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Nature-based solutions in Europe: A frame analysis on urban policy strategies

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Summary

Nature-based solutions (NbS) is a concept where ecosystem services are used to address societal challenges. It can replace the traditional, and often harmful, infrastructure measures while providing benefits for wellbeing and biodiversity. This concept has received a lot of attention in recent years, mainly from European countries. In Europe, most NbS policies and projects mainly focus on urban areas. However, NbS is considered a vague term by policymakers, as there are no clear guidelines of how NbS should be implemented. The IUCN tried to tackle this by developing criteria for NbS. One of these criteria is that NbS need to address societal challenges. To see how NbS and the relating societal challenges are addressed, this research carries out a frame analysis. By analysing the urban strategy policies of different European cities, it aims to make clear how NbS is framed in relation to societal challenges. From the European NbS database, eight policy strategy documents regarding NbS were selected and analysed. A mix of inductive and deductive coding was used for the frame analysis. The results show that policymakers mainly address climate change-related challenges. Also, the policy documents were not consistent in defining NbS, as they used different names and different definitions for NbS. Furthermore, as climate change was mostly the perceived challenge, the strategies often aimed to adapt to this challenge, rather than aiming to address other challenges.

This research has limitations, however. Only eight policy documents were analysed, thus the results do not represent all NbS policy strategies in European cities. However, it does show policy implications. With additional benefits not clearly being distinguished, it fails to show the potential of what societal challenges can be addressed by NbS. To conclude, this research shows that NbS in urban policy is mainly focused on addressing climate change rather than other societal challenges. For NbS to be successful, non-environmental challenges also have to be addressed.

List of Abbreviations

IUCN	International Union for Conservation of Nature
EC	European Commission
EU	European Union
NbS	Nature-based Solutions

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1. Introduction

In the past decades, grey infrastructure has been used as the default solution to prevent and mitigate flooding (Brears, 2018, p. 1). An example of a grey infrastructure measure is building concrete dams. The traditional grey measures, however, are not sustainable as they have unintended negative impacts (Alves, Gersonius, & Kapelan, 2019, p. 244; Brears, 2018, p.2). An example of these consequences is the disappearance of mangrove forests by the construction of a seawall. This measure causes erosion, and combined with the decrease of sediment supply, it leads to the disappearance of mangroves (Goudie, 2018). It would be unfortunate if traditional infrastructure measures lead to the disappearance of nature because nature can play an important role in the current global challenges such as climate change and disaster risk reduction (Albert et al., 2019). That is because nature provides ecosystem services. Ecosystem services are “*benefits that human populations derive from ecosystems.*” (Bolund & Hunhammar, 1999, p.293). The services range from flood mitigation to the purification of air (Daily, 1997, p. 3). Ecosystems services are valuable for the benefits that they bring, as well as for the new concept of problem-solving which is called ‘nature-based solutions’ (NbS) (Pauleit, Zölch, & Hansen, 2017, p. 42). This concept has been developed by the International Union for Conservation of Nature (IUCN) (Cohen-Shacham, Maynard & Nelson, 2019, p. 20). The IUCN describes nature-based solutions as “Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.” (Cohen-Shacham, Walters & Janzen, 2016, p. 2).

The concept of NbS has received more attention during the past five years (Li, Cheshmehzangi, & Chan, 2021, p. 8). Mainly member states of the EU were researching the topic, with the Netherlands, Germany, and Italy in particular, as well as the United Kingdom. The fact that the EU is giving NbS a lot of attention can be seen through the funding that the European Commission and European Research Council provide for researching NbS (Li et al. ,2012 p.9). The European Commission has published many documents and has implemented NbS in its policies during the last decade (Davies, Chen & Sanesi, 2021, p. 50). The EU sees potential and is leading in NbS policies, as they are investing in NbS with the ‘Horizon 2020’ program. This consists of NbS pilots to assess the benefits of NbS (Maes & Jacobs, 2015, p. 123). The EU policies and projects focus largely on NbS in urban areas (Zwierzchowska et al., 2019, 162).

NbS is a broad concept with a lot of overlap with other concepts. What makes NbS different from similar concepts, is that NbS is an umbrella term for those concepts (Pauleit et al., 2017, p.44). All the

approaches that are considered to be a part of NbS, should address one or multiple societal challenges while bringing benefits to human wellbeing and biodiversity (Cohen-Shacham et al., 2019, p.22). An example of such a substream of NbS is ecosystem-based disaster risk reduction (Eco-DRR). This is a concept that combines sustainable management, conservation, and restoration of ecosystems while reducing disaster risks (Renaud, Sudmeier-Rieux, & Estrella, 2016, p. 4).

There is some critique on NbS however. An important reason that withholds NbS from widely being implemented is the vagueness of the term itself, lacking clear principles and guidelines for policymakers (Cohen-Shacham et al., 2019, p.21). Other problems consist of missing data to operationalise NbS for decision-makers. Also, NbS policies are quite fragmented, which makes it difficult to operationalise it (Kumar et al., 2020, p.4).

To tackle this problem, the IUCN came up with principles in 2016 and with more criteria in 2020 (Cohen-Shacham et al., 2020; Cohen-Shacham et al., 2016). These should guide policymakers for NbS policy implementation by increasing the understanding of NbS. One of these criteria is that NbS not only needs to protect the environment but also has to address core societal problems (Cohen-Shacham et al., 2020, p.6).

That is why this thesis will answer the question of *“How are NbS and the relating societal problems and benefits framed in European urban strategy policies?”*. Since Europe is the most developed in NbS, European urban policies will be examined to see which problems are sought to be addressed in current NbS policies. This is relevant for sustainability because NbS can play a significant role in the current sustainability challenges by providing well-being and biodiversity benefits while tackling societal challenges. The research aims to give insights into how policymakers frame NbS when aiming to solve societal problems. This can help to reduce some of the vagueness surrounding the term NbS for policy makers. Furthermore, the research aims to provide a framework that can potentially prove useful in analysing how NbS is framed in NbS urban policy.

This proposal is structured as follows. In the next section, the theories and concepts are introduced. They will form the basis for the analytical framework that is presented in that section. The following section describes the method and the collected data. This is followed by the results, which will be reflected in the discussion. Finally, the conclusion will answer the research question.

2. Theory

This chapter starts by providing a background to the NbS criterion for addressing societal challenges. It will then provide a framework based NbS literature.

2.1 Nature-based solutions: principles

As stated in the introduction, the NbS definition of IUCN is “Actions to protect sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.” (Cohen-Shacham et al., 2016, p. 2). One part of this is that NbS has to address societal challenges (Dick, Carruthers-Jones, & Carver, 2020, p.2). Addressing societal challenges is an overarching goal of NbS. The IUCN argues that NbS are designed to address societal challenges (Cohen-Shacham et al., 2016, p. 5).

In the IUCN report of 2016, eight principles were introduced to make NbS better understandable (Cohen-Shacham et al., 2016). Principle 8, concerning societal challenges, is formulated as follows: “Nature-based Solutions are an integral part of the overall design of policies, and measures or actions, to address a specific challenge.” (Cohen-Shacham et al., 2016, p. 6). This was followed by a short clarification. NbS must explicitly address societal challenges, and the solutions should not only be aimed at addressing environmental challenges only nor minimizing environmental impacts exclusively. Yet, this may be a part of NbS (Cohen-Shacham, Walters & Janzen, 2016, p. 6). Furthermore, NbS principle 8 relates to principle 2 states:” Nature-Based Solutions can be implemented alone or in an integrated manner with other solutions to societal challenges (e.g. technological and engineering solutions)” (Cohen-Shacham et al., 2016, p. 6).

However, these principles are too broad according to Cohen-Shacham et al. (2019) and need more explanation. Then, in 2020, the ‘IUCN Global Standard for Nature-based Solutions’ was released (Angela, Dalton, & Cohen-Shacham, 2020). This report gives a better explanation of the criteria. The global standard is developed to offer a robust framework that can help policy development for NbS

The first criterion states: “NbS effectively address societal challenges” (Angela et al., 2020, p. 6). This criterion consists of three indicators (see Appendix A for this framework of criterion 1). The first addresses that the societal challenges must be specified and have a clear impact on society. This should be done together with stakeholders. The second indicator states that there should be a documented understanding of the challenges. This is for later optimisation purposes to ensure it contributes to human well-being. The benefits of NbS can address other societal challenges than those initially aimed for, which also should be documented. The third indicator addresses the human well-being outcomes and the setting of SMART targets. These are targets that are specific,

measurable, attainable, realistic, and timely (Doran, 1981). These indicators are still broad and cannot be used immediately, as they serve as guidance only.

In this research, only a few elements of this criterion have been chosen. Firstly, the societal challenge. Secondly, wellbeing benefits and additional benefits were chosen. Lastly, clear targets and monitoring are also included. These three categories are included because analysing these can tell what challenges are tackled and what benefits are perceived. Lastly, by including monitoring, something can be said about to what extent NbS policies are perceived as a serious solution. One category that is not included in the indicators of this criterion is the goal of NbS. This will be included as it is the overarching goal of NbS to address the societal challenges.

Although stakeholder involvement and problem rationale are two important aspects of the mentioned criterion, they are not included. This research does not evaluate whether stakeholders are involved in NbS, nor does it evaluate whether assessments have been carried out on the societal problems.

The categories for analysis are operationalised in the next section.

2.2 concepts of the framework

To further operationalise this, the next part discusses the literature for every used concept in this framework.

2.2.1 Societal challenges

Grin et al. (2010, p. 107-108) define societal challenges as problems that are persistent, hard to manage with a variety of stakeholders involved, difficult to interpret, and difficult to solve since they are entrenched in society. In the literature about NbS, there is a variety of societal challenges. The IUCN has six different categories of societal challenges. Those are water security, food security, human health, disaster risk reduction, climate change, and societal and economic development (Cohen-Shacham et al., 2016). Other authors, such as Albert et al. (2019) add conserving and enhancing biodiversity. Later on, IUCN adopted Environmental degradation and biodiversity loss as an additional challenge (Cohen-Shacham et al., 2019, p.7). These categories are not focused on urban NbS. They are general categories for societal challenges that NbS can solve, given by the IUCN. These categories are used as a starting point in the analysis, but not as a strict set of used categories, in case urban policy documents address different challenges.

2.2.2 Framing NbS

To see which problems are addressed, not only the challenges need to be identified. It is also important to know what challenges are aimed to be targeted. This is because addressing societal challenges is an overarching goal of NbS (Cohen-Shacham et al., 2016, p. 5). Thus the goals of using NbS should be identified. However, NbS is an umbrella term, so not every policymaker might use the term abs. Instead, other terms might be utilised. That is why there will be looked at how NbS is defined in the policy documents. NbS is an umbrella term and can go by different names (Appendix B shows an overview with NbS related terms as a background for how NbS could be named).

Secondly, NbS needs to explicitly address societal challenges and the solutions should not be aimed only at environmental challenges. However, solutions to environmental challenges can be a part of what NbS is aiming for (Cohen-Shacham et al., 2016, p. 6). Thus there will be looked at what the goal of the NbS strategy is to see whether the challenges from the previous section are addressed by the goals. This makes it possible to see if the focus is on environmental challenges only.

2.2.3 Additional benefits and Human well-being

NbS that tackle a specific societal challenge are likely to provide additional benefits or co-benefits. These co-benefits are positive effects in other challenges than the main challenge. A flood peak reduction project might for example lead to quality of life improvements (Raymond et al., 2017, p.17). These benefits can address other societal challenges which should be referred to. These additional benefits should be clearly stated. To identify these benefits, there will be looked at what benefits are mentioned and how these relate to the overall goal of the strategy.

According to the IUCN, human well-being outcomes are linked to NbS by promoting human health, social inclusion, social cohesion, and serving as a source of medicine (Cohen-Shacham et al., 2016). Measures such as green spaces in cities can increase mental health and reduce mortality among other wellbeing outcomes (Braubach et al., 2017). According to criterion 1, NbS should clearly define human wellbeing outcomes (Angela et al., 2020, p. 6). Thus there will be looked at how well-being benefits are mentioned.

2.2.4 Clear target

The criterion addressing societal challenges by the IUCN proposed to use SMART targets. That is a tool for developing effective and measurable goals and objectives (Bjerke & Renger, 2017). This approach is also being used in the sustainability field (Maxwell et al., 2015). There is no literature however that links this method to NbS. However, pre-defined targets are important to set for NbS

(Albert et al., 2020). This is so that the targets can be evaluated afterward. This research will not look specifically for the use of SMART targets, but it will look at if targets are measurable and timely.

To analyse this aspect, there will be looked at two different things. Firstly, there will be looked at the types of targets that are set. This involves looking for clear targets that are quantifiable in terms of taken measures (e.g. increasing green spaces such as parks by a certain amount) and also if there is a time scope for these targets. Secondly, there will be looked at what kind of monitoring is in place and if there are indicators given for monitoring. Table 2 shows the theoretical framework for analysing the framing of the selected components in NbS.

All the discussed indicators form a basis for the analytical framework that is presented in the next part, which is the methodology section.

Indicator	Question	Examples
Type of societal challenge	What societal problem(s) is/are named? How is the societal problem described?	water security, food security, human health, disaster risk reduction, climate change, and societal and economic development.
Framing NbS	How is NbS framed in the document? What is the goal of the NbS?	NbS, Green infrastructure, Eco-system based adaption.
Additional benefits	What are additional benefits of the strategy? How are these linked to societal challenges? How are human wellbeing outcomes discussed?	Heat reduction, flood risk reduction, Air quality improvement, Well-being, mental health, exercise.
Clear targets	What are the targets of the strategy? What kind of monitoring is in place?	Goal, target, date, objective Monitoring, yearly evaluation.

Table 2: the theoretical framework to analyse framing in NbS policy documents.

3. Methods

Framing analysis

To answer the research question, a framing analysis of urban European policy documents has been carried out. Framing analysis is a qualitative method that looks at how certain topics are framed by actors and how meanings are bend in a certain way (Lindekilde, 2014, p.6). It is similar to discourse analysis, but it is more targeted at explaining specific content in text with a more narrow scope. Framing analysis is done to identify core framing elements within urban NbS policy documents, based on the theoretical framework in table 2, but also based on the analysed documents themselves. Policy documents have been coded with a mix of inductive and deductive coding. The framework was developed with a deductive approach. To further operationalise this framework, inductive coding was used.

Initially, the start of the research included more criteria. This research is an iterative process. Certain criteria were left out and certain criteria were added based on the available literature. These are the criteria of stakeholder participation and impact assessments. These are important aspects of NbS. The amount of data was not sufficient however to answer the questions of who was involved in the framing of the NbS.

Eight case studies have been selected. These cases are from the website 'Oppla.eu'. This website describes Oppla as “the EU Repository of Nature-Based Solutions.” (Oppla, n.d.). Oppla is supported by the Seventh Framework Programme (FP7). This EU scheme finances research and development activities (EC, 2017). On the Oppla website, knowledge of NbS is collected and shared. It has a wide variety of case studies, including reports, scientific papers, and evaluations. More cases would increase the research's validity, but time is a limiting factor. The terms that have been used for searching the policy documents are “adaptation, greening, green roofs, heat stress, natural hazards, floods” and disaster risk reduction”. Oppla then shows case studies that are bound to cities on the world map. Oppla has a built-in search engine where the information of different NbS case studies is available. With this engine, it is possible to fill in keywords to search for projects and related documents with a specific theme or in a specific city. These documents include the strategy behind the NbS. To narrow it down, case studies in Europe will be selected that use NbS and are in urban areas. This is to reduce differences between policy documents. Then, cases with sufficient available data are selected. The selected case studies are also selected on the availability of English literature. Some policy documents of the Oppla database are only written in the Native language of that country. The chosen cases are spread across Europe, with most taking place in the Netherlands and in the United Kingdom. This is because NbS data in other countries often lacked usable data for this

research. Despite that, it is still valuable to analyse because the cases are all about urban NbS policy strategy.

The chosen cases are on nature-based solutions in Europe. They range from parks against heat stress to green areas against flooding. To keep a balance between the cases, only one document has been chosen for each city. The oppla database mentioned what document contained the main policy strategy per city, hence those were taken. London is an exception in this case, as it has two documents that have been analyzed. In the oppla database was mentioned that the 'London plan' has two goals, one of them being described in the Living Roofs and Walls Technical Report (Greater London Authority, 2011, 2008). To get a clear picture of the entire plan, both documents have been included. Table 3 shows a list of case studies and their sources.

City	Country	Document title	Source
Amsterdam	The Netherlands	Agenda groen (green agenda)	(Gemeente Amsterdam, 2015)
Bristol	United Kingdom	Bristol's Parks and Green Space Strategy.	(Bristol city council, 2008)
Bristol	United Kingdom	Bristol Local Flood Risk Management Strategy	(Bristol city council, 2018)
Dublin	United Kingdom	Dublin City Development Plan 2016–2022 Statement	(Dublin city council, 2016)
London	United Kingdom	The London Plan Living Roofs and Walls Technical Report: Supporting London Plan Policy	(Greater London Authority, 2011) (Greater London Authority, 2008)
Poznan	Poland	Development Strategy River Warta 2030	(City of Poznan, 2015)
Rotterdam	The Netherlands	Rotterdam Climate Change Adaptation Strategy	(City of Rotterdam, 2013)
Utrecht	The Netherlands	Actualisatie Groenstructuurplan 2017-2030	(Gemeente Utrecht ,2018)

Table 3: list of case studies and their documents

Every project document has been coded to analyse them on specific aspects. For every indicator from table 2, certain words were used to find and categorise codes. Exel has been used as a tool for coding and analysing the documents (Appendix C shows the coding system).

The next section will show the results of the analysis.

4. Results

This section shows the results per category.

Societal challenges

Climate Change

All the policy documents named the societal problem of climate change. Many however specified the societal challenges that are caused by climate change in the challenges they see for the city. Amsterdam for example sees two distinct challenges deriving from climate change. These are increased or heavy rainfall, and rising temperature. Wet circumstances will increase which leads to water nuisance. The other challenge is the well-being of its citizens (gemeente Amsterdam, 2015, p. 23). An increase in wet circumstances is also recognised by Bristol (2008). Climate change leads to warmer and drier summers and wet winters. This trend of wet winters is recognised by most cities.

More cities specify the climate change-induced challenges. Thus, the second most perceived societal challenge for urban areas is heavy rainfall. All documents, except Dublin, address this specifically in the sense that it is called “heavy” or “extreme” rainfall as a consequence of climate change. Another challenge induced by climate change is heat stress. Heat stress was framed as a challenge by Amsterdam, Rotterdam, Utrecht, London, and Bristol (2008). Utrecht for example linked heat stress to the amount of non-green spaces, which amplifies the effect (Gemeente Utrecht, 2018, p.10).

Floods are also named as a societal challenge deriving from climate change. It was named by the Bristol flood risk management strategy, Poznan, Dublin, and London. London and Dublin describe it as a consequence of climate change. Poznan and Bristol see it as a contemporary issue combined with urban creep (Bristol, 2018, p. 11). Lastly, the increase in storms was another challenge that was mentioned only by Bristol (2008) and by Dublin (2016).

Biodiversity

Other challenges were not directly linked to climate change. Biodiversity loss is seen as a current challenge by Utrecht and Dublin. Utrecht sees a loss in biodiversity because of urbanization (Gemeente Utrecht, 2018, p. 10). Amsterdam sees the increase of intensive park use as a potential problem for biodiversity. However, Amsterdam recognizes a positive trend as is stated that the biodiversity in Amsterdam has increased over the past years. Bristol (2008) also sees an increase in the use of green spaces as the temperature rises due to climate change, but this is not linked to biodiversity loss like Amsterdam does (Bristol City Council, 2008, p.27).

Well-being

Lastly, the well-being of citizens is seen as a stand-alone challenge by Amsterdam, Dublin, and Bristol. London, Utrecht, and Rotterdam see it as an issue as well, but only as a consequence of heat stress (City of Rotterdam, 2013, p. 6). Amsterdam for example recognizes that health issues are specifically a challenge to the poorer neighborhoods and that is a challenge on its own (Gemeente Amsterdam 2015, p.10).

Recap

Climate change is similarly perceived as a challenge by all policy documents. There are some notable differences, however. The flood risk reduction strategies of Poznan and Bristol (2018) see the flood as the main challenge. Some cities however see flooding as a consequence extreme rainfall, which is part of the climate change challenge. Only a few documents saw biodiversity loss as a challenge. In the end, most challenges were linked to the future impacts of climate change, which were mainly extreme rainfall and high temperatures in cities. Table 4 shows an overview of cities and their perceived challenges.

Challenges related to climate change according to documents						
Challenge \ City	Urban heat	Extreme rainfall	Storm	Flooding	Biodiversity degradation	Human well-being
Amsterdam	Green	Green	Grey	Grey	Green	Green
Bristol (2008)	Green	Green	Green	Grey	Grey	Grey
Bristol (2018)	Grey	Green	Grey	Green	Grey	Grey
Dublin	Grey	Grey	Green	Green	Green	Green
London	Green	Grey	Grey	Green	Grey	Green
Poznan	Grey	Grey	Grey	Green	Grey	Grey
Rotterdam	Green	Green	Grey	Grey	Grey	Grey
Utrecht	Green	Green	Grey	Grey	Green	Grey

Table 4. Green means that the city addressed the societal challenge.

NbS Framing

Nature based solutions

Not all policy strategies use the term NbS. Only Bristol (2018) and Utrecht do so. Utrecht uses the term nature-based solutions for its strategy. They say green has the potential to contribute to their ambitions of healthy urbanization. It is about using nature for the ecological, economic, and social qualities of the city. This makes Utrecht less dependent on technical measures as they make use of and enhances ecosystems. The strategy contributes to climate adaptation and healthy urbanization. These are solutions that are inspired by nature and at the same time bring economic, social, and environmental benefits and help to build resilience (Gemeente Utrecht, 2018, p. 27). The goals are to increase landscape quality (ecological, recreational) for citizens, increase the connection of green areas for citizens and nature, expand nature to outside areas, healthy urbanization, and climate adaptation.

Bristol (2018) also clearly states that it is using nature-based solutions. They aim to use ecosystem services and nature-based solutions to reduce the risk of flooding and contribute to wider benefits. This is how they describe nature-based solutions. They use this description because the 'innovative techniques' offer wider environmental benefits. These benefits can contribute to wider environmental objectives. The goal of using NbS is to reduce the amount of impermeable area and to slow the rate of surface runoff to prevent flooding (Bristol city council 2018, p.33).

In contrast to Utrecht, Bristol (2018, p.33) does not specify what NbS are in this case other than it giving additional environmental benefits by using ecosystem services. Utrecht on the other hand refers to the definition of the EU and also states this definition in their document, which grasps the fact that NbS can solve problems or provide benefits in not only the environmental dimension but also the economic and social dimension by using ecosystem services (Gemeente Utrecht, 2018, p. 27).

Green infrastructure

The term 'green infrastructure' was used in Bristol (2008), Dublin, and London. Bristol (2008) uses the term green infrastructure for strategically using green spaces such as parks but also the linkages between these spaces such as rivers (Bristol City Council, 2008, p.4). It describes green spaces and parks as the green lungs of the city. They are integral to the cultural life of the city. Green can fulfill the needs of the citizens and the visitors of Bristol. Parks and green spaces play a vital role in reducing the effects of climate change on the inhabitants of Bristol and its wildlife. Green is said to be central in the strategy to adapt to climate change. Green captures water and stores it after heavy rainfall, preventing localized flooding. It also helps to cool the city. Furthermore, the green has a role

in health and wellbeing by promoting active healthy lifestyles and social cohesion (Bristol City Council, 2008, p.27.)

London calls its approach using multifunctional green infrastructure. Green infrastructure, such as green roofs, helps to adapt to climate change and will help to improve the resilience of London in the face of its future impacts. Green infrastructure is explained as “the multifunctional, interdependent network of open and green spaces and green features (e.g. green roofs).” (Greater London Authority, 2011, p.72). It also provides multiple benefits for people and wildlife. With this they aim to help London adapt to climate change, improving energy balance, reducing urban heat, reducing flood risk, conserving, biodiversity, and enhancing the amenity.

Dublin calls its way of using nature as a solution ‘green infrastructure’. Green infrastructure is described as “a network of connected, high quality, multifunctional open spaces, corridors, and the links in between, that provide environmental services and multiple benefits for people and wildlife.” (Dublin City council, 2016, p.374). Dublin also uses the same term for sustainable technologies such as air turbines, but that definition is not used in this case since it is not part of NbS. Dublin says it is important to pursue this green infrastructure approach to ensure a sustainable city and they seek more approaches that work effectively with nature. The goals of this approach are to increase the green resilience of Dublin (Dublin city council 2016, p.161).

Out of these three, Bristol's (2008) description is the least clear, with only saying that green strategic places are being used. London explains that green infrastructure concerns green spaces that provide benefits to people and wildlife. Dublin however mentions environmental and the multiple benefits it provides. This definition comes closest to what NbS is out of the three that use the term green infrastructure.

Working with nature

Furthermore, Amsterdam and Rotterdam both called their strategy ‘building with nature’. Amsterdam calls Nbs in their case two different things. The first is embedding or using green. The second is ‘nature inclusive building’ (natuurinclusief bouwen) gemeente Amsterdam, 2015, p. 22). The former concerns the park policies, while the latter concerns green roofs. The reason for using green as a means is that green is not a luxury, but a necessity. They see 'nature-inclusive building' as an efficient and innovative way to add green to the urbanized areas. Amsterdam describes it as an innovative way to green the city, while Rotterdam sees it as a non-technical measure that also improves the environment. Rotterdam names its approach 'building with nature' as part of the wider adaptation strategy (City of Rotterdam, 2013, p. 6). They make use of nature’s potential in the face of

climate change instead of solely relying on technical measures. This is because it can also improve the environment. The goal of using this strategy is to improve the ecological quality of Rotterdam and also to make it more resilient during extreme rainfall or drought. Poznan's definition of design with nature is similar to this, where nature's aspects are used as a strategy. The way Poznan calls their way of working is called "design with nature". They seek to bring the river back in balance with nature again. Rivers need their natural space to maneuver. With this 'design with nature' strategy, they seek to create a safe environment, improve the quality of the river zone for the citizens of Poznan and improve water safety (City of Poznan, 2015, p.22).

Goals

There are different reasons why NbS (or one of the other names above) is said to be used in these documents. For Poznan and Bristol (2018) the main focus lies in flood risk reduction, as these strategies are about floods. That has a clear link with their perceived challenge of flood risk. London also named floods as a challenge, and they see green infrastructure as an answer to that. However, London has more reasons for using green infrastructure. They also want to adapt to climate change, reduce urban heat, conserving biodiversity, and enhance amenities. This however covers more than the named challenges in the previous section. London does not clearly aim to improve the health of the citizens with green infrastructure, although it was one of the perceived challenges. Biodiversity was not mentioned as a challenge by London but is framed as a goal for using green infrastructure. These inconsistencies are not present in the Bristol (2008) and Dublin green infrastructure strategies. Although Dublin does not say health improvement, they mention fulfilling the needs of the citizens, and increasing biodiversity as goals (Dublin city council, 2016, p.230).

Amsterdam, Utrecht, and Bristol (2008) all focus on human wellbeing as a goal of using their approach. What is furthermore important to mention is that all projects aim to adapt to climate change or increase their resilience through their strategies. That is the most notable similarity. Rotterdam however is the city that focuses most on this and solely seeks to use these measures as climate adaptation as the main goal (City of Rotterdam, 2013, p. 11). Amsterdam did not see biodiversity as the most important challenge but does see its improvement as a goal in their strategy. Dublin sees it as a challenge and goal. Rotterdam mentioned it as a challenge but not as a goal. London also did not mention it as a challenge but did mention it as a goal. Lastly, although lowering temperatures was clearly present as a challenge in the previous section, it is only clearly framed as a goal of NbS for London, Amsterdam, and Utrecht.

Recap

Three prominent names came forward. These are Green infra-structure, NbS, and building or working with nature. Overall they all had the goal to adapt to climate change. However, some added using ecosystem services and some cited the EU definition of NbS, while others like Rotterdam did not explain what building with nature entailed other than that this would help with climate change adaptation. Biodiversity and human wellbeing was seen as a goal by only a few. Furthermore, the goals of using NbS were not always consistent with the perceived challenges.

NbS framing City	Nature Based Solutions	Green infrastructure	Working/building with nature
Amsterdam			
Bristol (2008)			
Bristol (2018)			
Dublin			
London			
Poznan			
Rotterdam			
Utrecht			

Table 5 visualisation of used frames by different cities

Additional benefits & human wellbeing

Economic benefits

Apart from Utrecht and Bristol (2018), all documents mentioned gaining economic benefits from their strategies. These mostly concerned benefits of making the city more attractive to increase tourism or the creation of jobs. Poznan mentioned economic benefits most often. In addition to the above-mentioned economic benefits, they saw benefits in attracting businesses, companies, and new citizens to the city (City of Poznan, 2015, p.38). They also saw economic benefits in utilizing the increased functionality of the river, leading to shorter travel times (City of Poznan, 2015, 113). Poznan did not mention other additional benefits, however.

London and Rotterdam were exceptions, as they mentioned different types of economic benefits. London saw lower energy costs and enhanced rental costs and enhanced renting prices for buildings due to green roofs as economic benefits (Greater London Authority, 2011, p 15). Rotterdam saw a similar benefit in property value increase, but also mentioned the reduction of maintenance costs and the prevention of damage to private buildings as economic benefits (City of Rotterdam, 2013, p. 89).

Food production and education

Food production was mentioned as a benefit in several documents. Bristol vaguely mentioned food production as a benefit. London mentioned it as a benefit of green infrastructure but did not elaborate on it. Utrecht mentions it as a benefit of NbS. Only Amsterdam and Dublin gave a detailed description. Local food production was a goal in itself for Amsterdam, to produce food locally, but the benefit is framed as learning about healthy food and positively influence the citizens' well-being (Gemeente Amsterdam p. 26, 2015). Dublin describes that a community garden can educate children on food production and consumption (Dublin city council 2016, p.165). Furthermore involving children in green initiatives also has the benefit to educate children on nature. This is a benefit that is not named in any other document.

Environmental

There is a range of environmental benefits named by all documents. These are benefits such as water quality, air quality, noise reduction, heat reduction, and greenhouse gas reduction. Air quality and heat reduction were named the most often, not being named by only Poznan. Greenhouse gas reduction was mentioned by Amsterdam and London as an indirect effect of lower energy demand

(Amsterdam, 2015 p.10, Greater London Authority, 2011, 27). Only Dublin and Poznan did not mention cooling as a benefit, where the other documents did.

Biodiversity

An increase in biodiversity is seen as a benefit in different ways. Bristol (2008) says that urban greening provides a shelter for wildlife, which protects biodiversity. Bristol (2018) sees the biological quality of the river increasing, which has a positive effect on biodiversity. Rotterdam and Amsterdam mention biodiversity increase as a benefit from their strategy but do not explain this. London, Dublin, and Poznan do not mention biodiversity as an additional benefit.

Human wellbeing

Human wellbeing is recognized by all documents as a benefit of the strategies. Rotterdam, Poznan, and Bristol (2018) stand out since they speak in general about how well being of its citizens is improved, with Poznan naming recreation and physical activity once (city of Poznan, 2015, p. 51). Amsterdam and Bristol (2008) in contrast focus heavily on how important greening is for kids and adults. Amsterdam links it to their measures of creating recreational space for physical activity, such as cycling and walking routes. Bristol focuses more on the development of children through green playgrounds (Gemeente Amsterdam, 2015 p.10, Bristol City Council, 2008, p.12). This also increases social cohesion. Furthermore, Dublin and Utrecht recognize the role of green in relation to sports facilities and wellbeing, and social cohesion. Utrecht however stands out, as they explain how according to the World Health Organization (WHO) green positively influences people by stimulating sports activities or leisure activities, which in its turn increases mental health and reduces the chance of diseases (Gemeente Utrecht, 2018, p.24). Similarly, London recognizes that green improves mental health and lowers stress levels (Greater London Authority, 2011, p.79). Utrecht adds that it is not the amount of green but the quality of green that gives that is important for wellbeing. Also, if citizens feel responsible, they will be more involved in green management.

Lastly, air quality was already mentioned as a benefit in the previous section. However, Utrecht and Amsterdam link this to human wellbeing rather than being a stand-alone benefit.

Recap

Overall, all cities saw additional benefits in their strategies, with environmental and wellbeing benefits being recognized by every document. Poznan however, focused mainly on the economic benefits. The level of given details varied across the documents, as some only gave benefits in general, where others explained why the named benefits are categorised as benefits.

Targets & Monitoring

Amsterdam has clear targets and a monitoring system in place. They target to plant 50.000 square meters of green roofs, add 15 nature play parks, connect 80 ecological areas and add 20 small parks where food can be locally produced (Gemeente Amsterdam, 2015). The fact that they target to produce food locally is noteworthy since this was not mentioned before as a goal or challenge. There is a yearly publication on the spending and the current situation. The London plan has similar targets, as they plan to increase the amount of green surface in 2030 by five percent, and plant 10.000 trees by March 2012 and even two million by 2025 (Greater London Authority, 2011, p 15). They release annual reports on the plan and evaluate the impact of the plan. However, no indicators of how this is evaluated are mentioned. Utrecht has similar targets. They want to add wadis and green roofs for infiltration. They want to connect green corridors to promote physical activity and plan to add 86 hectares of recreational space (Gemeente Utrecht, 2018, p.20.) Trees will be planted. Utrecht has already been monitoring previous greening policies, to keep track of how many hectares of green space they have added. They also added a city map of what Utrecht would look like in 2030 in terms of green spaces. They measure the satisfaction of green per citizen and the availability of m² green space per household as an indicator (Gemeente Utrecht, 2018, p. 40). The target of Bristol (2008) is not as clear as Amsterdam or London. They do not mention the exact measure or amount of parks and spaces they will add. They only mention that they target to develop policy to adapt to climate change. In terms of monitoring, they monitor visitors' satisfaction of those who visit the parks and green areas. They also monitor the quality of the park every three years, but no indicators are given on what they monitor. Dublin also does not have quantifiable targets like Bristol (Bristol City Council, 2008, p.48). It plans to plant green along identified key routes to make it more permeable for cyclists. Also it targets to develop linear parks to connect green in the city. This happens through interconnecting different green areas. Like Amsterdam, it plans on developing urban food production/community garden. In contrast to Dublin and the other cases, Dublin makes use of SMART targets. It reviews these targets after two years to measure progress.

Bristol (2018) has set the target to complete green studies to assess the importance of green spaces on flood risk management in the (Bristol city council, 2018, p.34). They recognize the benefits NbS can deliver and want to monitor these to prove their effect city (Bristol city council, 2018, p.33). They also plan to use NbS but they do not have a clear target to use them on a specific scale.

Rotterdam targets to make their city 100% climate-proof in 2025 but does not explain what that entails. Poznan has the target of creating space for the river (City of Rotterdam, 2013, p. 22). There are no clear targets however of when and how much extra space it will need. Furthermore,

Rotterdam and Poznan both do not mention monitoring in their document. Oppla mentions that there is no active monitoring system in place for Rotterdam. For Poznan, oppla mentions that investments are monitored (Oppla, nd). However, this is not present in the document.

Recap

Out of all strategies, only Dublin used smart targets. There is no clear red line when comparing the targets and the monitoring, other than the additional benefits that were not being monitored. Furthermore Amsterdam had the clearest quantified targets and clear monitoring. The targets of Rotterdam, Bristol, and Poznan are vaguer. Poznan and Rotterdam also had no monitoring system in place in the document. In terms of wellbeing, Utrecht stood out the most for recognizing nature's potential for human wellbeing.

5. Discussion

This research analysed the framing of NbS in urban strategy policies in the EU. The developed theoretical framework provides an example of how aspects of NbS are framed in urban policy documents. The research's focus was on European policy documents in urban areas, but the framework is transferable to non-urban and non-European policy documents. This research can be improved by increasing the number of cases. The aim was to have between fifteen and twenty case studies. Thirteen case studies have been coded. This was an iterative process, and so five cases have not been included. This was to have the same type of data and make the analysis more valid.

A setback during the research was the number of broken web pages and missing documents on the Oppla website. On each case study page, the related sources were listed, but many of these links did not work properly. This might show a lack of interest in NbS by the EU or a lack of funding, but this is speculative.

There are some policy implications when looking at the results. In many of the cases, climate change was named as a societal challenge. This is one of the 6 societal challenges defined by NbS (Cohen-Shacham et al., 2016). However, other societal challenges such as flooding are named as climate change in the documents. This would be under the disaster risk reduction category, however. This means that there is an overlap in societal challenges, but it can also mean that climate change is quite a vague term as a challenge. The predefined categories for societal challenges might need to be expanded to make them more easily organizable.

In terms of setting targets and monitoring, NbS benefits were not aimed to be monitored. This is problematic for NbS, as this aspect is important for addressing societal challenges. Another point of critique for these policy documents is that they do not differentiate the main goal and the additional benefits. There were barely any statements that clearly defined additional benefits, and if they did, such as the case of Utrecht, it only gave a few examples. More often additional benefits seemed to be named in a more implicit manner such as green (roofs) facilitating cooling and water retention, but also stimulating biodiversity in Amsterdam. In that document, biodiversity was not seen as a challenge, because it was even said that the state of biodiversity was doing well in Amsterdam. In this way, it is possible to reason that biodiversity is an additional benefit, but it is nowhere near a literal statement. Notable is that most documents use their NbS strategy aim to tackle environmental challenges and human wellbeing challenges as main goal and not so much aim for tackling other societal challenges identified by IUCN. The focus on tackling climate change or adapting to the impacts was present in all documents. Perhaps this could be different if more documents are analysed. Furthermore, all these documents are from Western countries. The perceived challenges

could differ in poorer countries. This should be further researched. Also perceived problems could be different in urban areas.

Not every document used the term NbS, even though the website Oppla has identified all these strategies as part of NbS. Perhaps the term NbS being used or not being used might be explained by the time window the documents were written in. The term gained more attention after 2014 (Cohen et al., 2016) hence, Bristol city council names it green infrastructure in 2008, but is using NbS in the flood management plan of 2018.

The fact that Bristol (2018) is still researching how to implement NbS is understandable. The need for proof on effectiveness is recognized by them and also the literature calls for this issue (Kumar et al., 2020). This is somewhat of a paradox because projects have to be carried out to prove its effectiveness, and if that withholds policy makers from taking action then the NbS projects will not be carried out and no evidence is produced.

Lastly, it was surprising to see education being mentioned as a potential benefit of NbS and it can be seen as one of the strengths of this research. Education as benefit concerned gaining knowledge on healthy food, but also educating children about nature. This needs further research however to see if NbS could play a significant role in this.

6. Conclusion

This research was about framing in NbS. The main question of the research was *“How are NbS and the relating societal problems and benefits framed in European urban strategy policies?”*.

Even though not every part of the NbS theory has been included, the results do allow for drawing some conclusions based on the developed framework and the analysis. The analysed urban policies mainly addressed two challenges. Firstly, this is climate change and adapting to its impacts. Secondly, it aims to address the challenge of human wellbeing. Besides this, NbS can go by different names, but can still be considered as NbS. However, these other framings did not fully cover the definition of NbS in all cases. The difference between goals and benefits also has not been differentiated. Benefits that are only mentioned as benefits without involving the bigger picture of other societal challenges, what NbS should do, show a clear gap. If these benefits are not monitored, the effectiveness of NbS will remain vague. Adequate monitoring was often not in place. When it was in place, the additional benefits were not monitored.

To conclude, this research shows that NbS in urban policy is mainly focused on addressing climate change rather than other societal challenges. Goals and benefits are not being differentiated from each other. This leads to poorly addressing the societal challenges that additional benefits can potentially tackle. These gaps point towards the lack of understanding that is identified by the NbS literature. On a positive note, the potential of nature is recognized by all these policy strategies. To fully use the potential of NbS, a better understanding is still needed. That is why the current NbS calls for clear monitoring to show its effectiveness. Furthermore, there are potentially even more benefits than those that currently have been identified by NbS theory. This research thus advocates increasing the understanding of NbS by looking at education as a potential benefit. If NbS is better understood, it may become a standard. For now, however, it still has a long way to go.

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Appendix

Appendix A

Criterion 1: NbS effectively address societal challenges

Guidance:	Indicators
<p>The purpose of this Criterion is to ensure that the NbS is designed as a response to a societal challenge(s) that has been identified as a priority by those who are or will be directly affected by the challenge(s). All stakeholders, especially rights holders and beneficiaries of the NbS, must be involved in the decision-making process used for identifying the priority challenge(s) (Criterion 5).</p>	<p>1.1 The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritised Guidance: The NbS intervention must address clearly specified challenges that have significant and demonstrable impacts on society. Identification of the most pressing societal challenges is best informed by a transparent and inclusive consultation process (Criterion 5), as opinions may differ between external stakeholders and local populations and vice versa.</p>
	<p>1.2 The societal challenge(s) addressed are clearly understood and documented Guidance: Establishing a clear understanding and rationale of the challenges to be addressed, and ensuring these are documented, is important for future accountability and optimising those strategies to contribute to human well-being outcomes (1.3). An NbS often yields multiple societal benefits, such as job creation or increased flow of ecosystem services, and the societal challenges these additional benefits address should also be documented.</p>
	<p>1.3 Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed Guidance: NbS must deliver tangible and substantive benefits to human well-being. Specific, measurable, attainable, realistic and timely (SMART) targets should be used as appropriate, as they are important for accountability and informing adaptive management (Criterion 7).</p>

Table 6: The first criterion for NbS from Angela et al. (2020, p. 6)

Appendix B

Acronyms for nature based solutions in 5 categories				
Restoration	Issue-specific	Infrastructure	Management	Protection
Ecological Restoration (ER)	Ecosystem-based Adaptation (EbA)	Natural Infrastructure (NI)	Ecosystem-based Management (EbMgt)	Area-based Conservation (AbC)
Ecological Engineering (EE)	Ecosystem-based Mitigation (EbM)	Green Infrastructure (GI)		
Forest Landscape Restoration (FLR)	Climate Adaptation Services (CAS)			
	Ecosystem-based Disaster Risk Reduction (Eco-DRR)			

Table 6 List of NbS related terms identified by the iucn (Cohen-Shacham, Maynard & Nelson, 2019, p. 23).

Appendix C

Coding System

These are the key words that were looked for and were discovered during coding.

Words per indicator			
Type of societal challenge			
what/ are the societal problem(s) named?	How is the societal problem described?	how are nature based solutions framed.	What is the goal of nature based solutions
climate change Heavy rainfall rising temperature gezondheidsproblematiek Health and wellbeing rising sea level intense rainfall flooding risks of flooding overheating drought flooding heavy rainfall Global warming Urban Heat Island-effect extreme rainfall rising sea level extreme weather events klimaatverandering teruglopende biodiversiteit Hitte stress wateroverlast Biodiversity	This depends on the context of the societal challenge.	Ecological Restoration (ER) Ecosystem-based Adaptation (EbA) Natural Infrastructure (NI) Ecosystem-based Management (EbMgt) Area-based Conservation (AbC) Ecological Engineering (EE) Ecosystem-based Mitigation (EbM) Green Infrastructure (GI) Forest Landscape Restoration (FLR) Climate Adaptation Services (CAS) Ecosystem-based Disaster Risk Reduction (Eco-DRR) Nature based solutions (NBs) Working with nature Building with nature	Climate change adaptation Water storage reduce temperature Health and wellbeing climate change rising sea level intense rainfall urban creep risks of flooding overheating drought flooding heavy rainfall Global warming Urban Heat Island-effect extreme rainfall rising sea level extreme weather events klimaatverandering teruglopende biodiversiteit Hitte stress Mitigate

Clear targets		Additional benefits	
What are the targets/ linked to impact/ linked to	What kind of monitoring is in place?	What benefits of a project are linked to the challenges these address?	How are human wellbeing outcomes discussed?
m2 Target Percentages year	Monitor Monitoring Yearly Assessments Quality assessment Annual updates Documentation Survey Report Evaluation Doelen objective	economic benefits greenhouse gas reduction air quality biodiversity increase water quality recreational education biodiversity noise reduction protection from the elements storms food production water purification Cooling heat reduction greenhouse gas reduction amenity flood risk reduction food production ecological connectivity amenity recreational water quality community participation noise reduction water storage food circularity	meeting each other green for wellbeing Healthy food production, recreate peaceful silent places walking and cycle routes Children happier feel benefitting health of citizens p.6 quality of life p. 18 more physical activity for kids knowledge increase healthy food Live style Healthy social inclusion exercise physical fitness mental health air quality enjoyment of space Luchtkwaliteit geluid ontspanning sport