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Nature-based Solutions as Strategy for Sustainable Urban Development: A Climate Strategy Evaluation of Amsterdam, Hamburg and London



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Figure on front page: <https://www.smartcitiesworld.com>

Summary

With the effects of climate change becoming ever more prominent, cities are using strategies to mitigate and simultaneously adapting to them. Concerned by the effects of climate change, European cities have established strategic climate plans. More and more, cities use nature as a core component in their strategic climate plans. One concept, 'Nature-based solutions' (NBS) is gaining reputation within the field of urban planning as well as urban climate adaptation. In this paper the following research question is answered: How do nature-based solutions appear in climate adaptation strategies in Amsterdam, Hamburg and London, and how do they help achieve the U.N. (urban) Sustainable Development Goals? We have established that NBS are "adaptations and risk mitigation measures provided or inspired by nature and continuously supported by natural processes" in the context of climate strategies for Amsterdam, Hamburg and London. We have found that there is an overlap between the indicators established by the U.N. within the urban SDG and in other academic literature. By analysing the spatial aspects of the climate strategy of cities, with the help of an evaluative framework, we clarified to what extent the indicators are incorporated into the cities' climate strategies and what their contribution is towards urban sustainable development goals. NBS approaches that pertained to the indicators Climate adaptation & mitigation, green management and water management were most elaborated on in the strategies. Sustainable development, flood resilience, nature conservation, increasing or maintaining biodiversity, expansion of ecosystem services in line with the 11th (urban) sustainable development goal, means, that these cities therefore contribute, with the help of nature-based solutions to the USDG. Concludingly, there a number of NBS that Amsterdam, Hamburg and London can adopt from each other, such as London's Sustainable urban Drainage Systems, Hamburg's green network approach and green roof programme. Overall the amount of NBS suggested in the strategies are rather scarce. Only London addresses all indicator categories. This suggest that NBS approaches are not widely known within the branches of the municipal government in these cities. The sustainable development indicators, in line with the USDG, that are addressed are climate mitigation and adaptation and water management. Explicit research on the interplay between NBS approaches and urban SDGs would further current knowledge even more.

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Introduction

Background

With the effects of climate change becoming ever more prominent, cities are using strategies to mitigate and simultaneously adapting to them. The evident effects of a changing climate caused by anthropogenic influences are irrefutably present in urban areas. The U.N. Environment programme states that climate change is a global phenomenon that largely impacts urban life, with among its effects impacting cities' basic services, infrastructure, housing, human livelihoods and health. (UNEP, 2021).

Concerned by climate change and its effects, as well as the sustainable development goals, European cities have established strategic climate plans. Only a handful of studies have made comparisons between European cities on the progress towards sustainable development goals. Those that do often use indicators to establish progress made towards said goals. Klopp and Petretta (2017) conclude that indicator use comes with its own problems, namely poor availability of data which hinders monitoring for the USDG and "localization" effects - context specific application of goals within cities.

More and more, cities use nature as a core component in their strategic climate plans. One concept, 'Nature-based solutions' (NBS) is gaining reputation within the field of urban planning as well as urban climate adaptation. Implementing nature based solutions (NBS) as a strategy for making cities more sustainable provides more than just climate change mitigation and adaptation. Amongst other benefits, research has shown that Nature-Based Solutions has the potential to spark social innovation in cities and accelerate the progress towards sustainability goals. Implementation of NBS can potentially provide increased aesthetic and recreational values, alongside economic opportunities, green jobs and city branding. (Martín et al., 2020) In addition, this form of sustainable development is an alternative proposed to align human development with natural processes and assure that natural resources will be available to subsequent generations (Beatley, 2016). Researchers such as Laforteza and Sanesi (2019) advocate NBS as "the most fitting response to challenges posed by our changing climate and for the realization of sustainable and healthy cities".

Research Problem

Despite its increase in popularity, usage and recognised potential, NBS' contribution towards sustainable urban development goals is not yet fully understood. The trend of using NBS as a strategy is dynamic, complex and in many cases still in its infancy (Xing et al., 2017). Information about NBS approaches, particularly on implementation practices, effectiveness and monitoring remain scarce. (Fernandes and Guiomar, 2018) Additionally, relatively little is known about how these concepts are used and interpreted at the local (urban) level, as well as incorporation into decision-making and handling multi-criteria aspects in legal and organisational systems, (Sörensen, 2019) which has implications for policy formulation and actions (Baravikova, 2020).

Concludingly, because of their dynamic and complex nature, academic sources on implementation at the local level, effectiveness and monitoring remain scarce. Therefore, a knowledge gap on NBS approaches in general, when comparing cities' strategic (climate) plans remains. To summarize:

- Approaches using NBS are still in their infancy (Xing et al., 2017)
 - Scarcity of information on NBS approaches, implementation practices, effectiveness and monitoring. (Fernandes and Guiomar, 2018)
 - Little is known about usage and interpretation of NBS concepts and at the local urban level, concerning decision-making, along with legal and organisational implications on policy formulation and actions. (Baravikova, 2020; Sørensen, 2019)
 - Studies comparing cities on the subject of NBS approaches remain scarce
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For this research, the focus will be on local urban green spaces in particular. Within urban green spaces, the focus will be on achieving the urban SDGs. This means that both the indicators and to-be-analysed cities that are selected will be those that are associated with the theme of urban green.

When investigating European cities which can be analysed, three candidates stood out. These are Amsterdam, London and Hamburg. All have adopted some form of nature-oriented approaches towards sustainable development. For example, Hamburg is known for its extensive ‘green network’ approach, while Amsterdam aims to foster sustainable development through small local greening projects, such as the ‘Amsterdam Rainproof’ initiative whereas London has the ambition to become a ‘national park city’, where a network of green infrastructure is managed to benefit all Londoners. At the same time, the cities differ in their approaches, such as the spatial scale, both in size and in administrative outreach. Amsterdam is rather small, Hamburg is a fairly large city and London is an enormous agglomeration. Hence, the approaches of the local government towards sustainable development differs, which makes comparing these cities worth investigating.

Research questions

Main question:

Q.1: “How do nature-based solutions appear in climate adaptation strategies in Amsterdam, Hamburg and London, and how do they help achieve the U.N. (urban) Sustainable Development Goals?”

Secondary questions:

Q.2.1: How are NBS defined and how are they applied in city strategies?

Q.2.2: How can NBS strategies be assessed?

Q.2.3: How does the evaluative framework apply to cities using NBS strategies?

Q.2.4: How do Amsterdam, Hamburg and London include NBS approaches in their climate change strategies and how do they foster sustainable development?

Q.2.5: Which lessons can be learned from evaluating NBS approaches in climate strategies of Amsterdam, Hamburg and London?

Structure

First, a comprehensive literature review commences, gathering information about the concepts and theories involved. NBS policies, strategies, frameworks and theories are investigated to gain a clear understanding of the subject. From that, a definition of NBS follows which will be the guiding principle for the evaluative framework and its indicators.

Second, the criteria for evaluating NBS strategies are defined, per literature review, as input for the following evaluation. A qualitative method will be used to assess the impact of each NBS approach on urban sustainable development in European cities.

Third, an evaluative framework is presented, based on the information gathered by answering the two previous research questions.

Fourth, the established evaluative framework is utilized to evaluate the strategies and policies included in the climate strategies of Amsterdam, Hamburg and London. Background on the history of green management, decision making and the types of plans in each city is also provided. This requires thorough reading of official policy and spatial planning documents available online. This results in structured, detailed information on the implementation of policies and their spatial implications in each city.

Fifth, a final evaluation including a set of recommendations follows. The recommendations will be part of the evaluative process and will contribute to the current available scientific literature concerned with both SDGs and NBS. As a final step, we evaluate the findings and relate them to the sustainable development goals.

Finally, a conclusion is drawn, followed by a discussion. Concluding the paper will be recommendations for future research on the topics.

Theoretical Framework

Definition of NBS

Q.2.1: How are NBS defined and how are they applied in city strategies?

In recent years, there have been many definitions of NBS by different authors. The precise definition of NBS is still under debate. (Nesshöver et al, 2017) This lack of certainty makes research on NBS and its impacts and scale difficult. Albert et al (2017) argue that “lack of a precise definition for the term 'nature-based solutions' risks makes it seem arbitrary and impractical”. For the purposes of this research, only spatial urban interventions and policies that can be considered as NBS will be examined. This, however, brings with it the problem that there are many spatial interventions and policies that can be considered NBS. Therefore it is paramount for this research to formulate a definition on the function of NBS ourselves, in the theme of urban green, by building upon definitions by other researchers. This will aid in connecting NBS to the urban SDG targets.

Faivre et al. (2017) describe the function of NBS as operationalization of the concept of ecosystem services in real-world situations to promote sustainability more explicitly”, while Maes and Jacobs (2015) state that: “Nature-based solutions can help us to remain within the safe operating space for humanity, improve local ecological and social sustainability, and guarantee long-term productivity”. At the same time, Raymond et al. (2017) define NBS as solutions to societal challenges inspired and supported by nature. Since we are assessing climate strategies and in particular the spatial interventions derived from them, a more tangible definition within that theme would be suitable. Herein the most suitable would be the NBS definition formulated by the European Commission, that: “they are adaptations and risk mitigation measures provided or inspired by nature and continuously supported by natural processes.”

The application of NBS into each city’s climate strategies is complex and requires an understanding of the management of NBS in order to foster sustainable development (Wamsler et al., 2020). Implementation of NBS strategies often happens in a multi-disciplinary stakeholder approach, where various sustainable development goals are considered. Implemented strategies are increasingly focused on cooperation, stakeholder involvement and associated transdisciplinary approaches (Wamsler et al, 2015). Integration of NBS has to take place at municipal level, where international and national legislation and policies are translated into practice (Beery et al., 2016).

Critiques/problems measuring NBS

Q.2.2: How can NBS strategies be assessed?

There is an extensive knowledge available on the concept of NBS. The concept can be found in many studies in various contexts, such as urban planning, ecology and social sciences.

For assessing NBS strategies in strategic climate plans, an evaluative framework will be used, with indicators derived from academic literature. Raymond et al (2017) define NBS as solutions to societal challenges inspired and supported by nature. In their research, these authors define 10 ‘challenge areas’ which are indicators and methods for assessing NBS. Considering the established definition of NBS and the focus of this research, only ‘Water management’, ‘Green space management’ and ‘Climate mitigation and Adaptation’ are indicators which will be included in the evaluative framework.

The U.N. have established 17 SDGs in its ‘2030 Agenda for Sustainable Development’. The 11th SDG, ‘Sustainable Cities and Communities’ are aptly named the Urban Sustainable Development Goals (USDG) (DESA, 2021). The indicators for each of target within the USDG, are used as basis for the evaluative framework, together with the aforementioned indicators by Raymond et al. (2017) Since we have established that NBS are “adaptations and risk mitigation measures provided or inspired by nature and continuously supported by natural processes” the following indicators from the USDG will be used: ‘Natural protection’ and ‘green public spaces’. Together the five indicators make up the evaluative framework

The conceptual model below illustrates how the indicators are integrated into the evaluative framework and how they are to be utilized. By using this framework, with the determined indicators, we can analyse NBS approaches in Amsterdam, Hamburg and London’s climate strategies.

Conceptual model

The conceptual model (figure 1) illustrates how and which concepts will be integrated into the research. Input for the construction evaluative framework has been gathered beforehand. The evaluative framework will be used in an analysis of the three cities which have included sustainable development strategies in their climate strategies.

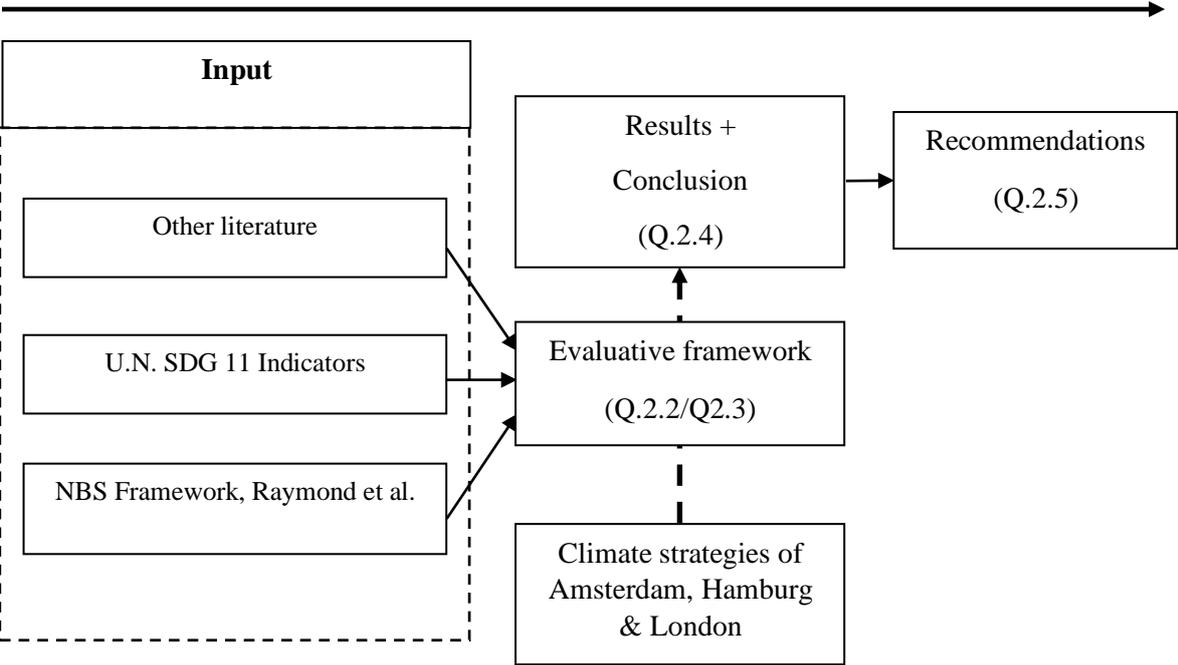


Fig. 1. Conceptual model

Evaluative framework

Q.2.3: How does the evaluative framework apply to cities using NBS strategies?

The input for the evaluative framework consists of a combination of indicators. This combination is comprised of the study by Raymond et al. (2017) and the targets within the USDG. A total amount of five indicators will be used in the evaluative framework, as listed in table 1.

Table 1

Definitive indicators with examples of NBS

<u>Indicators - Final</u>
Climate mitigation and adaptation
Water management
Green space management
Inclusivity/accessibility of green/public spaces
Natural protection

In order to better analyse the climate strategies, we need to know what concrete NBS approaches we can expect and their effects. NBS are used for different purposes like the regeneration of degraded urban areas, storm water management and flooding risk reduction (Antuña-Rozado et al., 2019). Sutherland et al. (2014) identified 25 solutions which pertain to the urban system, such as the use of permeable surfaces and vegetation, where possible, in hard landscape construction.

Methodology

For this thesis, a qualitative method is pursued, more specifically, a (comparative) document analysis. This is because of the complexity and holistic nature of climate strategies in general, requiring thorough reading of the relevant parts within each document. An adequate amount of documents needs to be available for a thorough evaluation of the chosen cities. The type of sources include: Strategic plans, policy documents, scientific articles and websites. These sources are gathered digitally. This means that all sources are part of a secondary data collection. Table 2 provides an overview of the sources that are used as base for the evaluation. Each of the cities' climate strategy documents will be analysed using the evaluative framework. Per city, a comprehensive table follows, addressing all five aforementioned indicators.

Table 2

Sources on climate strategies for each city

Document title	Type of publication	Publisher	Filetype	Year
'Strategie Klimaatadaptatie Amsterdam'	Strategy	Gemeente Amsterdam (Municipality of Amsterdam)	PDF	2020
'Hamburg Climate Plan'	Report from the senate to the Hamburg Parliament	Senate of Hamburg	PDF	2015
'First revision of the Hamburg Climate Plan'	Revision	Senate of Hamburg	PDF	2019
'London Environment strategy'	Strategy/ Policy document	Greater London Authority	PDF	2018

Data collection instrument

With the indicators established, we can evaluate each city's strategy accordingly. Using the evaluative framework, we aim to answer sub-questions 3, 4 and 5. The main focus of the framework will be on answering Q.2.4: "How do Amsterdam, Hamburg and London include NBS approaches in their climate change strategies and how do they foster sustainable development?"

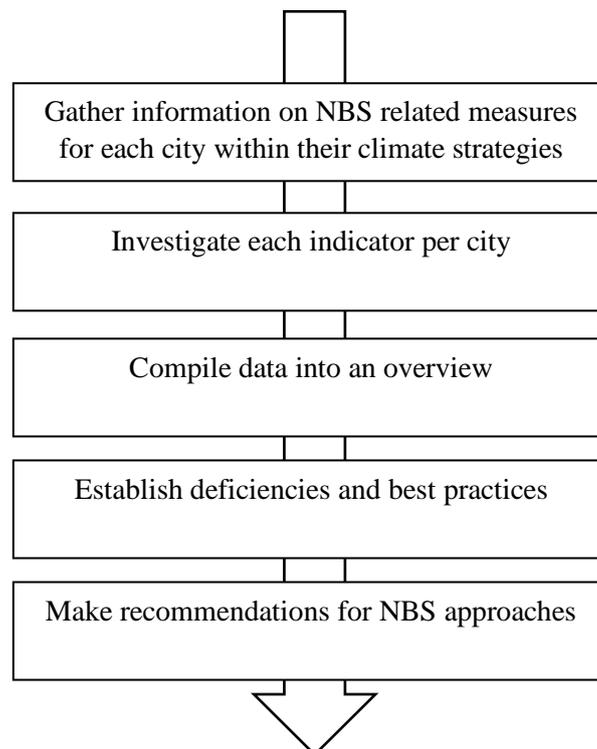


Fig. 2. Data analysis scheme

By analysing the climate strategy of each city, with the help of the indicators, a result follows which clarifies to what extent the indicators are incorporated into the cities and what their contribution is towards urban sustainable development goals. Figure 2 shows the data analysis scheme, which outlines the collection and processing data.

Results

Amsterdam

Amsterdam has a strong tradition with green, such as the tree-lined canals in the inner city from the 17th century and the ‘fingers of green’ extending outwards from the city into the surrounding areas. The municipality established this green structure in 1934. The city does have a handful of large city parks, such as the Vondelpark and Oost- and Westerpark. The majority of the municipality of Amsterdam consists of built-up areas however. Amsterdam’s visions for nature development are ambitious. In the overarching spatial development strategy ‘Structuurvisie Amsterdam 2040 – Sterk en Duurzaam’, a vision is shared to increase biodiversity, strengthen the ecological network and invest in city parks.

The strategy ‘Climate adaptation Amsterdam’ (Klimaatadaptatie Amsterdam) is a perspective document, which explores the possibility of a climate resilient Amsterdam. It is Amsterdam’s ambition to be as prepared as possible for the changing climate in 2050. The strategy does not pin down new plans that are to be developed, but forms a first step towards becoming a climate resilient city. According to the municipality, climate adaptation is essential to ensure that Amsterdam remains valuable physically, socially and economically attractive and sees the process as an opportunity to make an important contribution to a safe, green, livable and attractive city together with all inhabitants of the city. The aim is to make climate adaptation the ‘new normal’, meaning that climate adaptation is taken for granted in relevant developments and projects in the city.

Table 3

Evaluative framework for Amsterdam

<i>Indicator</i>	Present in strategy	Extent	NBS Examples in strategy
<i>Climate mitigation and adaptation</i>	Yes	Heat, drought, extreme precipitation and floods	Greening of outdoor spaces, roofs and facades; small parks to provide shade and cooling, with and without water
<i>Water management</i>	Yes	Focus on combating heat and drought	Replenish groundwater with natural surface water/water buffers; Local recycling of rainwater, local retention: green roofs and ponds
<i>Green space management</i>	No	Not mentioned	-
<i>Inclusivity/accessibility of green/public spaces</i>	No	Not mentioned	-
<i>Natural protection</i>	Yes	Limited	Establish blue-green infrastructure for animals/insects

Hamburg

Hamburg has a heritage of climate action, being one of the first cities to develop a comprehensible climate strategy. Hamburg is the quintessential ‘green waterfront city’, featuring a multitude of nature reserves, parks and green spaces, as well as the Alster and Elbe water bodies. Green spaces, recreational areas and forest make a substantial amount of the metropolitan area, accompanied by nature reserves and protected landscapes. (City of Hamburg, 2016) Hamburg's green environment is the result of an urban planning scheme that has been nearly 100 years in the making (Hamburg.com, 2021). The ‘GrünesNetzHamburg’ is a long-term, ongoing programme which has mapped all (potential) green spaces within the municipal border, along with possibilities for connecting now separated green spaces

The current climate strategy, ‘Hamburger Klimaplan’ stems from 2015. It was inspired by the vision: ‘Hamburg 2030 – Perspectives on urban development in Hamburg’ and by the Strategy for Adaptation to Climate Change, both were defined by the city. Hamburg aims to become a ‘climate smart city’. Along the climate strategy, multiple overarching strategies have been published by the city. ‘Hamburg – European Green Capital: 5 Years On’ provides visions for sustainable development in Hamburg, which also include NBS approaches, such as green roofs. The first revision of the aforementioned climate strategy from 2019 will be analysed too, it being the most recent addition on Hamburg’s climate policies.

Table 4

Evaluative framework for Hamburg

<i>Indicator</i>	<i>Present in strategy</i>	<i>Extent</i>	<i>Suggested NBS</i>
<i>Climate mitigation and adaptation</i>	Yes	Integrated with water management	Green roofs and facades
<i>Water management</i>	Yes	Integrated with green space management	Natural rainwater capture (on green roofs), rainwater recycling in open water
<i>Green space management</i>	Yes	Elaborative	No development allowed on current green axes, expansion and creation of green corridors, afforestation
<i>Inclusivity/accessibility of green/public spaces</i>	No	-	-
<i>Natural protection</i>	Yes	Extensively	Preservation of open spaces, protection of soils, Green network approach, protect vulnerable soils against evaporation

London

The overall aim of the Greater London Authority (GLA) with the ‘London Environment Strategy’ (LES) is to make London and Londoners resilient to severe weather and longer-term climate change impacts, more specifically, flooding, heat risk and drought.

Most of Greater London’s history concerning nature can be traced back to royal parks from the early 19th century. These parks were almost exclusively used as hunting grounds for members of the monarchy. From that time onwards, some, but not all parks were opened to the public.

The ‘green belt’ policy stemming from 1935 was and still is, a manner of controlling urban growth, acting as a boundary which should not be crossed when urban development encroaches on it. This policy is not native to London only though, since it is a national policy and multiple ‘greenbelts’ do exist in the UK. More recently, the growth of London over the centuries has resulted in a reduction in natural habitats and green open spaces. (GLA, 2018) The ‘London Plan’ and ‘All London Green Grid’ from the past have been effective at protecting and conserving the best of the city’s parks, green spaces and natural landscapes.

The LES is an integrated environment strategy for the Greater London area, combining policy and action. The overall aim of the Greater London Authority (GLA) with this strategy is to make London and Londoners resilient to severe weather and longer-term climate change impacts, more specifically, flooding, heat risk and drought.

Table 5

Evaluative framework for London

<i>Indicator</i>	Present in strategy	Extent	Suggested NBS
<i>Climate mitigation and adaptation</i>	Yes	Flooding, heat risk, drought	Natural river banks
<i>Water management</i>	Yes	Tidal, fluvial and precipitation flooding; groundwater	Sustainable drainage systems (SuDS) including green infrastructure, river vegetation restoration
<i>Green space management</i>	Yes	Only on surface level	Green roofs and - facades
<i>Inclusivity/accessibility of green/public spaces</i>	Yes	Importance of mental/physical health	Small and medium greening projects, including community gardens
<i>Natural protection</i>	Yes	Biodiversity	Habitat restoration

Evaluation

The evaluative framework has been applied to the climate strategies of Amsterdam, Hamburg and London. These three cities each have their unique approach to each of the indicators in the framework. As a final step, we evaluate the findings and relate them to the sustainable development goals. The findings will be evaluated on the basis of best practice, meaning looking at which indicators each of the cities excel. This means that the recommendations will also be based on this. Furthermore, what is missing in the climate strategy will also be assessed.

First, it is striking that both Hamburg and London include an extensive ‘green network’ approach in their climate strategy to improve accessibility and inclusivity of green spaces and to promote natural protection, while Amsterdam does not. This approach can help achieve specific urban sustainable development goals, as the amount of green space and its distribution, and the ease of access to such space are key contributors to cultural ecosystem services (e.g. those related to recreation, health and wellbeing, culture) in urban environments as well (Barbosa et al. 2007; Cook and Lier 1994). Landscape connectivity is a highly significant landscape attribute for conservation biology, as it is generally accepted that it enhances population viability and species richness (Noss and Coperrider, 1994; Meffé and Carroll, 1997; Beier and Noss, 1998; Gilbert-Norton et al., 2010; as cited in Pino and Marull, 2011), thus contributing to the natural protection USDG. Setting up habitat corridors is a classic approach to landscape connectivity management (Hobbs, 1992, as cited in Pino and Marull, 2011) that has been advocated as a key conservation strategy in human-modified landscapes (Wilson and Willis, 1975; Noss, 1987; Forman, 1995; Fischer and Lindenmayer, 2007, as cited in Pino and Marull, 2011) and therefore contributing to the USDG in cities.

Second, it can be seen that NBS approaches that pertained to the indicators ‘Climate adaptation & mitigation’, ‘green management’ and ‘water management’ were most elaborated on in all three strategies.

Third, London is the only city that considers natural drainage systems within the NBS approach. With this application of NBS, London has managed to restore a major part of the natural drainage systems into the Thames river. The adoption SuDS adoption can potentially contribute to the attainment of the United Nations (UN) sustainable development goals, which address the build-up of resilient urban areas and the mitigation and adaptation to natural disasters (e.g., flooding) related to climate change, respectively (UN, 2015). Since, storm surges and coastal flooding are a constant issue in Hamburg (City of Hamburg, 2015) and Amsterdam focusses on reducing the damage and nuisance by extreme precipitation as well as floods (Gemeente Amsterdam, 2020), both cities should investigate SuDS in their climate strategies. This will help both cities foster sustainable development for in line with the USDG.

Fourth, Hamburg performs best when considering NBS approaches, as can be seen in their renowned green roofs programme. Since 2014, 30 ha of green roofs have been implemented, reaching a total of 154 ha in the metropolitan area, of which 39 % is on housing, 35 % on industrial and business premises and 25 % on other buildings, 75% new buildings have had green roofs installed (Castellari et al., 2021).

Fifth, London's climate strategy is the most complete ,extensive and in-depth. This can be seen when looking at all three evaluative framework tables in the results section. London addresses all five indicators, while Amsterdam does not mention green space management and the accessibility and inclusivity of green spaces, while Hamburg only fails to mention the latter.

Concludingly, there a number of NBS that Amsterdam, Hamburg and London can adopt from each other, such as London's SuDS, Hamburg's green network approach and green roof programme.

Conclusion

In this paper the following research question is answered: How do nature-based solutions appear in climate adaptation strategies in Amsterdam, Hamburg and London, and how do they help achieve the U.N. (urban) Sustainable Development Goals?

We have found that the concept 'Nature-based solutions' is very broad and can be defined in many ways. For the purposes of this research, we have established that NBS are "adaptations and risk mitigation measures provided or inspired by nature and continuously supported by natural processes" in the context of climate strategies for Amsterdam, Hamburg and London.

We have found that there is an overlap between the indicators established by the U.N. within the urban SDG and in other academic literature, providing a foundation for the development of evaluative frameworks. By using a framework, with determined indicators, we can assess NBS approaches in cities' (such as Amsterdam, Hamburg and London) climate strategies.

By analysing the spatial aspects of the climate strategy of cities, with the help of indicators, a result followed which estimated to what extent the indicators are incorporated into the cities and their contribution towards urban sustainable development goals.

We have established that by applying an evaluative framework to the climate strategy of each city, that that will in a result which clarifies to what extent the indicators are incorporated into the cities and what their contribution is towards urban sustainable development goals

NBS approaches that pertained to the indicators Climate adaptation & mitigation, green management and water management were most elaborated on in the strategies. Sustainable development, flood resilience, nature conservation, increasing or maintaining biodiversity, expansion of ecosystem services in line with the 11th (urban) sustainable development goal, means, that these cities therefore contribute, with the help of nature-based solutions to the USDG.

Concludingly, there a number of NBS that Amsterdam, Hamburg and London can adopt from each other, such as London's SuDS, Hamburg's green network approach and green roof programme. The amount of NBS suggested are rather scarce. Only a few indicator categories are addressed with multiple being suggested. This suggest that NBS approaches are not widely known within the branches of municipal government in these cities. The sustainable development indicators, in line with the USDG, that are addressed are climate mitigation and adaptation and water management.

Discussion

In this paper, we investigated Nature-based solutions and the urban sustainable development goals. Naturally, there are some considerations given the research conducted in this paper. First, as indicated in the answering of the first sub-question, definitions of NBS remain vague to this date. This lack of certainty makes research on NBS and its impacts and scale difficult for researchers. Second, NBS approaches are rarely focused on a singular objective, making it difficult to point out its impact in cities within policies. Third, the recentness of the cities' climate strategies must be taken into account. Fourth, the complexity of the climate strategies must not be underestimated, and NBS must be seen as an integrated part in a larger, holistic approach. Fifth and last, the overarching nature of the analysed climate strategies made it difficult to find concrete NBS measures in the spatial dimension.

This research has added to academic literature on NBS approaches and urban sustainable development goals in particular. However, there still remain some knowledge gaps on the interaction between these two themes, suggestion further research is needed. Explicit research on the interplay between NBS approaches and urban SDGs would further current knowledge even more.

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Appendix B: Peer review form and changes made thereafter

Bachelor Thesis Peer Review Form

Reviewer: Sjoerd Duim (s3581896)

Thesis: Job Busscher: Nature-based solutions as a strategy for achieving urban sustainable development

goals: A case study of Amsterdam, Hamburg and London's climate plans

General	
Is the thesis clearly structured?	The structure is clear and makes it nice to read.
Is there a clear link between the different parts?	Yes, the clear structure contributes to the links between the different parts.
Are the majority of the sources of an academic nature? If not, is there a good reason for this?	Yes they are.
Is the literature of a recent date? If not, is there a good reason for this?	Yes.
Are all the sources used included in the references?	Yes.
Are the sources correctly cited in the body of the text?	Yes, sometimes interpunction is not completely correct, but these are typo's.
Are the sources correctly referred to in the reference list, in accordance with the Harvard system?	Yes.
Do the figures and tables clarify the text?	They do.
Are the figures and tables numbered correctly and are they referred to in the text?	The conceptual model and the evaluative framework are not numbered.
Is the text clear and readable?	Yes.
What is the sentence structure like?	Clear and readable. Nice use of the English language.
Are the spelling, grammar and punctuation correct?	Most of the time. There are some small typo's, mainly in the interpunction. Spelling is good.
Questions/Comments	
The font is not the same everywhere, but I'm sure you'll have a look at this later on.	

Summary	
Are the main aspects of the study discussed?	A summary of what research has been done is given, but results and conclusions are not there yet, but “more information will follow”. Nice beginning though.
Are the topic, aim, research questions, methods, results and conclusions summarized?	Topic and methods: clearly. Research questions: I can derive it, but not completely clear. Results and conclusions: no.
Questions/Comments	
Nice start for a summary, but I would advise to be a little more to the point. It doesn't have to be a real smooth story (in my opinion), just implement the topic, aim, research questions, methods, results and conclusions in a few sentences.	

Introduction	
Is the topic clearly defined?	The topic, NBS, is clearly defined.
Is the relevance of the topic clearly explained?	Yes, it is.
In your own words, what is the purpose of the research?	Achieving a better understanding of NBS and their contribution to the creation of environmentally friendly environments in the context of the SDG's.
Are the aim and research questions integrated into the academic literature?	Yes.
Does the Introduction arouse your interest? If so, how? If not, why not?	Yes, it does. The fact that there is still a knowledge gap interests me and I am wondering what the outcomes of the research will be.
Questions/Comments	
From what year are the strategy documents of the cities?	

Theoretical framework	
Do the theoretical insights that are discussed constitute a relevant basis for answering the research question(s)?	Yes, they do. Maybe a discussion between the different definitions of NBS would contribute to a better understanding of the concept.

Are the theoretical insights explained in a comprehensible way?	Yes, clearly.
Are there references to relevant international academic literature? (articles from academic journals and books)	Yes.
Is the theoretical framework logically structured?	Yes.
Does the conceptual model tie in with the research questions and theory?	The model is clear. However, it would be nice to see which research question is answered at what point. Maybe incorporate the research questions.
Questions/Comments	
-	

Methodology	
Is the choice of data collection and data analysis methods well explained?	Yes, it becomes clear how the research will be conducted.
Do the data collection and data analysis methods match the aim and research questions?	The Methodology does not say on the basis of what the recommendations (subquestion 5) will be based. (Probably on the best-practice of the case studies, but mention this)
Are the questionnaires, observation checklist, etc. included in the appendices?	Appendices do not exist yet.
Does the author clearly explain how he/she set about collecting and analyzing the data?	Yes, policy analysis, so that is clear.
Is there a reflection on the quality of the data that was collected?	Not really, but it does tell why the datasets are probably equal to each other.
Is there a satisfactory explanation of the ethical considerations relevant to the research and of how these were dealt with?	N/a
Are the Methodology sections logically structured?	Yes.
Questions/Comments	
-	

Results

Are the most relevant results discussed?	Especially subquestion 4 is answered thoroughly.
Are the results thoroughly analyzed (i.e. not just described)?	Yes, for Amsterdam at least. The results of the other two cities still have to come. Maybe the analysis is even too thorough (word limit).
Are the results linked to the research questions?	Yes they are.
Are the results sections logically structured?	Yes, clear structure.
Questions/Comments	
I'm excited to see the results of Hamburg and London.	

Conclusion/discussion	
Are the research questions answered?	n/a
Are the results placed in a broader theoretical perspective?	n/a
Are the results compared with other research results?	n/a
Are there recommendations for future research?	n/a
Questions/Comments	

Based on:

Pain, R. & G. Mowl (1996) Improving geography essay writing using innovative assessment. *Journal of Geography in Higher Education* 20(1): 19-32.

Kennedy-Kalafatis, S. (1996) Encouraging peer dialogue in the geography classroom: Peer editing to improve student writing. *Journal of Geography in Higher Education* 20(3): 323-341.

Changes made after the peer review (Assignment 6)

General

- The conceptual model and the evaluative framework were numbered
- Interpunction has been corrected
- A universal font has been introduced (Times New Roman, 12 pt.)

Summary

- Summary has been shortened
- More information from the thesis has been added (results, conclusions & discussion)

Introduction

- Peer-reviewer asked for the publication year of the climate strategies, these have been added in table 3, within the section 'Methodology'

Theoretical framework

- More definitions of NBS were introduced and discussed

Methodology

- Reflection on quality of the data was added
- Appendices have been added

Conclusion/discussion

- Results, conclusions and discussion have been added and finalized