBS interventions in one hundred European cities in 2017. It was the first systematic survey on NBS interventions in urban environments. In our case, the interventions analyzed were pointed out by survey respondents themselves and we sought to analyze which types of NBS were being implemented, in which places, and how they were being delivered, as well as the problems they aimed to solve, their type, form, role, and distribution.

4. Interpretation of results:

The analysis of the results to understand how nature-based solutions are being integrated into the urban agendas of the two cities aimed to respond to specific issues regarding each topic, as detailed in Table 3. These issues were defined by the authors, inspired by ALMASSY et al., 2018.

Table 3 – Specific issues analyzed in the NBS cases of Santos and Campinas

Key topics	Specific issues
(i) Urban challenges, including climate challenges	● Problem/motivation and relationship with climate change; ● Urban challenges addressed by the intervention; ● Integration with other actions, programs, strategies; ● Intervention scale (regional, municipal, local)
(ii) NBS Co-benefits	● Related ecosystem services (BPBES, 2019): ○ *Cultural*: religious and spiritual values, generation of knowledge (formal and traditional), educational values, tourism, sports, and leisure. ○ *Support*: oxygen production, soil formation and retention, nutrient and water cycling, habitat provision for species, and maintenance of genetic diversity. ○ *Regulation*: air quality maintenance, climate regulation,

1 It is a project conducted by Durham University, involving 14 partners and funded by Horizon Europe (Horizon 2020), the European Union's research and innovation funding program (www.naturvation.eu, last accessed on Mar/23/2022).

Key topics	Specific issues
	erosion control, water purification, pollination, coastal protection, and damage mitigation. ○ *Provision*: food and fiber, genetic resources, biochemical and medicinal products, and water.
(iii) NBS facilitators	● Agents involved (networks, international cooperation, other social segments), institutional arrangements; ● Social participation ● Plans, research projects, subsidies; ● Funding (funding sources, types of funding)
(iv) NBS potential and limitations	● Potential for innovation with social components (e.g. significant changes in policies, economic or governmental structures, cultural changes, etc.); ● Potential for replicability or transferability (e.g. in other areas of the city, in other cities, etc.); ● Impacts of the intervention and indicators adopted to assess/monitor them.

5. Discussion and conclusion:

The results were contextualized within the urban panorama of adaptation to the impacts of climate change in the urban context and the discussion on the implications, limitations, and possible future directions taken toward policies and research in the Brazilian case.