



Research article

Exploring environmental justice and nexus approaches in Paris urban nature policies



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ABSTRACT

Pathways to a just and sustainable future require integrated policies that account for the interlinkages between biodiversity, climate and human health. Cities have a vital role in implementing these approaches in their local policies to address urban challenges. However, significant knowledge gaps persist in understanding how current urban policies address the interconnections between issues, and in identifying nature-based initiatives that successfully replace siloed approaches with more integrated strategies. Moreover, these policies raise concerns for justice and equity, an important cross-cutting issue for environmental policies that is not always made visible. In this study, we analyzed how policy documents of Paris, France, jointly address the intertwined issues of biodiversity, climate and human health and its connections with environmental justice. We selected 32 plans addressing urban nature, spanning the period 2006–2022. We extracted and coded nexus and environmental justice information, as well as policy goals, actions, and actionability (budget, actors, indicators). We then conducted quantitative and statistical analyses. Few documents comprehensively targeted the entire nexus. Most of them focused solely on biodiversity or adaptation issues. Environmental justice, when mentioned, was mainly addressed by distributive interventions with unclear principles, and participation measures aimed at the general public, rather than specific recipients (e.g. vulnerable populations such as low-income people, children). This study offers new insights into the integrated governance of urban nature areas in large cities. It calls for a more in-depth translation of a nexus approach to city policies and a stronger consideration of environmental justice through detailed actions, with specific indicators.

1. Introduction

Cities generate environmental pressures that can adversely impact human well-being. These include air and noise pollution, and climate change-induced risks such as urban heatwaves (European Environment Agency, 2021). Urban nature has the potential to help address these multiple issues, as it supports a variety of ecosystem services. For instance, urban green spaces can support biodiversity conservation, including endangered species, even though urbanization is a threat for biodiversity in general (Ives et al., 2016; Kowarik et al., 2020; Oke et al., 2021). They also contribute to climate change adaptation and mitigation (Demuzere et al., 2014; Kabisch et al., 2016; Marando et al., 2019), which is a significant challenge to cities, as they tend to be more affected

(Dodman et al., 2022). Urban nature is also determinant for human quality of life, improving physical and mental health (Kabisch et al., 2017; Tzoulas et al., 2007; van den Bosch and Ode Sang, 2017), and social cohesion (Wan et al., 2021).

Effective urban nature management therefore requires integrated policies that recognize the complex and interdependent relationships between biodiversity, climate and human health or quality of life (Korn et al., 2019; Lampinen et al., 2023; Newell, 2023; Pedersen Zari et al., 2022). Policy integration is often analyzed through the lens of a nexus, which examines the interconnectedness and interactions between various environmental, social, and economic factors (Kim et al., 2024; Liu et al., 2018; Pascual et al., 2022). The nexus approach is intended to improve planning and governance as it informs multifunctional

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interventions, promotes cooperation between actors from different sectors, and reveals synergies, tradeoffs or unexpected consequences. Critical knowledge gaps remain in understanding how biodiversity-climate-health interconnections are addressed within urban policy frameworks, and identifying the nature-based initiatives that effectively break down siloed approaches to promote integrated ones instead.

To meet sustainability goals, urban policies must also consider socio-economic cross-cutting issues, such as equity and justice, poverty reduction and insecurity along with biodiversity, climate and health. Recent studies have alerted us on the unequal distribution and access to green spaces, for instance according to ethnicity, gender or social class (Colley et al., 2022; Kabisch and Haase, 2014; Rigolon et al., 2018). Greening strategies can also foster injustices, like in the case of green gentrification (Anguelovski et al., 2018; Garcia-Lamarca et al., 2021; Haase, 2024). Accordingly, the United Nations guidelines "Towards Green and Just Cities" recommend to better integrate environmental justice in urban greening initiatives (UNEP, 2021). However, translating these guidelines into operational plans is not an easy task, and in practice, environmental justice often remains overlooked in urban greening policies, despite declared ambitions in this regard (Gradinaru et al., 2023; Loh and Kim, 2021; Pearsall and Pierce, 2010). There is a need to understand how urban plans address equity concerns in their processes and outcomes, ensuring fairness across all segments of society. This requires understanding what are the different aspects of justice considered (distributive or participative justice for instance), as well as the broad principles which determine who should benefit from or participate in the design of urban nature policies.

This study focused on the following question: How do urban nature policy plans of the city of Paris (France) address a nexus comprising biodiversity conservation, climate adaptation and mitigation, and human health, and its connections with justice and inequities? Paris is particularly relevant for investigating this question as it is a densely populated city where urban nature challenges are addressed through multiple policies and municipal initiatives, designed by several departments within the municipal administration. Paris is also often used to examine urban sustainability challenges for large cities in the global North (Aubry and Kebir, 2013; de Munck et al., 2018; Shwartz et al., 2014). We selected 32 policy documents addressing urban nature, spanning the period 2006–2022. We extracted and coded nexus and

environmental inequities information, as well as policy goals, actions, and actionability (budget, actors, indicators). With this approach, we showcase an original application of plan content analysis to understand interactions between biodiversity conservation, health and climate with environmental justice in a large European city.

2. Materials and methods

2.1. Conceptualizing urban nature, the biodiversity-climate-health nexus and environmental justice

We focused our analysis on a Biodiversity-Climate-Health nexus related to Paris urban nature areas (Box 1).

Recent conceptual papers have proposed an extended nexus approach integrating societal dimensions such as human well-being, governance and justice (Pascual et al., 2022; Pörtner et al., 2021). We focused on environmental justice as a key crosscutting issue in relation to the Biodiversity-Climate-Health nexus (McElwee et al., 2024). We referred to Schlosberg's framework (Schlosberg, 2007) which is commonly used in literature (Grabowski et al., 2023; Lambrou and Loukaitou-Sideris, 2022; Menton et al., 2020). This framework distinguishes three complementary dimensions of justice: distributive (allocation of benefits, costs, and rights among people), procedural (the participation and involvement of various stakeholders and the public in both the decision-making process and policy implementation) and recognition (acknowledging the diversity of actors and including the plurality of needs, values, and preferences of the population to avoid cultural domination of certain actors) (Kato-Huerta and Geneletti, 2022; Loos et al., 2023; Schlosberg, 2007).

In this paper, we will focus our analysis of justice on urban nature and exclude other aspects of environmental justice such as differentiated responsibilities in carbon emissions or biodiversity erosion, access to water, etc. In addition to applying the three dimensions of the Schlosberg framework—distributive, procedural, and recognition—to analyze how justice is addressed, we also examine the underlying principles guiding these considerations. Justice principles are the normative rules that guide public action. They define what is fair and are for instance invoked for deciding the fair allocation of benefits, burdens, responsibilities (i.e. the distributive dimension of justice). Justice principles mentioned in the justice literature include: need (prioritization or

Box 1

Definitions of the elements in the nexus

Urban nature by opposition with the artificial environment, includes the diversity of terrestrial (green) and aquatic (blue) areas within cities such as parks, gardens, fallow land, urban forest, green roofs, rivers etc. It also includes all living organisms like plants, bacteria, fungi and non-human animals.

Biodiversity is “the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic, and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities and ecosystems” (Díaz et al., 2015).

Anthropogenic Climate Change refers to changes in the state of the climate that can be attributed directly or indirectly to human activities that alter the composition of the global atmosphere, in particular through the emission of greenhouse gases (such as CO₂, CH₄ and N₂O) from fossil fuel combustion, deforestation, industrial processes and agriculture, among other anthropogenic sources. Policies consider two complementary aspects: 1) mitigation, which is a “human intervention to reduce the emissions or enhance the sinks of greenhouse gases” (thanks to ecosystem sequestration only in this study: i.e. we excluded from the analyses measures seeking to decrease sectorial carbon emissions) and 2) adaptation, which is defined “In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects” (Intergovernmental Panel on Climate Change, 2022).

Health is “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (Constitution of the World Health Organization, 1946). Following IPBES nexus assessment, this article focuses on human health only, and do not consider ecosystem or animal health (McElwee et al., 2024). Therefore, actions focusing on restoring, preserving or enhancing ecological integrity were considered as part of the Biodiversity component of the nexus.

advantage of the most vulnerable or unfavored individuals), equality (uniform distribution or equal treatment of all individuals), merit (balance between input and output, also known as “proportionality” or “desert”) and sufficiency (an equitable distribution leading to the satisfaction of minimum acceptable thresholds of well-being) (Gurney et al., 2021; Lehmann et al., 2018; Wijsman and Berbés-Blázquez, 2022). The principles of justice introduce a more normative dimension to the analysis, in contrast to the three dimensions of the Schlosberg framework, which we applied in a descriptive way.

To complement the analysis of justice in the plans, we also examined what precise inequities are explicitly mentioned in the plans. We define inequities as differences between groups of actors based on their socio-economic characteristics, in relation to public policy issues such as housing, employment, access to environmental amenities, access to health, vulnerability or exposure to environmental externalities and hazards, etc. Inequities in distribution, participation, and recognition highlight existing disparities between population groups, whereas justice sets normative goals concerning these aspects, reflecting ideals of fairness—essentially the direction in which we aim to rectify existing inequities.

Inequities are underpinned by socio-economic factors, also called factors of differentiation (Collins et al., 2021; Djoudi et al., 2016; Vallet et al., 2019). Relevant socio-economic factors include income, age, gender, disabilities etc. They can cumulate one with each other, constituting cross-factor inequities or ‘intersectional inequities’, which are inequities resulting from more than one factor, such as being elders with low income (Amorim-Maia et al., 2022; Anguelovski et al., 2020).

2.2. Paris case study

Paris is a city of 2 million inhabitants, for an area of 105 km², divided into 20 districts. The Municipality of Paris exercises administrative authority over this territory and has financial autonomy. The municipality is organized into 23 different departments under the authority of the elected mayor and his/her deputies. Plans are generally drafted by the departments, with the help of some deputies, and adopted by the Paris City Council (composed of 163 elected deputies). Plans frame the public action of the City. Some plans are mandatory and respond to specific legislations, such as climate plans or urbanism plans. Others are voluntary and reflect political commitment. Plans provided by other levels of government may frame and influence Paris’ policies and public actions (Metropole du Grand Paris, Region Ile de France, national), but are not considered in this study as we focused on the Municipality of Paris.

Green areas represent around 31 % of Paris area, including two relatively large urban forests (Bois de Boulogne and Bois de Vincennes). These spaces include natural areas (forest, rivers, ponds), vegetated managed lands (public and private parks and gardens, squares, cemeteries), and built-up land (walls and roofs, riverbanks, etc.) (Plan Bio-diversité de Paris, 2018–2024, 2019). Paris counts about 500,000 trees (300,000 in the woods) and 2800 species of wild plants, fungi and animals have been identified in Paris between 2010 and 2020, some of them being protected at national and regional levels (Atlas de la nature de Paris, 2020, 2020). In terms of the distribution of green spaces, half of Parisians did not have access to a green space of more than 1.5 ha within 300 m of their home (considered in the literature as the minimum size allowing residents to engage in physical activity or relaxation within a 5-min walk of their home), with the northern part of Paris being particularly deprived (Liotta et al., 2020). Half of the neighborhoods identified as vulnerable in terms of environmental health also lacked access to green areas (Vernouillet et al., 2023).

2.3. Plan content analysis

Content analysis has proved to be effective to understand how policymakers consider and frame nature issues in city planning. It has been

used to explore greening strategies such as ecosystem-based adaptation in climate adaptation plans (Geneletti and Zardo, 2016), biodiversity conservation and ecosystem services in urban policies (Cortinovis and Geneletti, 2018; Nilon et al., 2017; Pierce et al., 2020), or the integration of green infrastructure principles in urban policies (Grădinaru and Hersperger, 2019). A few studies addressed environmental justice in plans regarding nature such as climate strategies (Fiack et al., 2021; Kato-Huerta and Geneletti, 2023), green infrastructure plans (Grabowski et al., 2023; Grădinaru et al., 2023) and urban forest management plans (Grant et al., 2022). In this study, we used a directed content analysis, which is a systematic method based on a coding protocol that helps interpret the content of documents or measure their characteristics based on an existing framework (Cortinovis and Geneletti, 2018; Lyles and Stevens, 2014). We followed a three-step approach: (1) creation of the corpus of plans (identification, collection and selection of relevant documents according to eligibility criteria), (2) information extraction, following the coding protocol, and (3) data analysis.

2.3.1. Identification of relevant documents (STEP 1)

Following Grabowski et al. (2023) we included diverse types of policies, and did not restrict the corpus to environmental plans. An initial corpus was identified from a document summarizing the ‘main policies of Paris’ over the period 2010–2020 (Ville de Paris, 2019). This corpus was iteratively augmented by adding plans mentioned in the documents (i.e snowball sampling) and by asking representatives of city departments to add plans produced by their teams. A total of 104 documents were identified as potentially relevant for the study (Fig. 1), but 27 of them were removed from the list as they were either not available online or through internal requests, or did not exist as a formal plan document (but only as a web page or as a deliberation project for the Paris Council). We screened 77 documents for eligibility. The eligibility criteria used were: (1) covering the entire city (documents or sections of document that were specific to particular districts or areas were not included in the analysis), (2) being a programmatic document (with explicit objectives/targets/orientations/commitments and/or actions) framing public action, (3) presence of several mentions of common urban nature-related semantics such as “nature in the city”, “green spaces”, “parks”, “gardens”, “tree”, “biodiversity in the city”, “river”(see the list in the Codebook). Following the screening of the 77 documents, six were excluded as they did not constitute a “plan” (a programmatic document outlining policies). Another 39 were excluded as they did not address urban nature. We ended with a selection of 32 documents that we included in the analysis (Table 1).

We did not find any relevant policy plans published before the 2000’s. The oldest document found dates back to 2006. Data collection stopped in September 2023. Plans that had not yet been officially published (e.g. prior to final adoption by the City Council) were excluded.

In this study, “plan” refers to all types of documents that have a programmatic aspect: it includes documents strictly called plans, but also strategies, roadmaps, contracts with the state or other public stakeholders, as well as master plans. Documents had different political importance: some were mandatory and legally binding (e.g. the local urbanization plan), or had more political support (e.g. the climate plan). Plans widely differed regarding their format and contents: some were “action oriented” with a highly operational focus, while others rather consisted in general guidelines, for communication with the general public.

The local urbanization plan was difficult to analyze since it is comprised of various documents including a territorial analysis, guidelines for urban development and a regulation document. Some of these documents were added years after the initial plan was created. We chose to limit the scope of our analysis to the programmatic guidelines documents that met the eligibility criteria (the “projet d’aménagement et de développement durable” and one of the “orientation d’aménagement et de programmation” that concerned the whole municipality territory)

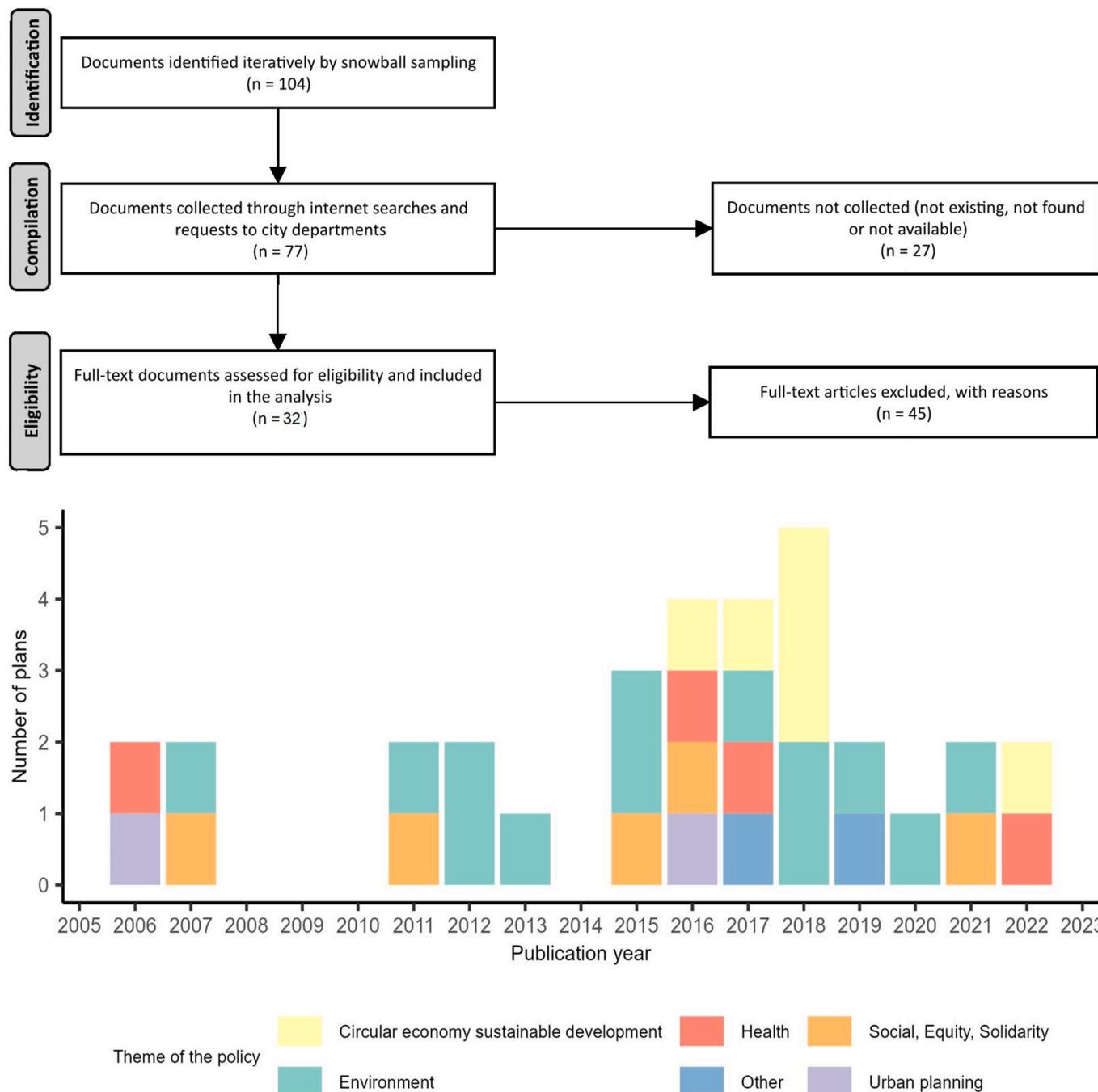


Fig. 1. Selection process and selected plans. Prisma Flow diagram outlining the steps for creating the final dataset. Theme and publication year of our 32 selected plans (addressing urban nature).

and excluded the territorial analysis (describing the current situation) and the regulation chapter (specific rules to be observed for urban development).

2.3.2. Information extraction (STEP 2)

Each document was carefully read by the first author, and data was extracted following a structured codebook (all supporting data is available at <https://doi.org/10.57745/I1DM36>). The authors discussed how to interpret and code the various types of information, establishing a set of “coding rules” that were then applied by a single reader and coder across the entire corpus. This approach helped to limit interpretation bias that might have arisen with multiple coders. The codebook was structured into 4 sections: (1) general information, (2) plan scoping

and actionability, (3) nexus dimensions (biodiversity, climate, health) in the plan and in the objectives, and (4) environmental justice.

General information: We recorded information on publication year, policy theme (“Environment”, “Circular economy sustainable development”, “Urban planning”, “Health”, “Social, Equity, Solidarity”, “Other”), department which redacted the plan, whether it is a new plan or a revision of an existing policy, whether the plan is a mandatory policy (required by national law, such as local urban plans and climate plans) or a voluntary initiative adopted at the municipality’s discretion.

Plan scoping and actionability: Two attributes of plans were assessed: their framing (production process, plan management, objective, actions, fact base and policy assessment) and their actionability (deadlines, resources, indicators, actors). We used a three-level scoring

Table 1

List of policy documents included in the analysis.

1. 2006, « Plan Local d'Urbanisme, Projet d'aménagement et de développement durable - Introduction»
2. 2006, « Le Plan de lutte contre le bruit »
3. 2007, « Plan Climat de Paris »
4. 2007, « Contrat urbain de cohésion social pour Paris 2007-2009 »
5. 2011, « Programme local de l'habitat 2011-2016 modifié - Programme d'actions »
6. 2011, « Plan Biodiversité 2011 de Paris »
7. 2012, « Plan Climat Energie de Paris actualisation 2012 »
8. 2012, « Plan Climat Energie de Paris - Carnet de l'administration »
9. 2013, « Plan Climat Energie de Paris - Carnet logement »
10. 2015, « Stratégie d'adaptation au changement climatique »
11. 2015, « Contrat de Ville 2015-2020 »
12. 2015, « Schéma directeur de valorisation et développement de l'eau non potable 2015-2020 »
13. 2016, « Plan compost parisien 2016-2020 »
14. 2016, « Plan prévention du bruit dans l'environnement 2015-2020 »
15. 2016, « Faire le Paris des enfants et des familles »
16. 2016, « Plan Local d'Urbanisme - Orientations d'aménagement et de programmation en faveur de la cohérence écologique »
17. 2017, « Plan santé environnement »
18. 2017, « Schéma de développement touristique de paris 2017-2022 »
19. 2017, « Stratégie de résilience de Paris »
20. 2017, « Plan économie circulaire de Paris 2017 2020 »
21. 2018, « Plan économie circulaire de Paris 2017-2020 - 2e feuille de route novembre 2018 »
22. 2018, « Stratégie de Paris pour une Alimentation Durable »
23. 2018, « Plan Paris Pluie »
24. 2018, « Plan Climat 2018»
25. 2018, « Paris Intelligente et durable, perspectives 2020 et au-delà »
26. 2019, « Plan Biodiversité 2018-2024 »
27. 2019, « Plan Transformations Olympiques »
28. 2020, « Contrat de territoire eau et climat 2020-2024 »
29. 2021, « Plan Arbre 2021-2026 »
30. 2021, « Projet Éducatif de Territoire 2021-2026 »
31. 2022, « Plan d'amélioration de l'environnement sonore 2021-2026 »
32. 2022, « Plan Alimentation Durable 2022-2027 »

scale to assess the level of integration in the plan: Not included (0), Partially included (not systemic or vague) (0.5), Included (systemic, sufficiently explicit and accurate) (1). In each plan we identified each objective addressing urban nature. One document can contain several objectives (e.g., “Refreshing the city during heatwaves” or “33ha of urban agriculture for 2020”), each of them with one or several actions (e.g., “Open parks and gardens 24h/24 during summer”, “develop agricultural garden on water reservoirs”). Actions, actors and deadlines for each objective related to urban nature were recorded. Actions were coded following a 15 categories typology of intervention (Table 2). One action (as represented in the policy) could map to more than one category of intervention in the typology. For example, the action “Strengthen the promotion of participatory science” (#Plan biodiversité 2018) corresponds to three intervention types: “Awareness raising”, “Monitoring or creation of knowledge” and “Participation”. Actors were also classified using the typology provided in Supplementary material (Table SM1).

Nexus dimensions: We analyzed the integration between biodiversity, climate, and health within plans at two levels. First, we recorded whether urban nature was related to each nexus element at the plan level. We also recorded the sign of the relationship, whether positive (synergy and co-benefits) or negative (opposition, trade-off,

contradiction). Then we analyzed the integration of the Biodiversity-Climate-Health nexus at the level of plan objectives: we surveyed every plan objective addressing urban nature in the document and assessed the consideration of each nexus element (even when implicit).

Environmental justice: First, we conducted a semantic analysis and checked whether different terms referring to justice concepts were present in each plan (i.e. they were coded as binary variable yes/no): “equity”, “equality”, “social justice”, “environmental justice”, “inequities”, “solidarity”. Then, multiple information was collected in relation with environmental justice, including consideration of social inequities in plan objectives, justice dimensions and their underlying principles in the plan, existence of inequities in relation to different environmental topics (such as access to nature, climate vulnerability, health, environmental hazards, and others), and their underlying socio-economic factors. The socio-economic factors considered are listed in the codebook, and include age, gender, level of education, income class, disability, etc., with the possibility to list multiple factors in an intersectional perspective (Benevolenza and DeRigne, 2019; Cardona et al., 2012; Szagri et al., 2023).

We determined whether each plan concerned distributive (allocation of benefits or costs), procedural (participation in decision making or implementation), or recognition (acknowledgment of different

Table 2

Typology of interventions with description and examples from the corpus.

Intervention type	Description	Examples
Assistance	Help and support, provide guidance, support initiatives, financial support.	"Supporting Parisian actors in their efforts to obtain the biodiversity label" (#Plan biodiversité 2018);
Awareness raising	Raise awareness, communicate, form, lobby, try to influence other actors.	"Distributing a new edition of the Atlas of Nature in Paris" (#Plan biodiversité 2018);
Change in practice or management	Change in usual practices or management.	"Supporting the transition of non-municipal green spaces to ecological management" (#Plan biodiversité 2018), "Adapting urban lighting to biodiversity" (#Plan biodiversité 2011);
Collaboration	Collaboration, coordination, developing partnerships, networking.	"Integrating biodiversity into cooperative activities with neighborhood communities" (#Plan biodiversité 2011), "Partnership agreement with AgroParisTech, focusing on agriculture in Paris." (#Stratégie "Ville intelligente et durable");
Conservation	Species or ecosystem conservation measures.	"Participate in regional action plans for odonates and chiropterans" (#Plan biodiversité 2018);
Construction	Design building, construction site management.	"Increasing the extent to which biodiversity is taken into account in construction, redevelopment and renovation projects carried out by actors in the Paris real estate sector" (#Plan biodiversité 2018);
Crisis management	Crisis prevention or management.	"Limiting the spread of disease-carrying animal species" (#Plan biodiversité 2018);
Experiment	Conduct experimental projects, develop or support new sectors, initiate a reflection.	"Implementing innovative greening solutions" (#Stratégie adaptation), "Experimenting with and developing oasis schoolyards" (#Plan biodiversité 2018);
Monitoring or knowledge creation	Conduct studies and assessments, develop indicators, monitor, develop knowledge, support research.	"Characterise the impact of climate change on existing flora and fauna" (#Plan biodiversité 2018), "Study to assess the ecological impact of artificial spawning grounds in canals" (#Contrat eau et climat);
Participation	Develop citizen participation, support citizen mobilization, organize public events.	"Supporting citizens' initiatives to green public spaces, particularly neglected areas" (#Contrat de Ville, 2015–2020);
Planning	Creating, modifying or adding elements to plans and strategies	"Reinforcing the content of the local urbanization plan, in particular by incorporating the Paris Green and Blue corridors", "Develop an action plan for the House Sparrow and breeding birds" (#Plan biodiversité 2018);
Resource development	Create an institution, a program, a tool; add or search for additional financial or human resources; extend an existing program.	"Continuing operations that enable Parisians to play an active role in biodiversity conservation" (#Plan biodiversité 2018), "Creation of a Permaculture school in Paris" (#Stratégie "Ville intelligente et durable");

Table 2 (continued)

Intervention type	Description	Examples
Urban development	Street planning, creation of green spaces or infrastructures.	"Creation or extension of green spaces" (#Contrat eau et climat);
Vegetation or ecosystem restoration	Planting, creating natural and semi-natural spaces, adding vegetation (on walls, roofs etc.).	"Increasing the greening of Parisian buildings" (#Plan biodiversité 2018), "Creating urban micro-forests in Paris public spaces" (#Contrat eau et climat);
Other/Unclear		

preferences, or values) justice dimensions. We distinguished between mentions related to general statements about environmental justice in Paris and those concerning municipal interventions. Finally, we identified the targeted public or 'recipients of justice' and the "justice principle" associated ("need", "equality", "sufficiency", "merit" or "unclear"). For that purpose, we differentiated between the following possible recipients of justice principles: vulnerable or unfavored groups that present some well-identified socio-economic vulnerability (e.g., "Priority [for greening] will be given [...], with special attention to disadvantaged neighborhoods."), specific group (not explicitly targeted for a specific socio-economic vulnerability, e.g., "Children will be associated with the actions of the new biodiversity plan of the City of Paris in 2016 which will allow them to be ambassadors for the protection and development of the wildlife of our city"), no particular group (when no specific recipient is targeted, and any Parisian could theoretically benefit or participate, e.g., "The goal is for all Parisians to have a garden within 300 m of their home"). Vulnerable groups are those that are considered disadvantaged or vulnerable according to the text, and are described by a list of characteristics, similar to the typology we used for factors of social inequities (See codebook). Plans may present multiple perspectives, such as distributive views for the general public (with an unclear principle) and distributive views for vulnerable or unfavored groups (need principle).

Data extraction was carried out using the kobotoolbox online platform ([KoboToolbox, s. d.](#)), using the codebook presented above. Data collected was exported from kobotoolbox as Excel spreadsheets, which are accessible in open access at <https://doi.org/10.57745/I1DM36>.

2.3.3. Statistical analyses (STEP 3)

We conducted several statistical analyses to address the following research questions focusing on the nexus and environmental justice:

Is there a relationship between the policy theme (especially environmental plans in comparison to the other themes) and the complexity of the nexus (assessed at the level of each policy objective)? And between policy theme and the dimension of justice or the principles of justice?

Does the nexus complexity change through time? Is there an effect of the mandates of the two different mayors over the studied period on the nexus complexity of objectives (comparison before and after 2014)? Is there a relationship between the mandates and the principles of justice or the dimensions of justice? Do objectives with a high nexus complexity also consider inequities?

We conducted Wilcoxon rank-sum tests to assess the relationship between the policy theme (specifically, whether it is an environmental policy or not) and: (1) the complexity of the nexus, and Chi-squared tests for the relationship with (2) the dimension of justice and (3) the principles of justice.

We used a linear regression to model the relationship between the year of publication (as explanatory variable) and the complexity of the nexus (as predictor) followed by an analysis of variance (anova). Normality of residuals, homoscedasticity and absence of residuals' overdispersion were verified. The same methods were used to analyze the relationship between the mayor mandate (before and after 2014)

and the nexus complexity.

The relationships between the period of publication (before and after 2014) and (1) the principles of justice and (2) the dimensions of justice were tested using a Chi-squared test.

The relationship between the nexus complexity and their consideration of inequities was tested using a Wilcoxon rank-sum test.

We note that the small sample sizes in our tests ($n = 144$ for test related to objectives and $n = 70$ for justice elements related test) may affect the statistical power of the analyses.

All analyses and figures were performed with R (R Core Team, 2021), with the following packages: functions “glm” (linear regression with a Poisson family link), “wilcox.test” and “chisq.test” from R (R Core Team, 2021), “tidyverse” package (Wickham et al., 2019) for data manipulation, “ggplot2” (Wickham, 2016) and “ggpubr” (Kassambara, 2023) for the figures and “DHARMa” (Hartig, 2022) for residual diagnostics for regression models. R script is available on public gitlab repository (available at <https://gitlab.dsi.universite-paris-saclay.fr/just-landscapes/paris/ej-nexus>).

3. Results

3.1. Presentation of the corpus

Thirty-two of the selected documents were included in the final analysis, covering the 2006–2022 period (Fig. 1). The reviewed plans consisted of thirteen environmental policy plans (e.g. climate plans, biodiversity plans, rain plan etc.), six plans related to circular economy and sustainable development (e.g. circular economy plans, food plans, smart city plan, etc.), five plans related to social, equity or solidarity (e.g. the social cohesion contract, the local housing program, the education project, etc.), four environmental health plans (e.g. noise plans and the environmental health plan), two urban planning documents (both included in the local urbanism plan) and two other types of plans (the tourism strategy and the Olympic games Transformations plan) (Table 1). Eleven of these documents were revisions of a same policy (for example, climate or noise plans) or a “roadmap” for a major policy (e.g. roadmap for climate policy for the administration, or roadmaps for the circular economy policies).

The level of consideration of urban nature varied depending on the plans: 4 plans did not have clear objectives related to urban nature (2 circular economy & sustainable development plans and 2 environmental plans related to climate), 8 had only 1 objective related to urban nature, 20 plans had 2 or more (with 3 plans having 19 or more objectives related to nature) (Table SM 2).

Regarding actionability, plans generally lacked information about actors, deadlines or resources which are crucial for policy implementation. More than half of the reviewed plans did not mention who are the actors in charge of implementing actions. Actors who were frequently in charge of urban nature actions included specific municipality departments (e.g., the “Environment and Green Spaces Department” and the “Roads and Mobility Department”), other institutional actors at municipality level (local agencies/institutes such as Eau de Paris, or the Parisian Agency for Climate) and the private sector (e.g. local firms, urban developers, SNCF) (Fig. SM1). Associations and NGOs or civil society were rarely mentioned (9.7 % of nature related objectives), which could indicate a lack of recognition and implication of these actors. Actors from higher administration levels (e.g., Ile-de-France region, Paris greater metropolis and State) were also rarely mentioned. Few plans proposed monitoring indicators of urban nature. When mentioned, they mainly focused on biodiversity or vegetation, and were mentioned only in environmental policies.

3.2. A nexus approach for nature in Paris?

Reviewed plans framed nature objectives primarily in terms of biodiversity, slightly less in terms of climate, and less frequently in terms

of health. Silo approaches were more frequent than integrated objectives (Fig. 2A).

The term “biodiversity” was mentioned in 91 % of the plans, while “climate change” and health risks related to the environment were mentioned in 81 % and 56 % of them, respectively. Urban nature was often mentioned in pair with biodiversity (69 %) and with climate adaptation (63 %) but less with health (34.38 %) issues in plans (Table SM 3). Interestingly, plans mainly emphasized positive (synergistic) relationships between nature and nexus elements (Table SM 3). Only three plans noted a negative relationship between urban nature and health risk (i.e. they refer to very specific elements of nature such as pollen allergies, rats, mosquitoes etc.).

Within the plans, we recorded 144 objectives targeting urban nature (of which 69 % were found in environmental plans). Urban nature objectives encompassed diverse policy targets such as “facilitate access to cooling spaces during summer” (#Stratégie d’adaptation), “develop urban agriculture” (# Plan Biodiversité 2018) and “conserve ecological corridor of regional importance” (# PLU– orientation d’aménagement et de programmation en faveur de la cohérence écologique). Of these 144 objectives only 14 % did not have any link to any of the nexus elements. Rather, objectives related to nature were frequently associated with nexus elements, particularly biodiversity and adaptation. Urban nature objectives addressed, in the first place, biodiversity (directly or implicitly), then climate and health (Fig. 2A). Climate encompassed both adaptation (54 reviewed objectives) and mitigation (8 reviewed objectives). Health was less frequently identified in reviewed objectives, although it is worth noting that it was more frequent in recent documents (Fig SM2). This might suggest that health is still an emerging issue in Paris urban nature policies.

56 % of the objectives addressed only one nexus element, mostly biodiversity (43 % of all nature objectives), followed by climate (11.11 %) and health (only 2 objectives). Only 30.6 % of the 144 objectives addressed 2 or 3 issues of the nexus, mainly biodiversity and climate (18.8 % of the 144 objectives) (Fig. 2). Only 5 policies included objectives targeting the full nexus (corresponding to 7 objectives), mostly environmental policies and from the recent period (#Stratégie d’adaptation 2015, #Plan climat 2018, #Plan Biodiversité 2018, #Plan arbre 2021, #Plan d’amélioration de l’environnement sonore 2021–2026). The nexus complexity tended to significantly improve between 2006 and 2022 (anova df = 1, Deviance = 4.355, $p < 0.05^*$) but could not be linked to the change of the mandate effect (in 2014 anova df = 1, Deviance = 0.045067, $p > 0.8$). The number of nexus elements was greater for environmental policies than other policies (Wilcoxon rank sum test, $W = 2952$, $p < 0.001^{**}$). The corresponding effect size was $r = 0.29$, suggesting a small-to-moderate effect.

We observed three different ways of integrating more than one nexus element in plans at the level of objectives (Fig. 2C), with (1) plans with sectoral objectives (e.g., #schéma directeur de valorisation et de développement de l’eau non potable 2015–2020); (2) plans focusing mainly on one nexus element comprising many objectives dedicated to this element along with a few objectives integrating several nexus elements (e.g., #Stratégie d’adaptation 2015, #Plan Biodiversité 2018); and (3) plans with few objectives related to urban nature but where objectives consider 2 or 3 elements simultaneously (e.g., #Plan d’amélioration de l’environnement sonore 2021–2026 #Projet éducatif de territoire 2021–2026). Most environmental plans fall into the second configuration while recent other policy themes often align with the third configuration.

A total of 420 actions were inventoried in relation to 140 urban nature related objectives in the reviewed plans (4 objectives had no clear actions). These 420 actions corresponded to 977 interventions according to our typology (Fig. 3). The most common interventions were “Awareness raising” (13 %), “Vegetation and ecosystem restoration” (12 %), “Urban development” (12 %), “Change in practice/management” (11 %), and mainly targeted biodiversity and climate issues (Fig. 3). Objectives that addressed biodiversity, climate, and health

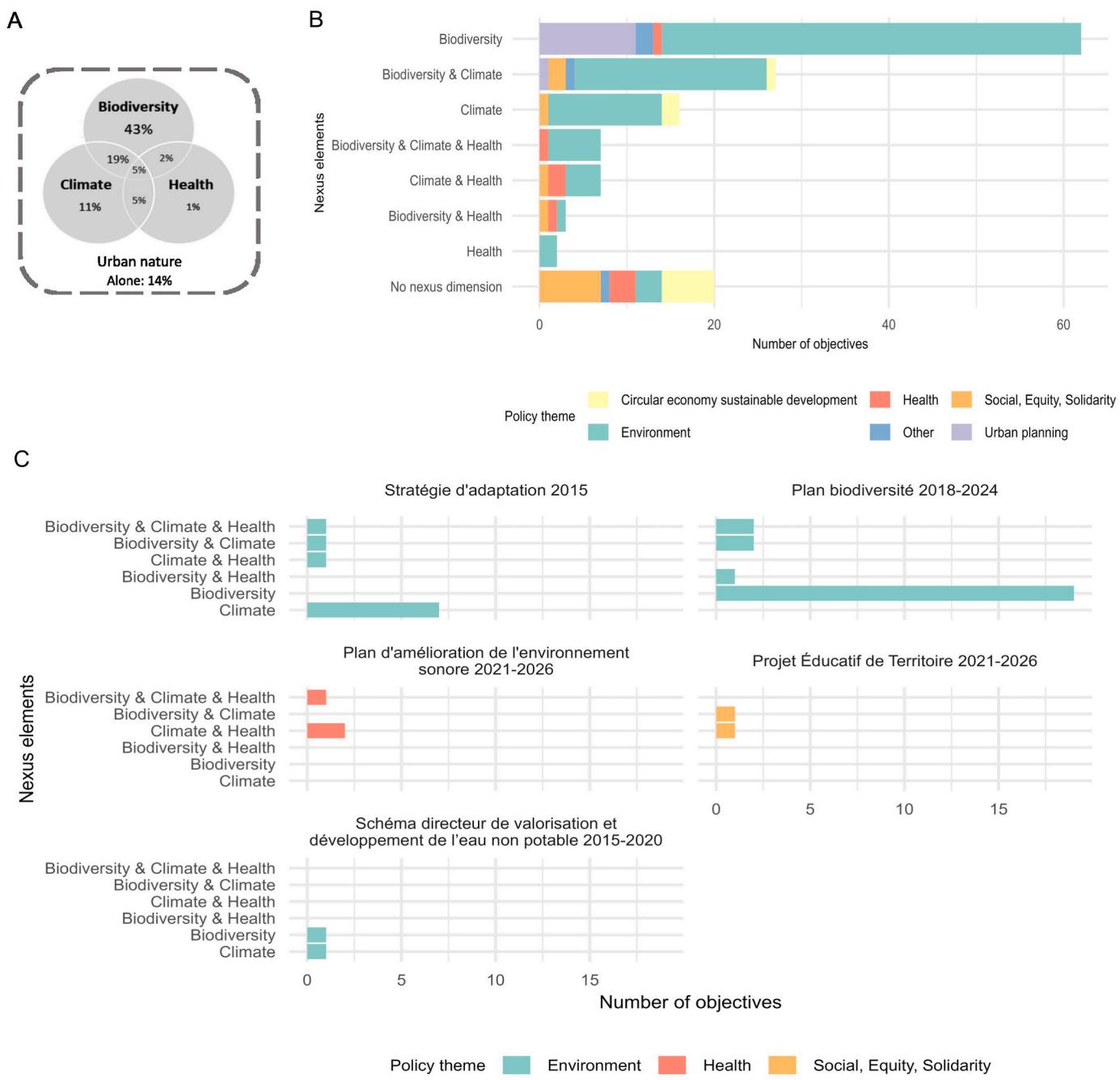


Fig. 2. Nexus elements targeted by policies objectives. Panel A: % of objectives addressing each element (or combination of elements) of the nexus; Panel B: Nexus addressed in objective by policy theme; Panel C: Examples of ways to integrate more than one nexus element through objectives.

simultaneously demonstrated a somewhat reduced diversity of interventions, as they did not encompass planning, construction, or collaboration.

3.3. Consideration of environmental justice and inequities

Justice and equity in relation to urban nature were rarely considered in the reviewed plans. The semantic analysis showed that the term 'equity' was explicitly mentioned in 19 % of the reviewed plans, while 'social inequities' were mentioned in half of the reviewed plans. The term 'environmental justice' was only mentioned explicitly in two plans, while 'social justice' was mentioned in eight plans (Fig. SM 3). 5 plans out of the 32 reviewed did not present any environmental justice element regarding urban nature (explicitly or implicitly). The remaining

27 plans tended to focus more often on the distributive dimension (61 % of environmental justice mentions), but participation dimension was also quite common (36 %) (Fig. 4 A). Recognition of value and preference regarding nature was rarely found (only 2 occurrences). Often, interventions related to participation consisted in participation in the implementation of the policy (64 %) such as collective nature stewardship (vegetation permit, community garden, gardening) or participatory science. Participation in the decision process, such as consultation or concertation, was less frequent (Fig. SM 4).

Justice principles underpinning interventions were rarely stated and often remained unclear (Fig. 4A). For example, several plans mentioned greening public areas or creating urban parks, to benefit the human population in general ('Carry out an extensive vegetation program to refresh the city', #Stratégie d'adaptation 2015). Few plans referred to

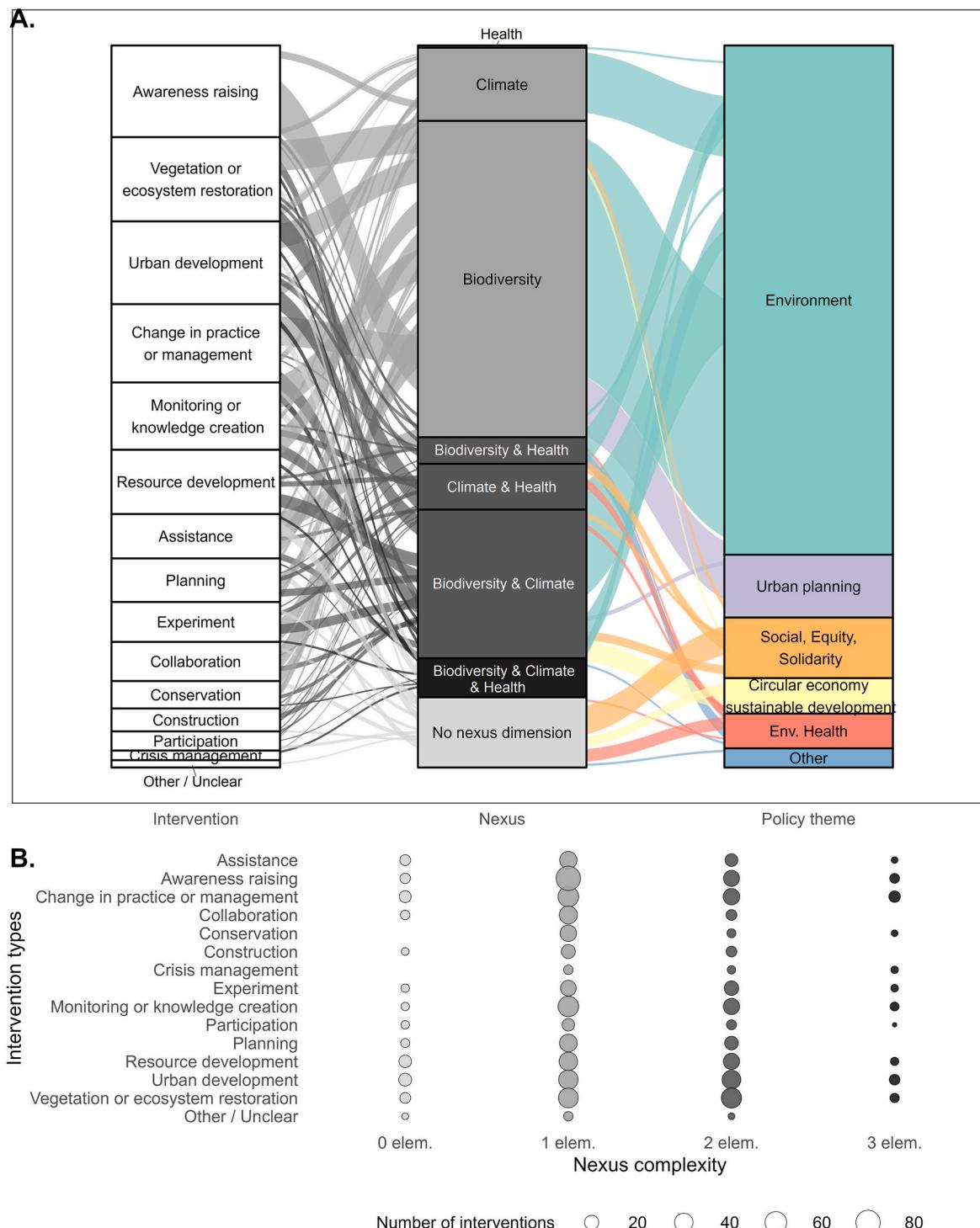


Fig. 3. Panel A: Sankey diagram of relation between interventions, nexus and policy theme. Panel B: Intervention types identified in reviewed policies, depending on nexus complexity.

each Parisian for the distribution of nature (e.g. “each Parisian is at less than 7 min away from a green space, “breathing space” or water space” #Stratégie d’adaptation 2015) or for the participation (e.g. “Open to all, participatory sciences [...]” #Plan Biodiversité 2018) and could be linked to the sufficiency or equality principle of justice. The distinction between both principles was made when a threshold was present and indicated a sufficiency principle. 26 % of justice mentions recognized social inequities or prioritized vulnerable or unfavored groups, which can be considered as the “need” principle.

Specific population groups concerned by distributive or procedural interventions and statements were often young people/children (38 %) and low-income population (38 %) (Fig. 4 B), a finding which directly connects with results about socio-economic factors underpinning inequities (income and age) (Fig SM 5). Young people or children were not always considered as vulnerable or unfavored when they were specifically targeted (Fig. 4B). 8.6 % of the justice mentions target specific groups that are not considered vulnerable or disadvantaged in the text while the justice principle remains unclear.

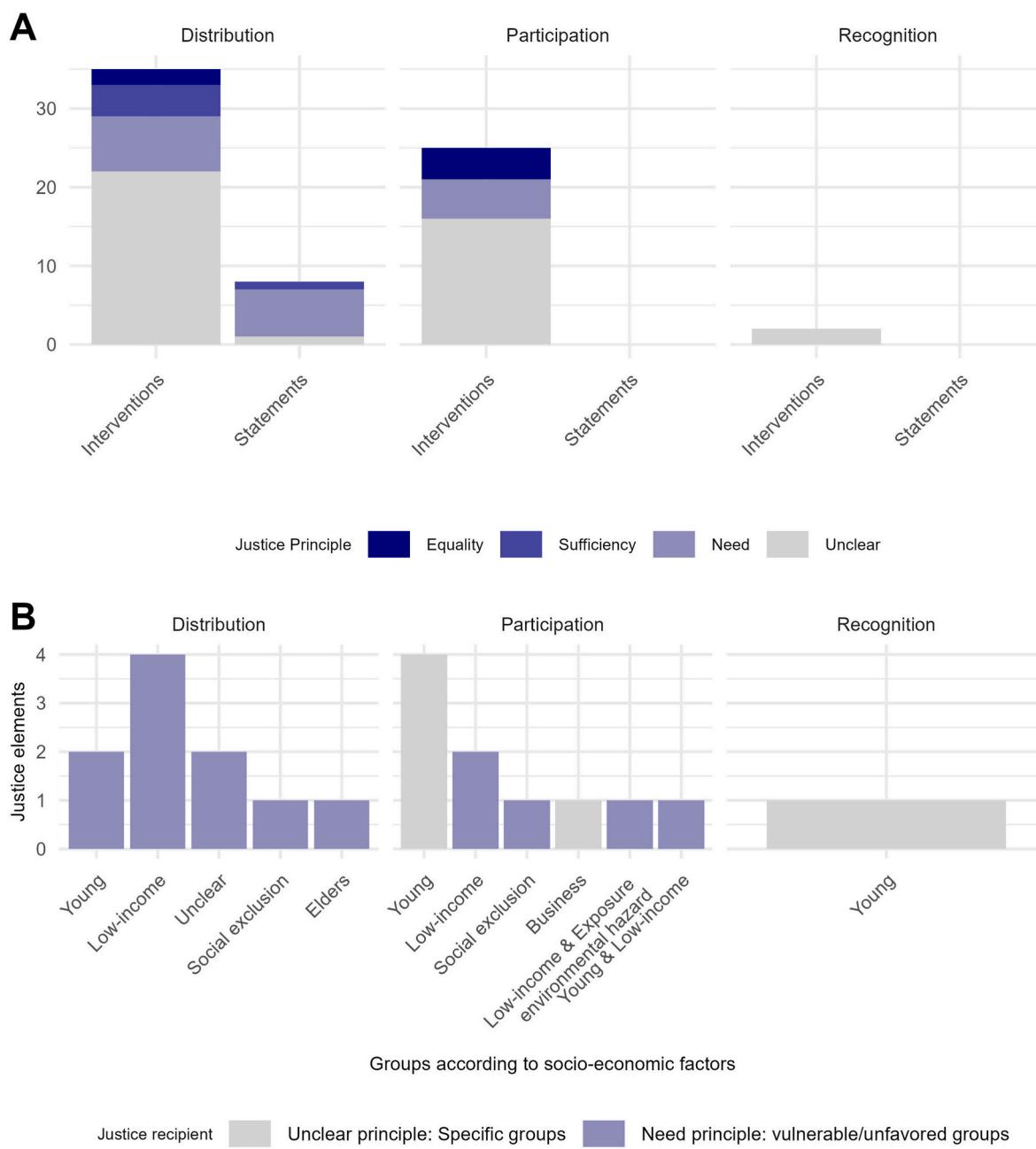


Fig. 4. Consideration of environmental justice in reviewed plans. Panel A: Environmental justice principles connecting to the three dimensions of justice. A difference is made between statements (i.e. the observation or recognition of injustices) and interventions (i.e. public action addressing justice dimensions related to urban nature). Panel B: Justice elements by targeted groups.

Mentions of environmental justice more frequently related to municipality interventions than to general statements about the current situation (which were only found for distributive dimension) (Fig. 4A). Justice dimensions were correlated neither with the policy theme nor with the publication period ($\chi^2 = 3.3241$, $df = 2$, $p\text{-value} = 0.19$, and $\chi^2 = 3.6177$, $df = 2$, $p\text{-value} = 0.16$, respectively). Likewise, justice principles were not correlated with the theme and the period ($\chi^2 = 1.5164$, $df = 3$, $p\text{-value} = 0.68$, $\chi^2 = 5.279$, $df = 3$, $p\text{-value} = 0.1525$, respectively). The respective effect sizes (Cramér's $V = 0.22$; Cramér's $V = 0.23$; Cramér's $V = 0.15$; Cramér's $V = 0.28$) suggest small to moderate associations.

Inequities were identified in 81 % of reviewed plans but few plans explicitly considered inequities in relation with urban nature (only 2

occurrences). Most of the inequities identified (58 %) were not related to environmental issues (e.g. housing, employment, transportation, education, sports, etc.). Environmental inequities concerned health (23 %), climate change (10 %) or environmental hazards (9 %). Age and income were the most frequent factors of inequities, whether or not related to the environment and urban nature (Fig. SM5). Indeed, income was the only mentioned factor in relation to urban nature. Inequities identified were often single-factor (65 % of reviewed inequities) (e.g. low income, age groups, disabilities, unclear, gender); two or more interacting factors was less common (e.g. young & low income, young & girls, low income & social exclusion) (Fig. SM8). This may indicate a lack of consideration for intersectional inequities in the reviewed plans. "Social, equity, solidarity" plans mentioned more inequities (10 types on average

per document compared with around 3.8 on average for environmental plans) (Fig. SM6).

When present at higher level in plans, inequities were rarely targeted by plan objectives and actions regarding urban nature (Fig. SM7). Only 11 urban nature related objectives (7.6 %) also targeted inequities. Logically, they were present in 2 “Social, equity, solidarity” plans (#Contrat de Ville 2015, #Contrat urbain de Cohésion social) and in 3 environmental plans (#Stratégie d’adaptation 2015, #Plan Biodiversité 2018, #Stratégie de résilience). Objectives addressing inequities addressed significantly less nexus elements than others (*wilcox.test*, $W = 1088$, $p.\text{value} < 0.005^{**}$), which can be explained by the fact that they were mainly found in plans which focused on “Social matters, equity, solidarity”. We also note that the effect size was small ($r = 0.25$). The 75 interventions associated with these objectives often consisted of urban development, resource development/program extension and vegetation or ecosystem restauration. No indicator for measuring environmental justice or related inequities regarding urban nature was found in the reviewed plans.

We note that 66 % of the reviewed plans stated that the policy design included a participatory aspect (consultation or concertation), indicating a form of procedural justice in policy making (moreover consultation was not legally required for every plan). In general, plans were consulted with sectoral stakeholders (56 % of the plans examined), citizens (31 %) and between administrative departments (12.5 %). However, how these opinions were (or were not) integrated into the plan was not explained in the policy document.

4. Discussion

4.1. A nexus approach in Paris urban nature policies?

This study aimed to analyze how urban nature plans of Paris address the necessary nexus and environmental justice approach to sustainability. We focused on the nexus comprising biodiversity conservation, climate (adaptation and mitigation), and human health, and its connections with environmental justice based on the review of 32 policy plans addressing urban nature, and spanning the 2006–2022 period. 59 % of reviewed plans were not “environmental policies” which indicates that the urban nature subject goes beyond just ecological considerations and can relate to a diversity of other policy topics. However, we found that most reviewed policies had a silo approach addressing only one nexus element (mainly biodiversity). Health was less addressed, which suggests an important gap in the design of current policies to recognize that the health of humans, and the conservation of wild animals, plants, or the wider environment (including ecosystems) are closely linked and interdependent. Our findings are closely aligned with conclusions of the IPBES recent nexus report which also found that health is less often included in nexus studies (McElwee et al., 2024). Within the Paris municipality, climate and biodiversity are both considered as “environmental issues”. They are dealt with by close city departments that share the same office building and are used to working together (moreover, both issues were dealt with by the same city department before 2022). On the other hand, health is not always considered as an environmental issue, and is rather considered in other policy approaches (risk approach, social issues) produced by another community of city experts and officials that are more distant from environmental topics. This may partly explain why it is more challenging to integrate health into urban nature policies. Reviewed plans mainly highlighted synergies between urban nature and nexus elements, and rarely tradeoffs. This is not surprising, as policy documents are communication tools for justifying public action (Lyles and Stevens, 2014). Trade-offs regarding urban nature are often overlooked but do exist (Depietri, 2022; Zhang and MacKenzie, 2024). For instance, tree planting—a strategy used for reducing urban heat stress—can unintentionally contribute to air quality degradation through the emission of volatile organic compounds and pollen (Choi et al., 2021). Similarly, urban greening can lead to

increased water demand and management costs (Roman et al., 2021), while biodiversity conservation goals may conflict with efforts to enhance access to green space for recreational activities (Abramowicz and Stepniewska, 2020; Kang et al., 2015). Some of these trade-offs can be mitigated through technical and design choices (such as selecting low-allergen, drought-resistant tree species or developing non-potable water systems for irrigation). Others require political arbitration, as they involve competing priorities. Considering co-benefits but also trade-offs in environmental policies would allow for better combination of policy or coordination between actors (Sharifi, 2020; Vallet et al., 2018; Wüstemann et al., 2017).

Our analysis identified three approaches for integrating different nexus elements with nature intervention at the objective level (Fig. 2C). Environmental plans were frequently sectoral but sought to bridge or highlight co-benefits in a few cross-cutting objectives (illustrating configuration 2). In contrast, non-environmental plans often had a single (or two) ‘generic environmental objective’, which attempted to bring all environmental issues together and deal with them all at once (configuration 3). Regarding configuration 1, it appears to be a matter of specific writing style for the document in question. However, our analysis doesn’t allow us to say which approach is the most effective in dealing with the different issues.

While it is natural to dedicate teams and experts to work on specific subjects, excessive sectoral fragmentation within the administration can hinder the implementation of integrated policies. For instance, conflicting priorities may arise—such as when public health objectives aimed at limiting zoonotic risks or pest proliferation take precedence over biodiversity conservation or animal welfare concerns. Similarly, overlapping mandates between closely related teams—such as those responsible for the climate adaptation plan and the resilience strategy—can result in duplicated efforts and dispersal of resources. Governance fragmentation across administrative levels poses further barriers. For example, local green space managers may receive directives from both district-level authorities and central city administration, leading to confusion or competing priorities. These challenges are also evident during the development of regional ecological corridor plans, where coordinating across multiple municipalities is difficult. Such institutional barriers when pursuing integrated environmental policies or nexus approach are common (Biesbroek et al., 2009; McElwee et al., 2024; Oseland, 2019) and must be addressed through strengthened cooperation, cross-sector collaboration, cohesive planning, and systematic knowledge sharing—both among experts from diverse fields and across different administrative levels and institutions.

In order to manage the complexity inherent in a nexus approach, we focused on three core elements relevant to the Parisian context of urban nature policies: biodiversity, climate, and health. While other dimensions – such as food production, tourism, energy, water or pollution – could have been included (Leck et al., 2015; McElwee et al., 2024; C. Zhang et al., 2018), our selection was guided by their contextual relevance. For instance, energy production in Paris is not directly linked to urban nature (e.g., the city does not exploit biomass from urban forests), and tourism strategies do not primarily emphasize green spaces. Food production, on the other hand, could be an interesting addition. Although urban agriculture programs are developing in Paris, they often emphasize social and economic goals over actual food yield, and agricultural use of intra-muros green spaces remains scarce. The city continues to rely mostly on food imports from the surrounding region and the rest of France. While the biodiversity–climate–health nexus is likely relevant across many urban contexts, it is important to note that the inclusion of additional elements should be tailored to each city’s specific environmental context and policy priorities. Nexus approaches can also help bridge more unexpected policy areas, such as urban forestry with active transport strategies and health objectives in Australia (Tang and Bush, 2025).

The identification of nexus elements targeted by policies objectives posed varying difficulties. For example, health was often mentioned

interchangeably with human well-being in reviewed plans, and not health explicitly. According to the World Health Organization (WHO), health is defined as “a state of complete [...] well-being.” However, outside the context of health policy, well-being is often understood more broadly and subjectively, commonly associated with quality of life. Some aspects of well-being, such as economic stability, cultural and recreational fulfillment or political and civil rights may not be reflected in health metrics. When urban policies aim to improve living conditions—such as through the creation of green spaces—policy documents may not explicitly link these actions to specific health outcomes for residents. Moreover, interventions designed to enhance health could have ambivalent effects on other dimensions of well-being. For instance, reducing car traffic to lower air pollution could create challenges related to mobility or increase feelings of isolation. It is worth noting that in this article we focused on human health, and did not consider animal or ecosystem health (these elements were considered in the “biodiversity” element) (Destoumieux-Garzón et al., 2018). Future research could build on current discussions on health (such as the One Health framework) to provide a better understanding of policies’ effects on various health dimensions, including physical and mental well-being (De Macedo Couto and Brandespim, 2020). For climate, we did not include plans aimed at reducing sectoral emissions (e.g., from transportation or industry) as they have no links with urban nature and are therefore of limited interest for our research question. We limited the analysis to ecosystem-based mitigation and adaptation.

Interestingly, our findings show that nexus consideration in reviewed plans changed over time, by adopting more objectives with more than one element in recent plans. Presently, Paris municipality supports biodiversity and climate (especially adaptation) quite frequently in its actions for urban nature. This is particularly visible in the new version of the urbanism plan (“plan d’urbanisme bioclimatique”, <https://www.paris.fr/pages/plan-local-d-urbanisme-bioclimatique-vers-un-paris-plus-vert-et-plus-solidaire-23805>).

4.2. Environmental justice in urban nature policies

We analyzed environmental justice in terms of dimensions of justice, principles of justice and recipients, and inequities. This analysis went beyond the distributive dimension of justice examining the dimensions of participation and recognition, although the latter was rarely addressed in the reviewed plans. This result is consistent with previous conclusions that distribution is often more considered than participation and recognition (Gradinaru et al., 2023; Grant et al., 2022; Kato-Huerta and Geneletti, 2022; Yazar et al., 2024). Furthermore, civil society and associations or NGOs were rarely mentioned as potential actors to implement the interventions, which also points to a lack of recognition and procedural justice. Notably, citizens were more often considered as beneficiaries of policies (e.g., enjoying the outcomes of urban nature initiatives or participating in specific programs) rather than as active stakeholders or partners in the policy implementation process. In addition, the participation dimension in the reviewed plans often emphasized popular participatory programs (such as community gardens) rather than participation in decision-making. Participation was often open to the general public, leaving aside the aspect of recognition of disadvantaged or marginalized populations in the decision-making and consultation process. Yazar et al. (2024) found that the Paris Climate Plan lacked real commitment to these aspects. The principles of justice were often unclear, with no specific group targeted, which suggests that fairness and equity might not be the justification for nature-based interventions. It may also indicate that most reviewed plans fall into the “universally good” narrative for green spaces where nature policies are seen as a neutral tool that benefits the whole population and where justice issues are not considered (Neidig et al., 2022; Rigolon et al., 2022). Most of the inequities identified were not related to urban nature and few objectives addressed inequities through nature objectives. Our finding confirms other studies showing that policies on green

infrastructures often fail to address equity issues or address them only in a superficial manner (Grabowski et al., 2023; Gradinaru et al., 2023). Moreover, our results suggest that the few objectives which intend to address social inequities through nature interventions might fail to consider issues of biodiversity, climate or health. We observed a decoupling between sectoral policies, with social plans rarely addressing urban nature or nexus elements (Fig. 2 B) and environmental plans sometimes lacking social or equity considerations. This is a concern because implementing environmental policies without considering justice could potentially reinforce inequities and have a negative impact on vulnerable populations (Haase, 2024; Wolch et al., 2014). Furthermore, this may result in a lack of acceptance of environmental projects (Clayton, 2018; Kollmann et al., 2024). Social plans may overlook urban nature altogether—missing a key opportunity to improve living conditions—or they may focus narrowly on greening, without considering how nature-based interventions can deliver multiple benefits for disadvantaged populations, such as climate adaptation, health improvements, and stronger connections to biodiversity. Decoupling social and environmental issues could therefore lead to missed opportunities to address multiple issues simultaneously and inefficient interventions due to lack of coordination at the municipality level (Liu et al., 2018).

Environmental justice was implicitly considered in many plans, but rarely explicitly, since it was not their primary focus. Therefore, justice principles that guide public action or justice recipients were rarely mentioned, resulting in the prevalence of the unclear category (Fig. 4). This finding aligns with other studies suggesting that even when articles focus on analyzing environmental justice, they rarely unravel the underlying principles of justice (Heyen, 2023).

In addition, recognition was defined in this article as the consideration of the preferences and values of actors. It is worth noting that this definition could be extended to consider recognition of needs (Anguelovski et al., 2020). For instance, in the case of interventions that aimed at improving distribution or participation for specific or vulnerable groups (i.e. low-income population, children) it could be interpreted as a recognition of their needs. This underlines the tight interconnections between dimensions of justice (Schlosberg, 2007; Wijsman and Berbés-Blázquez, 2022).

We did not find any mention of the “merit” principle of justice in our policy corpus. The merit principle is frequently mentioned in the literature for payment for ecosystem services schemes (Loft et al., 2019; Martin et al., 2014; McDermott et al., 2013), but its relevance to urban greening justice is questionable. Indeed, it is ambiguous how to apply a merit criterion in the context to determine who should or could be the beneficiaries of urban nature programs (such as access to green space or participation in initiatives). Should it be linked to neighborhoods that pay higher taxes? Or to individuals with stronger environmental commitments in their neighborhood? The application of merit in this context may also conflict with more widely accepted principles in Western societies, such as equality or need-based distribution of public goods (Siemoneit, 2023). Nevertheless, merit-based reasoning could be expected in competitive situations, such as when allocating subsidies or granting public land access to specific actors or associations. Urban agriculture initiatives offer an example, where merit can be evaluated using objective criteria that assess the quality of the project. For instance the “Parisculteurs” program awards urban land and support based on the merit of proposals submitted by organizations and collectives (see: Parisculteurs). But this situation was not explicitly presented in the documents we reviewed and therefore is not included in our results.

It was also sometimes difficult to distinguish between equality and sufficiency principles as the difference we made relied on the existence of a threshold which could be implicit. Moreover, some elements were difficult to categorize, such as an intervention that prioritizes neighborhoods without green spaces: this prioritization could be linked to an equality or sufficiency principle, but it could also be a non-human prioritization (e.g. a prioritization based on ecological continuity considerations). Therefore, these elements were classified as “unclear”. A

generic formulation and the absence of explicitly identified beneficiaries—such as references to “all Parisians,” “disadvantaged neighborhoods,” or “elderly people”—automatically led us to code the principle as “unclear,” which may result in the overrepresentation of this category. A more interpretive approach could argue that such generic language is likely intended to encompass the entire population and might therefore reflect an “equality” principle. In our coding, however, we aimed to minimize subjective interpretation of the text. It remains uncertain which approach would more accurately reflect the municipality’s true intentions.

Principles of justice might differ depending on whether we analyze justice through an approach focusing on outcomes or a rules-based approach focusing on means and fair process (Siemoneit, 2023; Wijsman and Berbés-Blázquez, 2022). What should the evaluation focus on in terms of justice to be perceived as fair? By whom? Through which evaluation approach? We did not address these questions in this article, but it may be relevant for future research and for the development of sustainable and equitable policies.

Another crucial research issue is the human versus nature – centered framing of environmental justice. In this article we used the mainstream environmental justice approach, which considered justice only between humans (Grabowski et al., 2023; Lambrou and Loukaitou-Sideris, 2022; Menton et al., 2020). New articles and discussions recently broadened the scope to extend justice to non-humans. For instance, ecological justice, socio-ecological justice or multispecies justice are more comprehensive approaches that includes non-human animals, plants, or ecosystems in the scope of justice and could provide interesting insights into urban nature and justice policies (Fieuw et al., 2022; Washington et al., 2018; Yaka, 2019).

4.3. Evaluating policies through the nexus and environmental justice lens

We examined intentionally a broad corpus of plans, where urban nature could possibly be a secondary (or even minor) issue. The plans reviewed were of different types: some were normative (such as the local urbanization plan), programmatic (with very detailed objectives and actions), informative (communication documents with limited details about objectives and actions). This heterogeneity is one of the recurrent challenges for gray literature reviews (Yoshida et al., 2024). Policy documents are often primarily intended for communication or public relations purposes, and therefore tend to emphasize positive outcomes and consensual interventions, while overlooking controversial or politically sensitive issues. They may also lack analytical rigor or fail to provide credible scientific justification or quantitative assessment of the proposed interventions. We note that legally binding documents are more likely to be consensual, with less ambitious objectives since they are negotiated and disputed several times from their writing to their approval by the Paris council. Negotiation mechanisms and their impacts for the definition of targets have been observed on a global scale in the context of climate change and biodiversity agreements (Dimitrov, 2016; Hughes and Grumbine, 2023).

In addition, the terminology varied from one plan to another (e.g., “actions” that were actually “objectives” in other plans, or vice versa), as did the level of formality (e.g. the Local urbanization plans should follow legal rules and are not expected to mention actors). Kobotoolbox allowed us to code objectives and actions in a flexible way, even when these levels were unclear. The corpus focused on plans applicable the entire city of Paris, deliberately excluding documents produced at the district level or by higher tiers of government. This choice was made to concentrate on the municipal scale, and to avoid the added complexity of analyzing mixed policies shaped by different governance levels—each with its own priorities, specific responsibilities and capacities, and political orientation. For a more comprehensive understanding of Parisian policies across scales, future research could incorporate those additional documents for specific Paris districts, neighborhoods, or broader areas like the metropolis or region. In addition, we focused on local urban

nature, but plans may also address spillovers and remote impacts on nature and biodiversity (for example, in food plans and administrative purchasing) that we did not examine (Pascual et al., 2017). Indeed, the consideration of multiple scales in the assessment of environmental policies is an important research priority for sustainability according to the recent interregional ‘telecoupling’ literature (Koellner et al., 2019; Liu et al., 2013).

Our analyses focused on stated policies objectives, which did not allow for the assessment of their effectiveness. Additionally, only a little over a quarter of the reviewed plans disclosed resources, both human and financial. The aim of this article was not to evaluate public plans, but to analyze policymakers’ framing of urban nature and how they might relate to the biodiversity-climate-health nexus and justice considerations. It would be interesting, in future research, to address efficiency and effectiveness: Are goals addressing multiple issues being achieved effectively? Do they affect the distributive outcomes of the policy? Are nexus-based plans more efficient than plans with a silo approach? Do they lead to multifunctional urban green spaces while maintaining biodiversity? These are important research questions at the science-policy interface.

In Paris, the political forces remained unchanged during the studied period, with two mayors from the same political party (Bertrand Delanoë and Anne Hidalgo from the socialist party). They maintained a strong majority on the Paris City Council, in collaboration with their allies from other left-wing groups. Some divergences exist among those groups, for example when the ecologists advocate for stronger environmental commitment (for instance: <https://groupe-ecologiste.paris/les-actualites/tour-triangle-les-ecologistes-demandent-labandon-dune-aberration-climatique/>). Nevertheless, these groups share common ideological goals, such as environmental sustainability and progressive social policies. This could explain why we did not find significant changes over time but slight incremental improvements regarding nexus complexity although the study covered a relatively long period of time (16 years). New versions of some plans (Climate Plan, PLU bioclimatique, Biodiversity Plan, Resilience Strategy and environmental health plan) were being finalized at the moment of writing this article and could not be included in our analysis. This new “generation” of plans is expected to better address, to some extent, the Biodiversity-climate-health nexus and environmental justice, as suggested by the first drafts of these plans.

4.4. For a better integration of justice and the nexus approach into urban policies

Our findings showed that jointly considering the nexus approach and environmental justice is challenging. Other studies often addressed equity in relation to a single issue, like climate or green infrastructure planning, and examined specific types of plans (e.g. Yazar et al., 2024 or Gradinaru et al., 2023), without considering interrelated issues. Our results showed that biodiversity and climate were often addressed by environmental plans, while inequities and health were in social plans. These results are based on a specific case study and are therefore shaped by the characteristics of the Parisian context—a dense and affluent capital city with relatively strong institutional capacity and a long-standing commitment to environmental governance. Despite these favorable conditions, we noted challenges in integrating both the nexus approach and justice considerations into planning practices for urban nature (though there are signs of improvement in recent years). Such integration may be even more difficult in smaller European cities with limited administrative resources, or in cities of the Global South. Further research could explore those specific and understudied contexts for both nexus approach and justice (Kato-Huerta and Geneletti, 2023). Moreover, identifying ways to address these challenges, in different urban contexts, should be an important focus of future work.

Some initiatives may help bridge environmental issues with health and justice. For example, the municipality of Paris has developed tools to

address health inequalities, in particular the “health impact assessment for urban development” tool, which can be utilized in the context of green space development (Vernouillet et al., 2023). Nature-based solutions (to be announced in Paris’ next Climate Plan) have the potential to address multiple urban challenges (Babí Almenar et al., 2021) and justice issues (Kato-Huerta and Geneletti, 2022; Sekulova et al., 2021; Tozer et al., 2020; Yazar and York, 2023), in a cost-efficient manner (González-García et al., 2023). Nature-based solutions projects are flourishing in cities across Europe, including French cities such as Marseille and Strasbourg, some of them being profiled in the *urban nature atlas* (<https://una.city/>). By addressing both ecological and social aspects in the design and management of green spaces nature-based solutions could be key to operationalizing the biodiversity-climate-health and justice nexus (Pascual et al., 2022). Implementing NBS with a nexus and justice approach may also enable municipalities to develop alternative project governance, as well as innovative methods and policy skills, which they could apply to other domains of ecological transition (e.g. food and transport).

We found few objectives that targeted social issues regarding urban nature (11 out of the 144 identified). They basically consisted in using social inequalities as a criterion to prioritize neighborhoods for greening policies (e.g., “quartier prioritaire de la ville”). However, this action mentioned in various plans (such as “Contrat de Ville, 2015–2020”, “Plan arbre 2022”) and in futures plans, needs to be carefully considered as it can lead to undesirable effects such as green gentrification if not offset by housing policies (e.g. social housing and rent control) and appropriation of these spaces by local residents, as shown in other studies in European cities, such as Nantes (France), Barcelona (Spain) and Leipzig (Germany) and in North American cities (Anguelovski et al., 2018; Cole et al., 2017; Garcia-Lamarca et al., 2021; Haase, 2024). In this regard, one promising action is the collaboration between social landlords and municipalities to vegetalize buildings and common spaces (such as green courtyard, or green wall and green roof), which directly influence the distributive dimension of environmental justice. In Paris, this measure is included in the Programme local de l’habitat, and it is also planned in other french cities such as Strasbourg EuroMetropole (<https://www.strasbourg.eu/aides-vegetalisation-bailleurs-sociaux>) or Lyon Metropole. The creation of programs specifically tailored to the needs and constraints of some vulnerable or marginalized groups can also improve their participation. For example, the City of Paris supports the creation of community gardens targeting unemployed or socially excluded populations (<https://www.paris.fr/pages/les-jardins-du-bet-on-l-insertion-par-le-jardinage-5834>). Other cities presented similar programs, for instance community gardens to engage immigrants in Melbourne (Australia) (Agustina and Beilin, 2012) or a therapeutic gardening project for homeless women in the USA (Grabbe et al., 2013).

Actions targeting recognition were rarely mentioned in the policies, but one example consisted in the regulation of parks and the development of green spaces taking into account children’s preferences and needs regarding the use of these spaces (e.g. “develop grass lawn allowing various activities and responding to children’s demand of “having green space where we can walk barefoot”, #Faire le Paris des enfants et des familles). Paris, along with Barcelona, Brussels and Rotterdam, is one of the study cases for the European “Cool Schools” project (<https://coolschools.eu/>) which analyses nature-based solutions for climate adaptation in elementary schools’ playgrounds, including the needs and views of children. This “Cours d’école Oasis” program, implemented in partnership with the Conseil d’architecture, d’urbanisme et de l’environnement of Paris (<https://www.caue75.fr/content/ressources-cours-oasis>), relies on the extensive participation of children, whose preferences and needs are incorporated into the design of the new schoolyards. Developing these approaches more systematically for the design of public spaces and taking into account other socio-demographic groups (e.g. the elderly, people with different disabilities or the homeless) could be a way to improve recognition in relation to urban nature policies.

We suggest two ways to improve the integration of environmental

justice into the biodiversity-climate-health nexus. First, there is a need to design and adopt indicators that describe the means and outcomes of environmental justice policies. Indicators were rarely used to track the effect or the implementation of reviewed plans, particularly when they addressed environmental justice. However, some environmental justice indicators have been proposed in the literature and include, for example, distance to green spaces, perceived safety, percentage of minority representation in decision-making bodies, satisfaction with process outcomes, or perceived sense of displacement (Kato-Huerta and Geneletti, 2022). Selecting the relevant indicators and integrating them in monitoring and evaluation systems remains a challenge for cities as it requires additional human and economic resources.

Second, the development of a dedicated legal or regulatory framework could foster the consideration of environmental justice in urban plans. For example, in the United States of America executive orders have been used to propose a legal definition of environmental justice, including procedural and recognition aspect (OCDE, 2024). Recognition of environmental justice can also be integrated in regulation through judiciary decision as it is the case in Columbia (OCDE, 2024). In France, environmental justice is a relatively new topic, and its integration into policies is nascent. A better consideration of environmental justice in national legislation could improve its translation into local policies (including participation and recognition aspects). However, legislation is not a panacea and may not always guarantee the inclusion of all environmental justice aspects in local environmental plans (Fiack et al., 2021; Grabowski et al., 2023). It should be developed jointly with other interventions such as public education, grassroots advocacy, and community-driven initiatives to ensure comprehensive consideration of environmental justice.

5. Conclusion

This content analysis of Paris plans targeting urban nature provides insights into the level to which these documents bridge a biodiversity-climate-health nexus approach with environmental justice. Our findings show that the nexus approach and environmental justice considerations are still uncommon in the reviewed plans, highlighting the difficulties cities face in integrating environmental and social issues, particularly those related to human health and justice. Although this study focused on a single city and on the restricted biodiversity-climate-health nexus, those results point to broader challenges for sustainable policies, such as ensuring equitable access to urban green spaces and mitigating the uneven distribution of environmental benefits and burdens. Key questions remain as to what measures can be taken to more effectively integrate the nexus approach and environmental justice considerations into urban policies. Future research should also explore the practical implementation of the nexus approach and environmental justice in public interventions, for instance leveraging nature-based solutions that address both environmental sustainability and social equity.

CRediT authorship contribution statement

Lisa Lejemtel: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Améline Vallet:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **François Chiron:** Formal analysis, Conceptualization, Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology. **Harold Levrel:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Sandra Lavorel:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used DeepL in order to translate, improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Declaration of competing interest

Ville de Paris funds first author PhD, under a CIFRE agreement, which encourage research partnerships between academic and socio-economic actors. Ville de Paris did not commission this specific study which was conducted independently by the authors, with complete impartiality, and without any influence from the funder.

Other authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvman.2025.126547>.

Data availability

The data supporting the analysis is accessible in open access through Recherche Data Gouv at <https://entrepot.recherche.data.gouv.fr/dataset.xhtml?persistentId=doi:10.57745/I1DM36> (the repository doi is <https://doi.org/10.57745/I1DM36>). The R scripts are available on gitlab at <https://gitlab.dsi.universite-paris-saclay.fr/just-landscapes/paris-ej-nexus> (the repository doi is <https://doi.org/10.5281/zenodo.16315978>).

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