

Policy Instruments to Encourage the Adoption of Nature-Based Solutions in Urban Landscapes

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Abstract: Urban landscapes are under great pressure and particularly vulnerable, due to climate change, population growth and economic development. Despite the growing understanding that Nature-Based Solutions (NBS) represent efficient solutions to facilitate adaptation to climate change and increase cities' resilience, their wide-scale adoption is still limited. There is a need to include NBS in urban governance and planning agendas through policy instruments, such as plan/legislative, economic and information instruments. However, there is a lack of studies that assess such policy instruments and, through the use of specific examples, how they can foster NBS adoption. The objective of this study is to address this gap by conducting a systematic literature review, using a bibliometric and a content analysis, collating and reviewing papers that consider policy instruments and NBS in order to: (i) assess the existence of policy instruments that influence the adoption of NBS; and (ii) evaluate the existence of specific examples of policy instruments. Results show that plan/legislative instruments are most mentioned, followed by economic and information instruments. However, examples of specific policy instruments being used in practice are still scarce in literature, as most studies remain theoretical.

Keywords: Nature-Based Solutions; economic instruments; information instruments; planning instruments; urban policy



Citation: Mendonça, R.; Roebeling, P.; Fidélis, T.; Saraiva, M. Policy Instruments to Encourage the Adoption of Nature-Based Solutions in Urban Landscapes. *Resources* **2021**, *10*, 81. <https://doi.org/10.3390/resources10080081>

Academic Editor: Volker Beckmann

Received: 10 May 2021

Accepted: 2 August 2021

Published: 9 August 2021

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1. Introduction

Urban landscapes are under great pressure and particularly vulnerable, due to climate change, population growth, economic development and infrastructure characteristics [1]. Urban areas and consumption patterns are increasing worldwide. It is forecasted that, by 2050, 70% of the world's population will be living in cities and gross domestic production is expected to suffer an annual decline of up to almost 80% due to the climate risk [2–5]. It is becoming increasingly clear that modern urbanization patterns are entwined with socio-ecological trends. These growing pressures in urban centers highlight the need for more sustainable planning and governance, namely in relation to heat waves, water and air pollution, flooding and erosion, droughts, human health degradation and biodiversity loss [6–8]. Hence, cities need to become more resilient in order to adapt to and mitigate climate change impacts. For this reason, new solutions and approaches are needed.

Nature-based solutions (NBS) are considered to represent possible solutions to increase cities' resilience, attracting a growing interest from researchers, policy makers and environmental organizations [3,4,9,10]. The European Commission defines NBS as 'solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide

environmental, social and economic benefits and help build resilience’ [11]. Alternatively, the International Union for Conservation of Nature (IUCN) defines NBS 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’ [12]. The NBS concept is relatively recent, aiming to address climate change impacts and societal problems while increasing urban resilience [8,13].

The NBS concept is related to and integrates other concepts, such as Ecosystem Services, Green and Blue Infrastructure Ecological Engineering, and Ecosystem-based adaptation [9,12,14–16]. Despite being somewhat complementary, there are differences between these concepts, as NBS covers parts of the other concepts but not necessarily everything they represent [9,17]. The differentiation of NBS is grounded in the integration of societal challenges, human well-being and biodiversity benefits that are less evident in the other concepts, as NBS have a broader scope while integrating several issues simultaneously [8]. In fact, NBS are not supposed to replace other concepts, but are intended instead to support and build upon them [18].

In general, NBS are increasingly seen as a more promising approach to increase cities’ resilience and sustainability than traditional grey solutions and, hence, able to effectively address urbanization pressures. NBS are regarded as more cost-efficient, sustainable, multi-purpose and flexible, creating more aesthetic and social settings and, thus, promoting citizens engagement [8,19–21]. Hence, the European Union proposes a shift from grey to green (NBS) solutions and to better integrate both types of solutions in urban concepts in order to take advantage of NBS benefits and co-benefits [22,23]. NBS provide, simultaneously, benefits and co-benefits through the provision of ecosystem services [23], such as cost savings, water and air quality improvement, flood and temperature control, biodiversity, improved quality of life, health, a sense of belonging, food security, decreasing energy consumption, the promotion of the green economy, environmental awareness, urban regeneration and decreasing vulnerability to disasters [2,12,13,15,22,24,25]. In addition, NBS need to be planned and managed across urban and peri-urban landscapes, as they are interconnected and impact urban development patterns [8,26] ([17] see this report for a detailed description of NBS types and characteristics).

NBS were mostly absent from political agendas until very recently [27]. However, NBS are increasingly being applied in cities to reach economic, environmental and societal goals and are starting to be acknowledged in policies agendas—promoting the recovery of natural settings through adapted governance mechanisms and progressively overtaking other concepts, such as ecosystem-based approaches [4,27,28]. Urban planning and governance policies play a key role in promoting NBS integration and implementation [27,29]. Notwithstanding, NBS have only recently been integrated in environmental policy [29]. Consequently, and as envisioned by the European Union, NBS need to be integrated in existing policy mixes, namely in spatial planning at different levels [30,31].

Policies can reflect the current reality at a certain time and place, and interactions between different policies affect the resulting policy implementation outcome [32]. Policies range from global (macroscale) to local (microscale), including initiatives such as EU directives, national and regional adaptation plans and strategies, and local governance arrangements [13,33]. The policy cycle should entail the agenda setting, impact analysis, policy formulation, policy implementation and policy evaluation. This is in order to ensure that the problem and objective is identified, alternatives are considered, potential negative and positive impacts are considered, and the policy is designed, implemented and evaluated [34]. For NBS, specifically, it is recommended that the policy cycle also entails stakeholder engagement and benefits communication [35].

There are different barriers and enablers to NBS implementation. Governance and local policies steer their adoption and can either hinder or potentiate them. Bureaucracy, lack of financing models, private land ownership, lack of social acceptance, lack of knowledge, awareness of technical levels and benefits, lack of cooperation between sectors, perceived costs, social inequalities, institutional fragmentation and inadequate regulations are re-

garded as the main barriers to NBS implementation [18,25,36,37]. Contrarily, recognized enablers include easy access to policies, good communication, stakeholder engagement, supportive regulations, inclusion of NBS in plans, guidelines and strategies, pilot projects, awareness marketing, involvement of different institutions, financial incentives, and monitoring and evaluation [18,27,36]. In fact, policy drivers, such as financial incentives, collaboration and communication are acknowledged as major NBS enablers [25,27].

Regulations supporting NBS adoption are diffuse and, generally, more technical than policy-oriented [38,39]. To put NBS on governance agendas, policy instruments related to specific frameworks and goals are acknowledged as key-catalyzers. In fact, the success of NBS adoption relies, to a large extent, on their integration in urban planning and policies [25,38–40] (see Figure 1). Hence, policy instruments are governance tools that have the potential to influence NBS adoption [36]. Such policy instruments can be divided into the following categories: command-and-control/planning/legislative (plan/legislative), economic or market-based (economic), and citizen engagement and information (information) [13,36]. Plan/legislative instruments can be formal (e.g., laws, regulations and prohibitions) or informal (e.g., plans, strategies and other visioning and management documents). Economic instruments provide price signals that aim to integrate positive impacts and negative externalities, encouraging behavior shifts (e.g., subsidies, charges, levies, taxes, tradable permits and other payment systems). Information instruments include training and education, as well as communication processes (e.g., workshops, surveys, websites, articles, labels and certifications). Other tools referred to are modelling approaches, risk assessments and land mapping [13,15,19,21,33,41,42]. In fact, the literature acknowledges plan and legislation (plan/legislative), economic instruments (economic), and education and stakeholder engagement (information) as NBS implementation enablers [25].

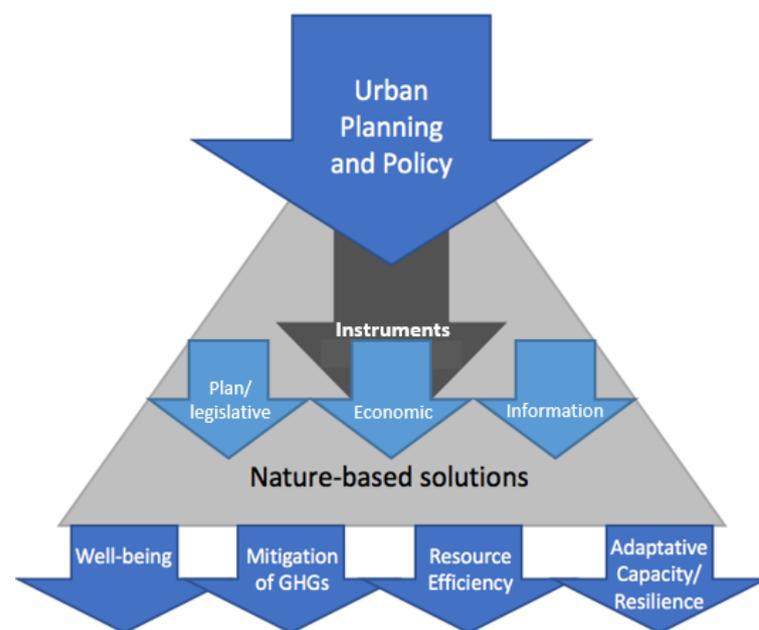


Figure 1. Conceptual framework for the articulation between urban planning, policy instruments and NBS (adapted from [4]).

Most of the NBS literature focuses not on policy instruments, but on NBS impacts and potentialities [25,38]. Despite being essential in demonstrating their benefits and co-benefits in order to get or keep NBS on political agendas and in decision-making processes, there is also a need to assess the role of policy instruments in encouraging the adoption of NBS [43,44]. Furthermore, local planning practices, real-world applications, concrete planning, implementation barriers and challenges are pinpointed as gaps in the literature [5,31,44,45]. In fact, most authors focus on barriers to the implementation of NBS,

revealing the importance of policy instruments to increase their success [20,45,46], and provide implementation strategies and suggestions [2,13,20,22,47].

Despite the fact that several studies exist regarding NBS policy instruments, most of this literature either focusses on general governance or superficially studies the existence of policy instruments that support NBS implementation, barriers and enablers—thereby not assessing their effectiveness or providing specific examples [25,38]. Hence, studies that integrate policy instruments and NBS are still scarce, which is in line with Albert et al. [29] findings which show that the NBS concept only recently began to be integrated in environmental policy. Similarly, Ingold et al. [37] findings pinpoint that most policy studies focus only on the political perspective. According to Mendonça et al. [48], policy instruments have the potential to steer urbanization patterns, however this study does not assess NBS. Similarly, Kärkkäinen et al. [7] studies different policy instruments in relation to greenhouse gas mitigation in agricultural settings but not NBS. Falcone and Sica and Ingold et al. [34,37] evaluate instrument mix acceptance in relation to energy transition, rather than NBS. Regarding the NBS related literature, there is still limited knowledge around NBS integration in planning and governance. Albert et al. [29] performed a review on NBS implementation and landscape planning and governance research. Martin et al. [27] studied NBS and governance enablers in disaster risk reduction. Frantzeskaki et al. [35] assessed policy needs and barriers for NBS implementation. Sarabi et al., 2019 assessed enablers and barriers of NBS, Davies et al. [38] developed a roadmap for NBS implementation and Mendes et al. [33] performed NBS discourse analysis. However, none of these studies review integrated policy instruments for NBS adoption.

Therefore, although NBS are increasingly being contemplated and integrated into policy-making and planning guidelines, integration of policy instruments is needed for the success of NBS [15,38,44]. Hence, further research on NBS and associated planning policies and instruments is needed, in order to ensure their implementation and upscaling [13,38]. However, governments and the scientific community struggle with the challenge of shifting from general announcements to practical applications, which might be facilitated by policy instruments [28,31].

As a consequence, the objective of this study is to assess the policy instruments that might encourage the adoption of NBS in urban contexts. To this end, a systematic literature review was performed, followed by a bibliometric and content analysis in order to assess policy instruments that have the potential to influence the adoption of NBS as well as to formulate policy recommendations and pinpoint gaps in the literature. Hence, the study includes a general overview of the aforementioned policy instruments in the reviewed papers, as well as a second analysis in order to identify specific policy instruments examples for NBS adoption. Bearing this in mind, the following research questions were considered:

Which policy instruments are mentioned with the potential to encourage the adoption of NBS in urban contexts?

Does the literature provide specific policy instruments for NBS adoption in urban contexts?

The next section presents the methodology used (Section 2), followed by the results (Section 3), which includes the bibliometric analysis (Section 3.1.) and the content analysis (Section 3.2.). Following this, Section 4 includes the discussion and, finally, conclusions and recommendations are presented in Section 5.

2. Materials and Methods

A systematic literature review was performed in order to gather all the relevant literature to fulfil the objectives of this study, following Faivre et al. [9]. This review was based on peer-reviewed papers published in international scientific journals. Grey literature and conference papers were not included in order to ensure the credibility and quality of the information used and to assure that only primary data was assessed (following, e.g., Scarano and Pita et al. [31,49]). English-written papers from 2010 until 2018 were considered, as NBS represents a recent concept [14]. To capture most relevant

papers, the search (performed November 2019) included the key words “Nature-based solution*” and words containing “econom*” or “polic*” or “plan*” was performed to include singular/plural and related words, in the categories “title, abstract and keywords” in the Scopus database (www.scopus.pt, accessed on 19 November 2019), as a relevant and complete scientific database (as used by Escobedo et al. [14]). This review follows the methodology of Sarabi et al. and Mendes et al. [25,33], by focusing only on the NBS and not associated concepts, considering that these are not interchangeable (as discussed in the Section 1).

The query was chosen with a view to including all papers that include public policy instruments together with NBS, in order to assess the existence of policy instruments that influence NBS. Hence, words related to “econom*” or “polic*” or “plan*” were selected as they include the content information that is considered to be relevant to the objective of this study.

Figure 2 shows that a total of 141 papers were found, of which 15 were excluded for being grey literature, books or conference papers. The remaining 126 abstracts were carefully read, which resulted in the exclusion of an additional 71 papers due to their being considered out of the scope. The majority of papers considered to be out of the scope focused on the bio-physical or socio-economic impacts of NBS or were from other subject areas (such as medical-focused papers). The remaining 55 papers were fully read, and 4 more papers were excluded after reading due to their being considered out of the scope for the same reasons.

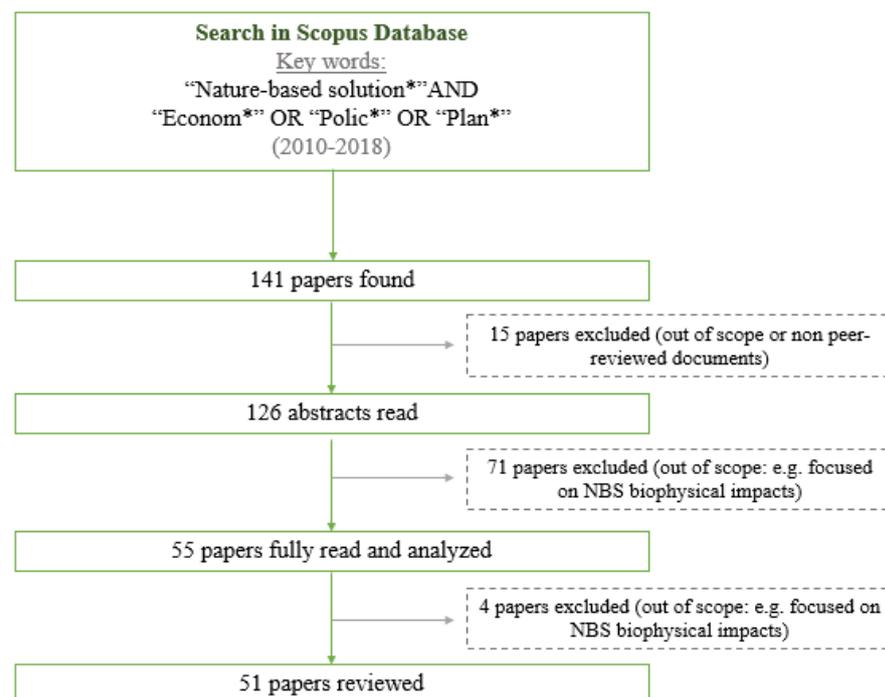


Figure 2. Systematic review process.

Consequently, this study assessed the remaining 51 papers. To keep a coherent analysis, a data sheet was developed with the author, paper and content information, such as the instrument type, case study location and methodology used. This information was used to perform both a bibliometric and a content analysis. For the bibliometric study, descriptive statistics were derived for the year of publication, the methodology used, and the case studies assessed. A time series analysis was performed in order to evaluate the temporal distribution and novelty of the subject. The methodology analysis provided information regarding the theoretical or practical application. The case study analysis provided insight into the geographical focus of the study as well as the scale of analysis (city, regional or country level).

The content analysis was carried out in order to make a list of the policy instruments that were included and proposed by the authors. In the first assessment, all pinpointed policy instruments (plan/legislative, economic or information) were listed, even if they were only mentioned in a general way. In the second assessment, examples of specific NBS policy instruments were listed (policy instruments within the plan/legislative, economic or information categories).

3. Results

The results section includes a bibliometric analysis, evaluating the studies' time series, methods used and case study metrics (Section 3.1), as well as a content analysis, focusing on the instruments mentioned in each study (Section 3.2).

3.1. Bibliometric Analysis

For the bibliometric analysis, Figure 3 shows the time series trend of the reviewed publications. It can be observed that the older publications are from 2015 and the number of published papers has been continuously and linearly increasing ever since. The number of publications ranges from 1 in 2015 to 25 in 2018.

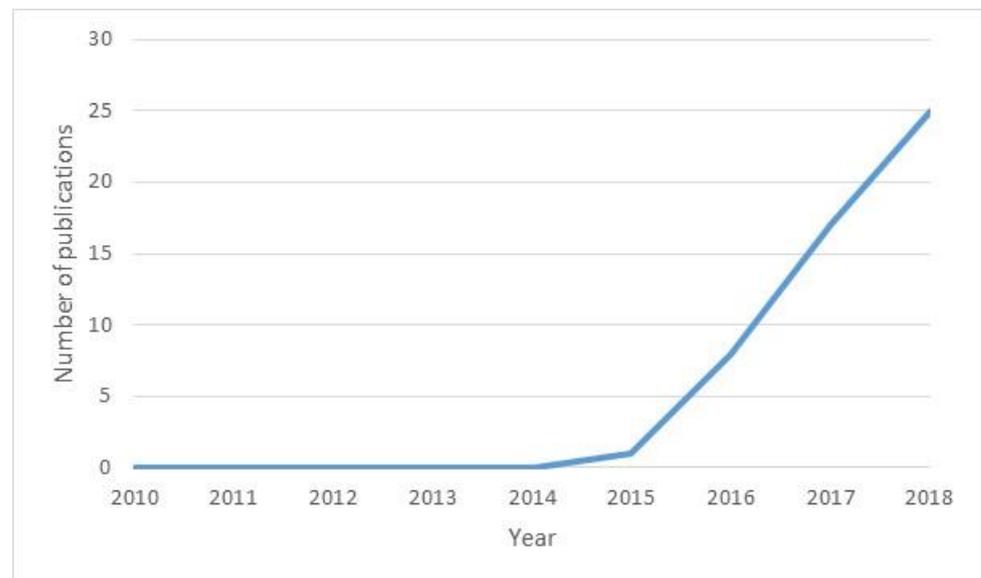


Figure 3. Number of publications per year reviewed.

After the time series analysis, the methodologies used by the authors (Figure 4) were convened. The following categories of methodologies were found: conceptual, statistical, simulation and stakeholder engagement. Conceptual methodologies include reviews, systematic literature reviews, document analysis and conceptual frameworks. Statistical methodologies use statistical models, based on observed data. Simulation methodologies represent ex-ante models that are able to simulate scenarios. The stakeholder engagement category includes workshops, interviews and surveys. Combinations of the above categories were also assessed. The methodology most frequently used was conceptual (27), followed by stakeholder engagement (9), conceptual+stakeholder engagement (8) and simulation (4). Stakeholder engagement+statistical (2) and conceptual+simulation (1) methodologies were almost never used. No paper used the stakeholder engagement+simulation methodology. Considering all the individual categories mentioned, ~71% of the papers included a conceptual methodology, followed by ~22% that used stakeholder engagement methodologies; statistical and simulation methodologies together only accounted for ~8%.

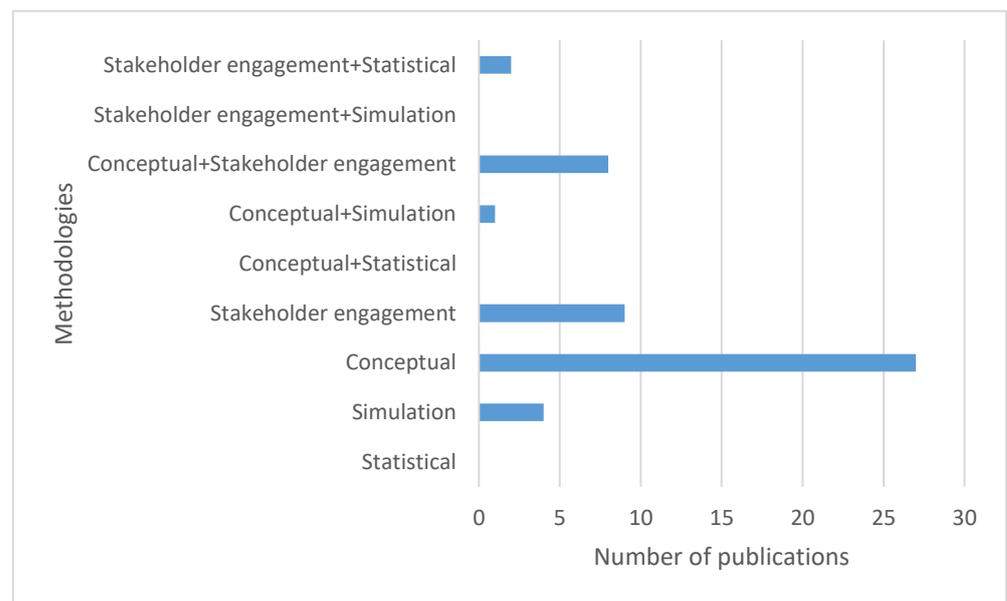


Figure 4. Methodologies used in the reviewed publications.

The number of case studies in the papers (Figure 5) was also evaluated. The majority of the papers (15; ~30%) do not include any case study. Following this, 13 (~26%) papers include one case study (city or region level) and 9 (~18%) papers study an entire country. The comparative studies (papers that include more than one case study; labelled “Cities”) represented 12 (~24%) of the papers reviewed. It is noteworthy that 2 (~4%) of the papers study more than one country (labelled “Countries”).

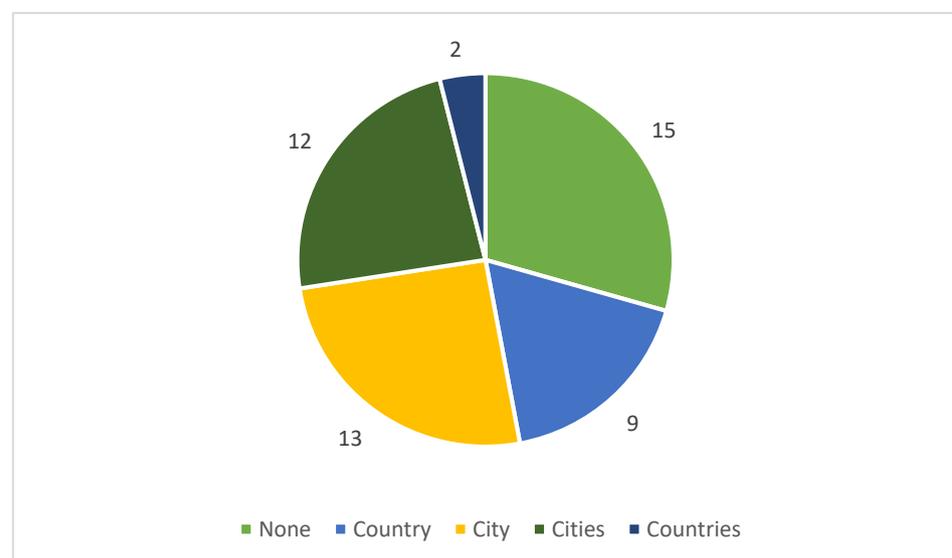


Figure 5. Number of case studies in the reviewed publications.

3.2. Content Analysis

Concerning the content analysis, the mentioned NBS policy instruments were divided in plan/legislative, economic and information categories, as well as association categories when more than one instrument was mentioned. For this first analysis (Figure 6), all references were considered (even if the policy instrument was just mentioned in a general way). Most of the papers mention, at least one time, all the instrument types (20; 40%), followed by plan/legislative (13; 25%), and information + plan/legislative and economic + plan/legislative (both 6 times; 12%). Information (1; ~2%), information+economic (2; ~4%)

and economic (3; ~6%) were the least mentioned instruments. Considering each instrument in total, plan/legislative instruments appear in ~89% of the papers, economic in ~61% and information in ~57% of the reviewed papers.

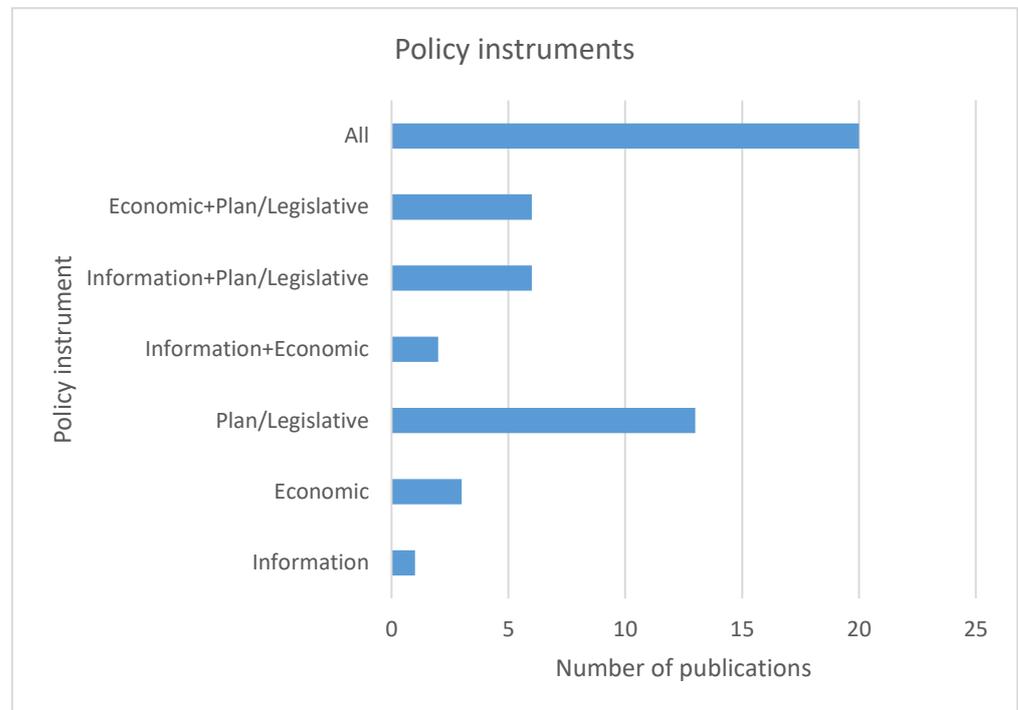


Figure 6. Policy instruments categories in the reviewed publications.

In a more detailed analysis, a division was made between the papers that mentioned, in a general way, a type of instrument or provided a specific policy instrument. Table 1 summarizes which studies mention each instrument type: plan/legislative, economic and information.

Table 1. Studies that mention plan/legislative, economic or information instruments.

Plan/Legislative instruments (45)	[1–5]; [9]; [10]; [13–15]; [19]; [20]; [22–24]; [28]; [30]; [32]; [33]; [40]; [42–47]; [50–68].
Economic instruments (31)	[2–4]; [13]; [15]; [16]; [19]; [21]; [30]; [32]; [33]; [40]; [41]; [45]; [47]; [49]; [51]; [52]; [55–57]; [59]; [61–63]; [65]; [67–71].
Information instruments (29)	[1]; [3–5]; [10]; [13]; [15]; [16]; [19]; [30]; [33]; [40]; [42]; [45]; [47]; [51–56]; [59]; [61]; [63–65]; [68]; [70]; [72].

The majority of the reviewed papers generally mention plan/legislative instruments. In a broad way, the papers draw attention to the need for supportive institutional frameworks, with legislation, regulations, norms, guidelines and designs to promote NBS adoption. Moreover, the time of intervention is considered. Adaptation to other countries’ plans, strategy plans, inclusion of risk analysis, ex-ante assessments, environmental impact assessments, bottom-up approaches, science-policy integration, indicators, evidence databases, practical experimentation and promotion of technological innovation are also referred to by the authors.

Concerning references to economic instruments, the translation of ecosystem services to monetary values and inclusion of externalities and ideal win-win situations, as well as inclusion of cost-benefit analysis, promotion of green jobs, low-interest loans, grants, fees, taxes, incentives for green behaviors and environmental compensation, and innovative funding approaches are often mentioned. Furthermore, unit costs, willingness to pay, total economic value or cost-benefit analysis are proposed by the authors.

Regarding the information instruments, stakeholder involvement, analysis and knowledge use as well as different engagement techniques (such as interviews, participatory workshops, people's perception, dialogue platforms, communication of benefits and co-benefits, participative governance, voluntaries and advices) are mentioned several times. Furthermore, partnerships with other institutions, scientists, citizens and other countries with and provisioning of expertise and training, as well as certifications or labels, are also referred by the authors.

For the most specific NBS policy instruments within the plan/legislation category, the following were provided by the authors:

- Municipalities to allow access to land and legal permissions [13];
- Benchmarks with desired characteristics, operational aspects and monitoring [46];
- Prohibition of new developments in risk areas and permission of new developments if developers assure mitigation measures or incentivize creative urban design with green engineering [4,19,54];
- Gardens regulated by the municipality, divided into parcels for citizens [52];
- Plan greener bicycle lanes [63];
- Municipalities green spaces and rivers' restauration [4,23]; and
- Creation of an area in a city center closed to motorized traffic [23].

For the most specific policy instruments within the economic category, the following were provided by the authors:

- Insurance companies to consider NBS, including externalities to increase value [2];
- Subsidized start-up costs for gardeners and tax breaks for rooftop farmers [13];
- Water companies to offer economic incentives to consumers that divert water into their lawns to help in flood control [45];
- Lease agreements for spaces for maintaining gardens and payment of small fees to enter [42];
- Private companies to internalize services provided by the landscape [68];
- Subsidize farmers to adopt more sustainable practices [67];
- Congestion tax and transit subsidies to reduce the number of automobiles [4];
- Land acquisition and taxes to promote land conservation [4]; and
- Encourage the creation of small businesses for the maintenance of green spaces [4].

For the most specific policy instruments within the information category, the following were provided by the authors:

- Creation of city concepts (for example, Sponge Cities in China) [54,64,66];
- Ask citizens to indicate vacant land and citizen engagement [56];
- Certification of products to encourage farmers to produce in a more sustainable way [69];
- Environmental education at all academic levels [4]; and
- Green marketing to promote sustainable consumerism [4].

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

4. Discussion

The use of policy instruments to promote the adoption of NBS is pinpointed by all reviewed papers. Nevertheless, many of these papers also add that several constraints need to be addressed when promoting the adoption of NBS in cities. In fact, the lack of knowledge on how to integrate environmental matters into urban policy is a major concern [29,37]. Furthermore, there are several government-related barriers, such as external pressures, unsupportive governance, national and local regulations, lack of political will and the existence of conflicts of interest [1,25,45,46]. The general lack of knowledge, lack of cooperation, poor communication, stakeholder engagement and scientific uncertainty together with the fact that scientists, decision-makers and citizens usually speak different

“languages”, is hampering NBS implementation [2,37,62]. In addition, funding and cost problems, land use ownership issues and lack of space are also highlighted as significant issues [46,62,72]. According to Connop et al. [55], real applicability and scaling-up are hindered by all these barriers. To overcome them, it is important to synthesize case-specific drivers and constraints before implementation [13]. In fact, the acknowledgement of barriers feeds the need for effective instruments to achieve a policy-mix to adopt NBS, especially as the advantages are considered to outweigh the constraints [13]. There are few, albeit a growing number of, studies regarding NBS (mostly focused on biophysical impacts or general governance, barriers and enablers) as well as NBS policies (mostly focused on the political perspective). Hence, the integration of these two concepts still represents a gap in literature.

Regarding the bibliometric analysis performed in this study, the first considered paper is from 2015. This is in line with Escobedo et al. [14] findings, stating that the NBS concept is relatively recent. However, papers growth in recent years shows the increasing attention devoted to the subject, a finding that is supported by Martin et al. [27]. The methodology used in this study was a systematic literature review. Despite the fact that several authors used conceptual methodologies, a systematic literature review was only used by Artmann and Sartison [13] within the assessed studies. Nevertheless, the aim of their paper was to integrate urban agriculture in the NBS context. The methodology follows Sarabi et al. and Mendes et al. [25,33] by focusing on the NBS concept (and not related concepts), as well as excluding non-peer reviewed papers. However, [33] combined NBS with the governance concept and [25] with enablers and barriers.

The vast majority of reviewed papers presented conceptual approaches (almost 71%), followed by stakeholder engagement (almost 22%) and model-based methodologies (statistical and simulation, comprising 8% of the studies). This highlights the fact that this concept is seldomly applied and mostly conceptual, evidencing the lack of real applicability assessments [55]. As for the case studies used, most of them are, once again, theoretical in the sense that they do not provide an empirical study (almost 30%). However, there is still a considerable number of papers that include case studies, namely at the city level (26%) or as a comparison between cities (24%), indicating that the policy instrument and NBS sphere is mainly being dealt with at city level and not at the country or higher level. Furthermore, a lot of cooperation is clear, with authors from different countries co-authoring several papers. The majority of the studies are European, which was expected because this concept was introduced by the European Commission, despite also currently gaining traction in non-European countries [14].

As for the content analysis, the majority of papers only generally mention policy instruments to encourage NBS adoption. In fact, only 17 papers discussed specific NBS policy instruments and only in very specific cases. Within these, 9 economic instruments, 7 plan/legislative and 5 information examples of policy instruments were found. Despite being the most generally mentioned instruments, plan/legislative policy instruments entail a more theoretical approach which might explain why these papers included less specific examples than those papers that discussed economic policy instruments. The same can be argued for information policy instruments, which, besides being the least generally mentioned, still encompass a more theoretical perspective [7,25,56].

The plan/legislative instruments were mentioned the most frequently (in almost 90% of the papers), which was expected as these comprise the first step in integrating a concept in the decision-making processes while noting the novelty of the NBS concept [8]. A complete understanding of the concept is thus necessary, as well as concrete planning and discourse integration [13,31]. Moreover, guidelines and norms reflect the national view and perspective on the matter, meaning that this step needs to be completed in an integrated fashion [42,43]. Specific plan/legislative instruments include legal permissions, benchmarks, no-construction areas, green planning and no-traffic areas. These findings are in line with Hawxwell et al. [36], as these instruments are fundamental in supporting NBS implementation, despite the author considering that governance adaptation is not

always straightforward and governments can, in fact, act as barriers or enablers to NBS adoption [25]. Comprehensively, these might represent a first (but not sufficient) step, as stated by Slovic and Ribeiro [73], implying that complementary approaches may be needed. Overall, there is still an opportunity for improvement as regulations to support NBS implementation are still scattered [25].

Economic instruments were the second most mentioned type of instrument in the literature (almost 61%). In fact, research on cost-effectiveness of NBS is acknowledged to help promote long term funding and implementation [20]. Furthermore, the valuation of natural settings (such as NBS) might serve as a justification for different investments, especially if all benefits are considered. The environment represents a market failure by not including tradable market-values, thus generating externalities that are not considered [16,52,71]. Indeed, Derkzen et al. [3] found that most people were willing to pay a tax per year for the adoption of NBS. Notwithstanding, discussion regarding economic instruments still represent a gap in literature, as more effective methods need to be found [9,67,72]. Specific economic instruments in the assessed studies include taxes, subsidies, economic incentives and cost internalization. The potential of economic instruments is in line with Mendonça et al. [48] findings regarding their effectiveness in steering urban development patterns, although this study did not consider NBS. Sarabi et al. [25] also consider the potential of economic policy instruments in NBS adoption. However, it is important to note that, according to Haxwell et al. [36], economic instruments may represent either a barrier or act as enabler to NBS implementation, depending on how they are formulated. Moreover, economic instruments application represent a greater challenge compared to the other two categories, which may explain why they are less prevalent in the literature than plan/legislative instruments [7].

Information instruments were the least mentioned (appearing in almost 57% of the reviewed papers), despite occurring in almost the same percentage as the economic instruments. This might indicate that there is a need to identify opportunities and increase citizen engagement within policy-making, which may justify the shortage of this type of instrument and could also be the reason as to why there are so few real-world adoption cases [41,56]. In fact, all authors that mention stakeholder engagement state that this is a crucial step in NBS adoption and demonstrate positive outcomes when it is undertaken, with different approaches available [19,41]. According to the same authors, citizens welcome better adaptation measures and NBS adoption when citizen engagement is fulfilled. In general, discussion regarding information instruments can be considered a gap in literature [56]. Specific information instruments include green city concepts, citizen engagement, education, green marketing and certification. These were the least mentioned instruments, despite their recognized importance as stated by Ríos-White et al. [41]. This is also reinforced by Falcone and De Rosa's [6] findings, in which they argue that information policy instruments are the most effective instruments, despite their study being focused on municipal waste optimization. According to Kärkkäinen et al. [7], information instruments entail less challenges than economic instruments, although their study only assessed greenhouse gas emissions. In addition, Sarabi et al. and Ingold et al. [25,37] claim that citizen's engagement and behavior are key for the success of sustainability policies.

The lack of specific examples of NBS policy instruments may be due to the fact that, despite NBS being considered more effective and less expensive than grey solutions, their benefits and co-benefits are still diffuse, green valuation is hard to assess, returns are hard to predict, and several barriers still exist [25]. Policy instruments can act as enablers or barriers to NBS adoption, depending on how they are formulated and embedded in governance, which increases the pressure on their design and implementation [36]. Policy instruments to encourage NBS adoption can target land, building, water, air, environmental protection and conservation and social aspects [36], which is in line with this study's findings. Despite most of these categories being present in the list of specific policy instruments, they are scattered and not organized, entailing the need for their effective integration in literature.

Although several papers mention, at least once, all the policy instrument types (40%), only 12% mention plan/legislative and information or plan/legislative and economic instruments. In addition, only 4% of the studies mention information and economic instruments, highlighting the need for attention to these policy instruments. As for specific policy instrument, only Fink [4] provides examples for all the categories, indicating a gap in the literature regarding policy mix. This might constitute a following step for the NBS policy literature studies, which would comprise of combining plan/legislative instruments with other incentives and citizen engagement [36]. In fact, Falcone and Sica and Ingold et al. [34,37] argue that when seeking to attain multiple objectives, a policy mix is key, as goals are rarely reached with a single intervention. Hence, more attention needs to be paid to the design of policy instruments in order to increase the probability of their success [7].

As the European Commission introduced the NBS concept alongside substantial investments in NBS projects [8], some information is only present in project and European Commission reports that were not considered in this study. This means that there still is the potential for this knowledge base to be transferred to peer-reviewed papers in the future and to be used as a foundation for more technical studies. Despite the recent mainstream uptake of NBS in policy, the majority of NBS integration is still voluntary, which leads to fragmented adoption. Thus, there is still opportunity to improve [27].

Overall, there is a need to better integrate policy instruments in NBS adoption, in order to achieve a policy mix that promotes transparency, citizen engagement and environmental justice, as well considering the existent constraints [15]. While NBS standards and guidelines are scarce and municipalities are struggling to introduce them in real-world contexts, demonstration projects and scientific contributions should encourage their integration [1,5,9].

5. Conclusions and Recommendations

Besides the integration of instruments to encourage NBS adoption, general suggestions are also recognized by many authors. Firstly, urban planners need a strong evidence-base regarding NBS for adoption and up-scaling processes. For that, a NBS portfolio is beneficial, including monitoring through indicators and ex-ante assessments as well as post-construction evaluations [2,17,22,70]. Furthermore, NBS should be integrated gradually in urban policy and planning, and solutions should be prioritized according to the specifications of the context together with an identification of the expected constraints [15,47,59,60]. All stakeholders (citizens, municipalities, environmental organizations, researchers, and other relevant stakeholders in each case) must be integrated in the process in order to better communicate the benefits and to promote acceptance and awareness [41,47]. Institutional changes and adaptations should also be carried out towards integrated, bottom-up and co-governance approaches [20,28,38]. In addition, cost-efficiency analysis should also be included, allowing comparison with previously identified alternatives (including hybrid solutions), avoided costs and potential benefits to justify investments as well as financing models [2,4,36]. The intervention area should be fully characterized, spatial and time limits defined as well as expected services and benefits analyzed [13]. A one-size-fits-all approach might not be ideal in all cases, so an implementation strategy should be attained, and demonstration projects should be considered [20,46]. All of these aspects are important in order to maximize the associated benefits and to avoid repeating mistakes or missed opportunities [70].

Overall, a holistic approach should be conducted, and the instruments should be transparent and not be too bureaucratized, in order to enable the communication and implementation of the selected solutions while at the same time assuring that the proposed technical aspects are effective and that natural settings are promoted [15]. The choice of policy instruments should consider their effectiveness, efficiency, democracy, legality and legitimacy, while bearing in mind their objectives [7].

The objective of this study was to assess the existence of policy instruments that might encourage the adoption of NBS in urban contexts. Hence, a systematic literature

review was performed (2010–2018), followed by a bibliometric and content analysis to collect the policy instruments that have the potential to influence the adoption of NBS, as well as to formulate policy recommendations and pinpoint gaps in the literature. Given that NBS is a relatively recent concept, it can be expected that the number of relevant peer-reviewed papers will increase quickly over the coming years and, hence, performing a similar systematic literature review in some years' time might provide interesting insights into the development of the NBS concept and associated policy instruments.

Regarding the research questions, it can be argued that plan/legislative, economic and information instruments to encourage NBS adoption exist and are acknowledged in the literature, despite this occurring mostly in a superficial fashion. Moreover, papers on specific instruments are scarce, indicating the novelty of the concept and highlighting that the concept is mostly considered from a conceptual perspective. Policy mix in NBS adoption also constitutes a literature gap. This paves the way for new studies that focus on the development of new instruments, as well as assessment of the effectiveness of different instruments. Plan/legislative are the most frequently mentioned policy instruments in literature, which is in line with the attempt to integrate NBS in urban planning, as well as a shift from top-down to bottom-up governance and can be considered as a first step in their integration [36]. More attention should hence be paid to economic and information instruments, as they represent the least frequently mentioned instruments in the reviewed literature and are considered to be a promising tool in steering urban phenomena [7,17,41,48].

This study answers the proposed questions by (i) reviewing the mentioning of policy instruments that could encourage the adoption of NBS and by (ii) identifying specific examples of policy instruments that are used to encourage NBS adoption. Overall, few studies integrated specific examples of policy instruments to encourage NBS and only one study was found regarding NBS and a policy mix approach. It can be concluded that policy instruments are rather diffuse concerning NBS adoption and that NBS supported by policies should be more significant, a finding which may constitute the next step in this field [38].

In conclusion, NBS policy instruments are addressed in the literature mostly from a general perspective, hence the evidence base on the efficiency of specific NBS policy instruments is rather thin. Indeed, there is a need for different policy instrument that encourage the adoption of NBS in order to increase cities' resilience to climate change—one of the biggest challenges in current urban policy and planning. Besides efficacy evidences, it is important to have an integrated and informed approach to policy instruments that would encourage NBS adoption.

Author Contributions: Conceptualization, R.M.; Methodology, R.M. and P.R.; Interpretation of results, R.M. and P.R.; Formal Analysis, R.M., P.R. and T.F.; Writing-Original Draft Preparation, R.M.; Writing-Review & Editing, R.M., P.R., T.F. and M.S. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the UNaLab project (Grant Agreement No. 730052, Topic: SCC-2-2016-2017: Smart Cities and Communities Nature-based solutions). Thanks are also due for the financial support to the PhD grants of R. Mendonça (SFRH/BD/147005/2019). Finally, thanks are due to FCT/MCTES for the financial support to (UIDP/50017/2020 + UIDB/50017/2020), through national funds.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Liu, L.; Jensen, M.B. Climate resilience strategies of Beijing and Copenhagen and their links to sustainability. *Hydrol. Res.* **2017**, *19*, 997–1013. [CrossRef]
2. Denjean, B.; Altamirano, M.A.; Graveline, N.; Giordano, R.; van der Keur, P.; Moncoulon, D.; Weinberg, J.; Costa, M.M.; Kozinc, Z.; Mulligan, M.; et al. Natural Assurance Scheme: A level playing field framework for Green-Grey infrastructure development. *Environ. Res.* **2017**, *159*, 24–38. [CrossRef] [PubMed]
3. Derkzen, M.L.; van Teeffelen, A.J.; Verburg, P. Green infrastructure for urban climate adaptation: How do residents' views on climate impacts and green infrastructure shape adaptation preferences? *Landsc. Urban Plan.* **2017**, *157*, 106–130. [CrossRef]
4. Fink, H.S. Human-Nature for Climate Action: Nature-Based Solutions for Urban Sustainability. *Sustainability* **2016**, *8*, 254. [CrossRef]
5. Schubert, P.; Ekelund, N.G.A.; Beery, T.; Wamsler, C.; Jönsson, K.I.; Roth, A.; Stålhammar, S.; Bramryd, T.; Johansson, M.; Palo, T. Implementation of the ecosystem services approach in Swedish municipal planning. *J. Environ. Policy Plan.* **2017**, *20*, 298–312. [CrossRef]
6. Falcone, P.M.; De Rosa, S.P. Use of fuzzy cognitive maps to develop policy strategies for the optimization of municipal waste management: A case study of the land of fires (Italy). *Land Use Policy* **2020**, *96*, 104680. [CrossRef]
7. Kärkkäinen, L.; Lehtonen, H.; Helin, J.; Lintunen, J.; Peltonen-Sainio, P.; Reginac, K.; Uusivuori, J.; Packalena, T. Evaluation of policy instruments for supporting greenhouse gas mitigation efforts in agricultural and urban land use. *Land Use Policy* **2020**, *99*, 104991. [CrossRef]
8. Ruangpan, L.; Vojinovic, Z.; Di Sabatino, S.; Leo, L.S.; Capobianco, V.; Oen, A.M.P.; McClain, M.E.; Lopez-Gunn, E. Nature-based solutions for hydro-meteorological risk reduction: A state-of-the-art review of the research area. *Nat. Hazards Earth Syst. Sci.* **2020**, *20*, 243–270. [CrossRef]
9. Faivre, N.; Fritz, M.; Freitas, T.; De Boissezon, B.; Vandewoestijne, S. Nature-Based Solutions in the EU: Innovating with nature to address social, economic and environmental challenges. *Environ. Res.* **2017**, *159*, 509–518. [CrossRef]
10. Fan, P.; Ouyang, Z.; Basnou, C.; Pino, J.; Park, H.; Chen, J. Nature-based solutions for urban landscapes under post-industrialization and globalization: Barcelona versus Shanghai. *Environ. Res.* **2017**, *156*, 272–283. [CrossRef]
11. European Commission. The EU and Nature-Based Solutions. Available online: https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en (accessed on 1 December 2020).
12. Cohen-Shacham, E.; Walters, G.; Janzen, C.; Maginnis, S. *Nature-Based Solutions to Address Global Societal Challenges*; IUCN: Gland, Switzerland, 2016; 97p. [CrossRef]
13. Artmann, M.; Sartison, K. The Role of Urban Agriculture as a Nature-Based Solution: A Review for Developing a Systemic Assessment Framework. *Sustainability* **2018**, *10*, 1937. [CrossRef]
14. Escobedo, F.J.; Giannico, V.; Jim, C.; Sanesi, G.; Laforteza, R. Urban forests, ecosystem services, green infrastructure and nature-based solutions: Nexus or evolving metaphors? *Urban For. Urban Green.* **2019**, *37*, 3–12. [CrossRef]
15. Fernandes, J.P.; Guiomar, N. Nature-based solutions: The need to increase the knowledge on their potentialities and limits. *Land Degrad. Dev.* **2018**, *29*, 1925–1939. [CrossRef]
16. Almenar, J.B.; Rugani, B.; Geneletti, D.; Brewer, T. Integration of ecosystem services into a conceptual spatial planning framework based on a landscape ecology perspective. *Landsc. Ecol.* **2018**, *33*, 2047–2059. [CrossRef]
17. Eisenberg, B.; Polcher, V. Nature Based Solutions Technical Handbook. In *UNaLab D5.1 Project Deliverable NBS Technical Handbook*; European Commission: Brussels, Belgium, 2018; 174p.
18. Hawxwell, T.; Mok, S.; Maciulyte, E.; Sautter, J.; Theobald, J.A.; Dobrokhotova, E.; Suska, P. Municipal Governance Guidelines. In *UNaLab D6.2 Project Deliverable*; European Commission: Brussels, Belgium, 2018; 81p.
19. Brink, E.; Wamsler, C. Collaborative Governance for Climate Change Adaptation: Mapping citizen-municipality interactions. *Environ. Policy Gov.* **2017**, *28*, 82–97. [CrossRef]
20. Kabisch, N.; Frantzeskaki, N.; Pauleit, S.; Naumann, S.; Davis, M.; Artmann, M.; Haase, D.; Knapp, S.; Korn, H.; Stadler, J.; et al. Nature-based solutions to climate change mitigation and adaptation in urban areas: Perspectives on indicators, knowledge gaps, barriers, and opportunities for action. *Ecol. Soc.* **2016**, *21*. [CrossRef]
21. Loiseau, E.; Saikku, L.; Antikainen, R.; Droste, N.; Hansjürgens, B.; Pitkänen, K.; Leskinen, P.; Kuikman, P.; Thomsen, M. Green economy and related concepts: An overview. *J. Clean. Prod.* **2016**, *139*, 361–371. [CrossRef]
22. Pontee, N.; Narayan, S.; Beck, M.; Hosking, A.H. Nature-based solutions: Lessons from around the world. *Proc. Inst. Civ. Eng.-Marit. Eng.* **2016**, *169*, 29–36. [CrossRef]
23. Faivre, N.; Sgobbi, A.; Happaerts, S.; Raynal, J.; Schmidt, L. Translating the Sendai Framework into action: The EU approach to ecosystem-based disaster risk reduction. *Int. J. Disaster Risk Reduct.* **2018**, *32*, 4–10. [CrossRef]
24. Zölch, T.; Wamsler, C.; Pauleit, S. Integrating the ecosystem-based approach into municipal climate adaptation strategies: The case of Germany. *J. Clean. Prod.* **2018**, *170*, 966–977. [CrossRef]
25. Sarabi, S.E.; Han, Q.; Romme, A.G.L.; De Vries, B.; Wendling, L. Key Enablers of and Barriers to the Uptake and Implementation of Nature-Based Solutions in Urban Settings: A Review. *Resource* **2019**, *8*, 121. [CrossRef]
26. Roebeling, P.; Saraiva, M.; Palla, A.; Gnecco, I.; Teotónio, C.; Fidélis, T.; Martins, F.; Alves, H.; Rocha, J. Assessing the socio-economic impacts of green/blue space, urban residential and road infrastructure projects in the Confluence (Lyon): A hedonic pricing simulation approach. *J. Environ. Plan. Manag.* **2016**, *60*, 482–499. [CrossRef]

27. Martin, J.; Scolobig, A.; Linnerooth-Bayer, J.; Liu, W.; Balsiger, J. Catalyzing Innovation: Governance Enablers of Nature-Based Solutions. *Sustainability* **2021**, *13*, 1971. [[CrossRef](#)]
28. Laforteza, R.; Chen, J.; van den Bosch, C.K.; Randrup, T.B. Nature-based solutions for resilient landscapes and cities. *Environ. Res.* **2018**, *165*, 431–441. [[CrossRef](#)]
29. Albert, C.; Schröter, B.; Haase, D.; Brillinger, M.; Henze, J.; Herrmann, S.; Gottwald, S.; Guerrero, P.; Nicolas, C.; Matzdorf, B. Addressing societal challenges through nature-based solutions: How can landscape planning and governance research contribute? *Landsc. Urban Plan.* **2019**, *182*, 12–21. [[CrossRef](#)]
30. Nordin, A.; Hanson, H.I.; Olsson, J.A. Integration of the ecosystem services concept in planning documents from six municipalities in southwestern Sweden. *Ecol. Soc.* **2017**, *22*, 26. [[CrossRef](#)]
31. Scarano, F. Ecosystem-based adaptation to climate change: Concept, scalability and a role for conservation science. *Perspect. Ecol. Conserv.* **2017**, *15*, 65–73. [[CrossRef](#)]
32. Nesshöver, C.; Assmuth, T.; Irvine, K.N.; Rusch, G.M.; Waylen, K.A.; Delbaere, B.; Haase, D.; Jones-Walters, L.; Keune, H.; Kovacs, E.; et al. The science, policy and practice of nature-based solutions: An interdisciplinary perspective. *Sci. Total Environ.* **2017**, *579*, 1215–1227. [[CrossRef](#)] [[PubMed](#)]
33. Mendes, R.; Fidélis, T.; Roebeling, P.; Teles, F. The Institutionalization of Nature-Based Solutions—A Discourse Analysis of Emergent Literature. *Resource* **2020**, *9*, 6. [[CrossRef](#)]
34. Falcone, P.M.; Lopolito, A.; Sica, E. Instrument mix for energy transition: A method for policy formulation. *Technol. Forecast. Soc. Chang.* **2019**, *148*, 119706. [[CrossRef](#)]
35. Frantzeskaki, N.; Vandergert, P.; Connop, S.; Schipper, K.; Zwierzchowska, I.; Collier, M.; Lodder, M. Examining the policy needs for implementing nature-based solutions in cities: Findings from city-wide transdisciplinary experiences in Glasgow (UK), Genk (Belgium) and Poznań (Poland). *Land Use Policy* **2020**, *96*, 104688. [[CrossRef](#)]
36. Hawxwell, T.; Mok, S.; Maciulyte, E.; Sautter, J.; Theobald, J.A.; Dobrokhotova, E.; Suska, P. Municipal governance recommendations for front-runner cities. In *UNaLab D5.2 Project Deliverable*; European Commission: Brussels, Belgium, 2019; 126p.
37. Ingold, K.; Stadelmann-Steffen, I.; Kammermann, L. The acceptance of instruments in instrument mix situations: Citizens' perspective on Swiss energy transition. *Res. Policy* **2019**, *48*, 103694. [[CrossRef](#)]
38. Davies, C.; Chen, W.Y.; Sanesi, G.; Laforteza, R. The European Union roadmap for implementing nature-based solutions: A review. *Environ. Sci. Policy* **2021**, *121*, 49–67. [[CrossRef](#)]
39. Davis, M.; Abhold, K.; Mederake, L.; Knoblauch, D. *Nature-Based Solutions in European and National Policy Frameworks*; Deliverable 1.5, NATURVATION, 2018. Horizon 2020 Grant Agreement No 730243; European Commission: Geneva, Switzerland, 2018; 50p.
40. Whelchel, A.W.; Reguero, B.G.; van Wesenbeeck, B.; Renaud, F.G. Advancing disaster risk reduction through the integration of science, design, and policy into eco-engineering and several global resource management processes. *Int. J. Disaster Risk Reduct.* **2018**, *32*, 29–41. [[CrossRef](#)]
41. DeLosRíos-White, M.I.; Roebeling, P.; Valente, S.; Vaithinen, I. Mapping the Life Cycle Co-Creation Process of Nature-Based Solutions for Urban Climate Change Adaptation. *Resource* **2020**, *9*, 39. [[CrossRef](#)]
42. van der Jagt, A.P.; Szaraz, L.R.; Delshammar, T.; Cvejić, R.; Santos, A.; Goodness, J.; Buijs, A. Cultivating nature-based solutions: The governance of communal urban gardens in the European Union. *Environ. Res.* **2017**, *159*, 264–275. [[CrossRef](#)] [[PubMed](#)]
43. Castonguay, A.; Iftekhar, S.; Urich, C.; Bach, P.; Deletic, A. Integrated modelling of stormwater treatment systems uptake. *Water Res.* **2018**, *142*, 301–312. [[CrossRef](#)] [[PubMed](#)]
44. Catalano, C.; Laudicina, V.A.; Badalucco, L.; Guarino, R. Some European green roof norms and guidelines through the lens of biodiversity: Do ecoregions and plant traits also matter? *Ecol. Eng.* **2018**, *115*, 15–26. [[CrossRef](#)]
45. van Oudenhoven, A.P.; Aukes, E.; Bontje, L.E.; Vikolainen, V.; van Bodegom, P.M.; Slinger, J.H. 'Mind the Gap' between ecosystem services classification and strategic decision making. *Ecosyst. Serv.* **2018**, *33*, 77–88. [[CrossRef](#)]
46. Wamsler, C.; Niven, L.; Beery, T.H.; Bramryd, T.; Ekelund, N.; Jönsson, K.I.; Osmani, A.; Palo, T.; Stålhammar, S. St Operationalizing ecosystem-based adaptation: Harnessing ecosystem services to buffer communities against climate change. *Ecol. Soc.* **2016**, *21*, 31. [[CrossRef](#)]
47. Calvert, T.; Sinnett, D.; Smith, N.; Jerome, G.; Burgess, S.; King, L. Setting the Standard for Green Infrastructure: The Need for, and Features of, a Benchmark in England. *Plan. Pract. Res.* **2018**. [[CrossRef](#)]
48. Mendonça, R.; Mendonça, R.; Roebeling, P.; Roebeling, P.; Martins, F.; Martins, F.; Fidélis, T.; Fidélis, T.; Teotónio, C.; Teotónio, C.; et al. Assessing economic instruments to steer urban residential sprawl, using a hedonic pricing simulation modelling approach. *Land Use Policy* **2020**, *92*. [[CrossRef](#)]
49. Pita, C.; Pierce, G.; Theodossiou, I.; MacPherson, K. An overview of commercial fishers' attitudes towards marine protected areas. *Hydrobiology* **2011**, *670*, 289–306. [[CrossRef](#)]
50. Raymond, C.; Frantzeskaki, N.; Kabisch, N.; Berry, P.; Breil, M.; Nita, M.R.; Geneletti, D.; Calfapietra, C. A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environ. Sci. Policy* **2017**, *77*, 15–24. [[CrossRef](#)]
51. Boelee, E.; Janse, J.; Le Gal, A.; Kok, M.; Alkemade, R.; Ligtvoet, W. Overcoming water challenges through nature-based solutions. *Hydrol. Res.* **2017**, *19*, 820–836. [[CrossRef](#)]
52. Camps-Calvet, M.; Langemeyer, J.; Calvet-Mir, L.; Gómez-Baggethun, E. Ecosystem services provided by urban gardens in Barcelona, Spain: Insights for policy and planning. *Environ. Sci. Policy* **2016**, *62*, 14–23. [[CrossRef](#)]

53. Capotorti, G.; Mollo, B.; Zavattoni, L.; Anzellotti, I.; Celesti-Grapow, L. Setting Priorities for Urban Forest Planning. A Comprehensive Response to Ecological and Social Needs for the Metropolitan Area of Rome (Italy). *Sustainability* **2015**, *7*, 3958–3976. [[CrossRef](#)]
54. Chan, F.K.S.; Griffiths, J.A.; Higgitt, D.; Xu, S.; Zhu, F.; Tang, Y.-T.; Xu, Y.; Thorne, C.R. “Sponge City” in China—A breakthrough of planning and flood risk management in the urban context. *Land Use Policy* **2018**, *76*, 772–778. [[CrossRef](#)]
55. Connop, S.; Vandergert, P.; Eisenberg, B.; Collier, M.J.; Nash, C.; Clough, J.; Newport, D. Renaturing cities using a regionally-focused biodiversity-led multifunctional benefits approach to urban green infrastructure. *Environ. Sci. Policy* **2016**, *62*, 99–111. [[CrossRef](#)]
56. Bellamy, C.C.; van der Jagt, A.P.; Barbour, S.; Smith, M.; Moseley, D. A spatial framework for targeting urban planning for pollinators and people with local stakeholders: A route to healthy, blossoming communities? *Environ. Res.* **2017**, *158*, 255–268. [[CrossRef](#)]
57. Davies, H.J.; Doick, K.J.; Hudson, M.D.; Schreckenberger, K. Challenges for tree officers to enhance the provision of regulating ecosystem services from urban forests. *Environ. Res.* **2017**, *156*, 97–107. [[CrossRef](#)] [[PubMed](#)]
58. Gulrud, N.M.; Hertzog, K.; Shears, I. Innovative urban forestry governance in Melbourne?: Investigating “green placemaking” as a nature-based solution. *Environ. Res.* **2018**, *161*, 158–167. [[CrossRef](#)] [[PubMed](#)]
59. Hernández-Morcillo, M.; Burgess, P.; Mirck, J.; Pantera, A.; Plieninger, T. Scanning agroforestry-based solutions for climate change mitigation and adaptation in Europe. *Environ. Sci. Policy* **2018**, *80*, 44–52. [[CrossRef](#)]
60. Jim, C.Y.; Bosch, C.K.V.D.; Chen, W.Y. Acute Challenges and Solutions for Urban Forestry in Compact and Densifying Cities. *J. Urban Plan. Dev.* **2018**, *144*, 04018025. [[CrossRef](#)]
61. Liqueste, C.; Udias, A.; Conte, G.; Grizzetti, B.; Masi, F. Integrated valuation of a nature-based solution for water pollution control. Highlighting hidden benefits. *Ecosyst. Serv.* **2016**, *22*, 392–401. [[CrossRef](#)]
62. McVittie, A.; Cole, L.; Wreford, A.; Sgobbi, A.; Yordi, B. Ecosystem-based solutions for disaster risk reduction: Lessons from European applications of ecosystem-based adaptation measures. *Int. J. Disaster Risk Reduct.* **2018**, *32*, 42–54. [[CrossRef](#)]
63. Niță, M.R.; Badiu, D.L.; Onose, D.A.; Gavrilidis, A.A.; Grădinaru, S.R.; Năstase, I.I.; Lafortezza, R. Using local knowledge and sustainable transport to promote a greener city: The case of Bucharest, Romania. *Environ. Res.* **2018**, *160*, 331–338. [[CrossRef](#)] [[PubMed](#)]
64. Shafaray, E.; Kim, S. A Study of Walkable Spaces with Natural Elements for Urban Regeneration: A Focus on Cases in Seoul, South Korea. *Sustainability* **2017**, *9*, 587. [[CrossRef](#)]
65. Turkelboom, F.; Leone, M.; Jacobs, S.; Kelemen, E.; García-Llorente, M.; Baró, F.; Termansen, M.; Barton, D.N.; Berry, P.; Stange, E.; et al. When we cannot have it all: Ecosystem services trade-offs in the context of spatial planning. *Ecosyst. Serv.* **2018**, *29*, 566–578. [[CrossRef](#)]
66. Zevenbergen, C.; Fu, D.; Pathirana, A. Transitioning to Sponge Cities: Challenges and Opportunities to Address Urban Water Problems in China. *Water* **2018**, *10*, 1230. [[CrossRef](#)]
67. Opdam, P.; Steingröver, E. How could companies engage in sustainable landscape management? An exploratory perspective. *Sustainability* **2018**, *10*, 220. [[CrossRef](#)]
68. Rambonilaza, T.; Neang, M. Exploring the potential of local market in remunerating water ecosystem services in Cambodia: An application for endogenous attribute non-attendance modelling. *Water Resour. Econ.* **2019**, *25*, 14–26. [[CrossRef](#)]
69. Fu, Y.; Zhao, J.; Peng, W.; Zhu, G.; Quan, Z.; Li, C. Spatial modelling of the regulating function of the Huangqihai Lake wetland ecosystem. *J. Hydrol.* **2018**, *564*, 283–293. [[CrossRef](#)]
70. Xing, Y.; Jones, P.; Donnison, I. Characterisation of Nature-Based Solutions for the Built Environment. *Sustainability* **2017**, *9*, 149. [[CrossRef](#)]
71. Wild, T.; Henneberry, J.; Gill, L. Comprehending the multiple ‘values’ of green infrastructure—Valuing nature-based solutions for urban water management from multiple perspectives. *Environ. Res.* **2017**, *158*, 179–187. [[CrossRef](#)] [[PubMed](#)]
72. Hoyle, H.; Jorgensen, A.; Warren, P.; Dunnett, N.; Evans, K. “Not in their front yard” The opportunities and challenges of introducing perennial urban meadows: A local authority stakeholder perspective. *Urban For. Urban Green.* **2017**, *25*, 139–149. [[CrossRef](#)]
73. Slovic, A.D.; Ribeiro, H. Policy instruments surrounding urban air quality: The cases of São Paulo, New York City and Paris. *Environ. Sci. Policy* **2018**, *81*, 1–9. [[CrossRef](#)]