

WP1 EXECUTIVE SUMMARY

NATWIP

**Nature-based Solutions for Water Management in the Peri-urban:
Linking ecological, Social and Economic Dimensions**



NATWIP

Work Package 1: Review of International Experiences of NBS for Water in the Peri-Urban – Executive Summary

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INTRODUCTION

This executive summary is based on the WP1 report of the NATWIP project (Nature-based Solutions for Water Management in the Peri-urban: Linking ecological, Social and Economic Dimensions) as a Water Joint Programming Initiative with an international consortium working on recognising how to advance on the water challenges through Nature-based Solutions (NbS).

Work package 1- is oriented to the development of a literature review, which is led by the Lab for Social Studies in Civil Engineering research group (LESEC) of the Research Institute of Sustainability Science and Technology (ISST) of the Universitat Politècnica de Catalunya (UPC) in Barcelona.

The aim was to summarise the available knowledge on Nature-based Solutions (NbS) for water management in peri-urban contexts. The purpose of the literature review is to identify barriers, lessons learned and challenges in implementing different NbS to deal with water management in the peri-urban, to expose the theoretical basis in the evolution of the NBS definition and the practical applications available for water management. We conducted this research through a Systematic Literature Review (SLR) of peer-reviewed articles, which will be complemented with a qualitative approach based on in-depth interviews to key informants as input from the Consortium partners.

The literature review was conducted at UPC from November 2019 until June 2020. This report is presented in September 2020.

SLR FINDINGS

<p>NbS as an Integrative Concept</p> <p>(Section Error! No s'ha trobat l'origen de la referència.)</p>	<p>Our analysis found that the overlapping of themes within the sustainability dimensions called for an examination through other lense, for which we included a topic as a means to recognise a main focus in the reference and not as a categorisation. Consequently, we could identify the presence of knowledge diversity within the literature, supported by the use of different terms which are somehow related or close to each other. This approach has helped us to recognise the relevance of the operationalization of the concept. In fact, we found that more than half of the references are oriented to assessment, tools and the changing environment (Climate change). The references with specific theoretical aspects included as methodological and governance are less frequent and there are no references for political, legal and financial aspects. Finally, the literature exposes the interest of crossing themes, relating different topics through a specific case study, experience, methodology, etc. and in general the overlapping of terms in the same article exposes how the NbS is an integrative concept, and usually supported by a combination of topics for a holistic approach. Consequently, the combination of NbS-ES-GI and other keywords emerged as an interesting aspect to be considered for the examination of the NbS definition.</p>
<p>NbS as an Umbrella Concept, with a problem-solving feature</p> <p>(Section Error! No s'ha trobat l'origen de la referència.)</p>	<p>The literature exposed as a main NbS definition the one provided by European Commission, followed by one from IUCN. An argument present in most of the references is the conceptual link with related terms, for which we explored the NbS-ES-GI and subsequent links, finding that it is mainly associated with Climate Change, Land use change, and Urban planning. Despite the keywords could be associated differently depending on the authors' interpretation, we found two terms associated only to NbS: Co-benefits & Urban and Peri-urban. The NbS definition has been explored by several authors, and part of its analysis takes place as an European centred discussion. Two core ideas emerged in the conceptual debate, its characterisation as an umbrella concept and its compound term with a problem-solving feature (i.e. solutions to challenges and Nature-based as a metaphor). Furthermore, the socio-technical approach to NbS is exposed in the Transdisciplinary approach and cross-sectoral character of involved benefits and the Provision of co-benefits. Finally, part of the literature discloses a narrower focus presenting in-depth knowledge on specific cases, experiences and a specific research on topics as assessment, tools, mapping techniques. This fact could facilitate the analysis of NbS international experiences, determining its operationalisation.</p>
<p>Nbs as a Process described through its boundaries, problem-solving and approach features.</p> <p>(Section Error! No s'ha trobat l'origen de la referència.)</p>	<p>The Natwip framework is a comprehensive tool to explore the understanding of NbS throughout the NATWIP framework. The Context dimension could help in the background's understanding conditions, regarding the NbS boundaries, NbS problem-solving feature, and the approach implemented. In fact, as previously mentioned to advance on the operationalisation of NbS and thus to close the water cycle gap, the Context dimension could provide a general perspective on the NbS in terms of its inputs and related processes. Therefore, this proposal aims to facilitate its applicability, and it is the result of the iterative reviewing of these case studies and the conceptual analysis.</p>

INTERNATIONAL EXPERIENCES

#	CITY	COUNTRY	SOURCE
1	Gorla Maggiore	Italy	(Liquete et al., 2016)
2	Santa Cruz de la Sierra	Bolivia	(Castelli et al., 2017)
3	Nairobi	Kenia	(Mulligan et al., 2020)
4	Ljubljana	Slovenia	(Pagano et al., 2019)
5	Port Vila	Vanuatu	(Maibritt Pedersen Zari et al., 2019)
6	Rome	Italy	(Marando et al., 2019)
7	Aarhus	Denmark	(Riegels et al., 2020)
8	Avola	Italy	(La Rosa & Pappalardo, 2020)
9	Gorla Maggiore	Italy	(Reynaud et al., 2017)
10	Barcelona	Spain	(Langemeyer et al., 2020)
11	Nagpur	India	(Dhyani et al., 2018)
12	Barcelona	Spain	(Fan et al., 2017)
	Shanghai	China	
13	Bogotá	Colombia	(Gunnell et al., 2019)
	London	United Kingdom	
	Chennai	India	
	Guayaquil	Ecuador	
14	Hong Kong	China	(Fung & Jim, 2020)
15	Melbourne	Australia	(Furlong, Phelan, & Dodson, 2018)
16	Liverpool	United Kingdom	(Jerome et al., 2017)
17	Rescaldina	Italy	(Ronchi et al., 2020)
18	Detroit	United States	(McFarland, Larsen, Yeshitela, Engida, & Love, 2019)
	Addis Ababa	Ethiopia	
19	Kristianstad	Sweden	(Beery et al., 2017)
	Copenhagen	Denmark	
20	Villeurbanne	France	(Belmeziti et al., 2018)
21	-	Canada	(Thompson, Sherren, & Duinker, 2019)
22	Jiangsu	China	(C. Yang, Nan, Yu, & Li, 2020)
23	Addis Ababa	Ethiopia	(Herslund & Mguni, 2019)
	Dar es Salaam	Tanzania	
24	Moncalieri	Italy	(Brunetta & Salata, 2019)
25	Trento	Italy	(C. Cortinovis et al., 2018)
26	-	Iran	(Arabameri, Rezaei, Cerdà, Conoscenti, & Kalantari, 2019)
27	Rome	Italy	(Capotorti, De Lazzari, & Ortí, 2019)
28	-	China	(Jia et al., 2019)
29	Foyle	United Kingdom	(Hazbavi et al., 2018)
	Xarrama	Portugal	
	Shazand	Iran	
30	Bratislava	Wroclaw	(Belčáková, Świader, & Bartyna-Zielińska, 2019)
31	Athens	Greece	(Tomao et al., 2017)
32	-	Cambodia	(Carrard, Foster, & Willetts, 2019)
	-	Indonesia	
	-	Lao PDR	
	-	Myanmar	
	-	Timor Leste	
	-	Vietnam	
33	Texas	United States	(Kim, 2019)
34	London	United Kingdom	(Bricker, Banks, Galik, Tapete, & Jones, 2017)
35	Rotterdam	Netherlands	(Säumel et al., 2019)
	Andernach	Germany	
	Oslo	Norway	
	Heidelberg	Germany	
	Havana	Cuba	

Table 1. List of the 35 papers and 53 experiences included in this review.

CHARACTERISATION

The literature exposes a slight tendency towards including a geographical scope in 42 percent (66 references) of the publications, to contextualise the initiatives with the specificities of the societal challenges and the place-based concerns, Figure 1 shows the worldwide distribution of case studies per country. In terms of continents, the literature focuses more on the European context (60 percent - 21 references), followed by Asia (29 percent - 10 references), America (17 percent - 6 references), Africa (9 percent - 3 references) and Oceania (3 percent - 1 reference).

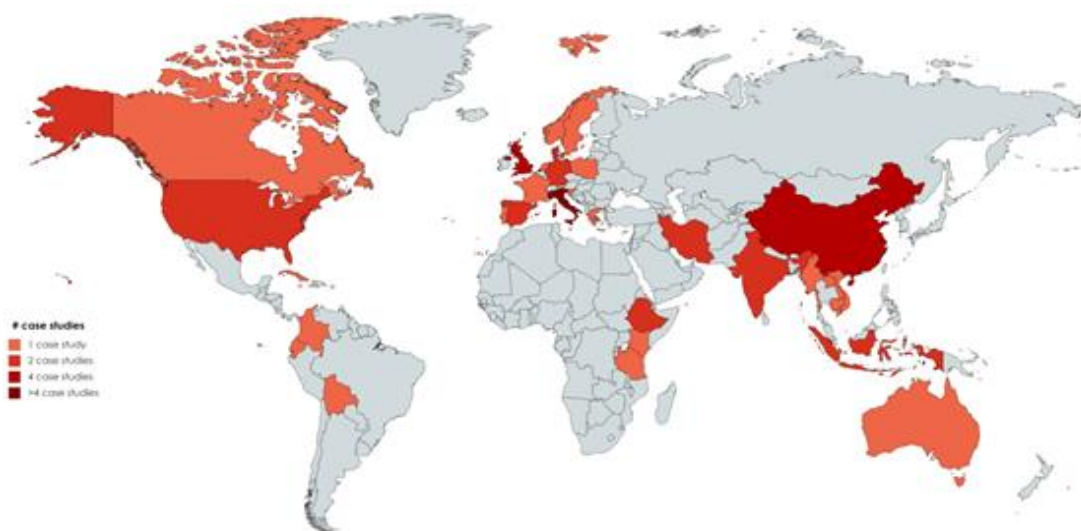


Figure 1. Case studies Location

According to its geographical position, we found some relations between the place where the case is being analysed and other variables. As we examined the cases in each continent differentiating the built environments, Figure 2 exposes these relationships:

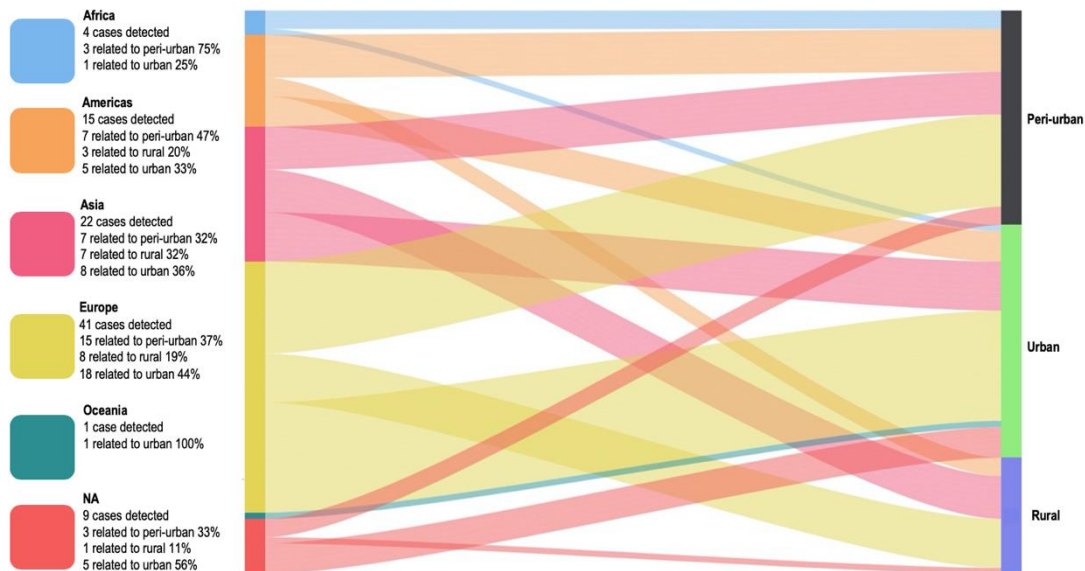


Figure 2. Relation between continent and environment

NbS TYPE

The most addressed types of solutions concern wetland-like approaches (e.g. natural wetlands, constructed wetlands, purpose-built wetlands, etc.). The second most addressed type of NbS concerns Sustainable Urban Drainage systems (SUDs). It is important to note that there is not a clear border for what is SUD and what is not in the literature. For example, other types of solutions, mentioned in the literature, are considered SUDs due to their drainage or filtration functions, e.g. permeable pavement, rain gardens, bioswales, green roofs, detention and retention basins, wetlands, etc. However, if these types of solutions appeared several times in the literature, they were considered separate from SUDs when counting them. Green roofs are equally addressed as SUDs in the literature, even though some articles consider green roofs as a type of SUDs.

Other solutions mentioned in the literature refer to:

- **Vegetation:** riparian corridors, coastal vegetation, private gardens, street trees, forests
- **Water:** ponds, wet meadows, other water bodies
- **Soil:** wildlife crossings
- **Floodable areas:** floodplains, retention/detention basins, semi-natural waterways, drainage corridors

IMPLEMENTATION SCALES

The most addressed scale in the case studies reviewed in this study is the Municipality scale (Figure 3). This can be because most of the problems addressed by NbS have an urban or peri-urban scope, over which municipalities have competences.

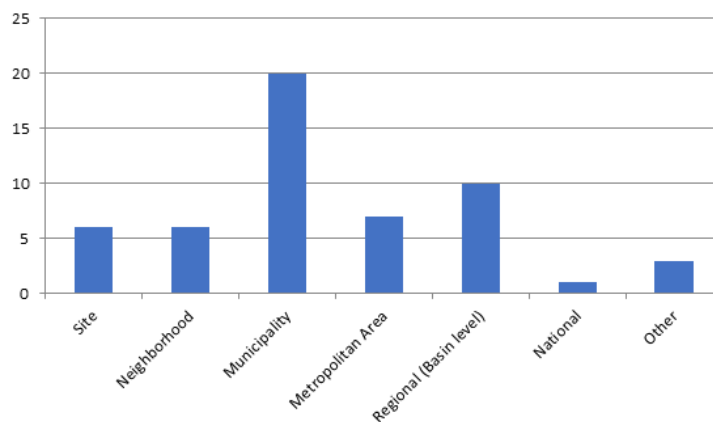


Figure 3. NbS implementation scales addressed in the literature

Figure 4 shows the scales addressed in each continent. While the Municipality scale is the most frequent in Europe and America, the microscale (Site and/or Neighbourhood) is the most frequent in Africa and Oceania, and the Regional scale (basin level) is the most frequent in Asia.

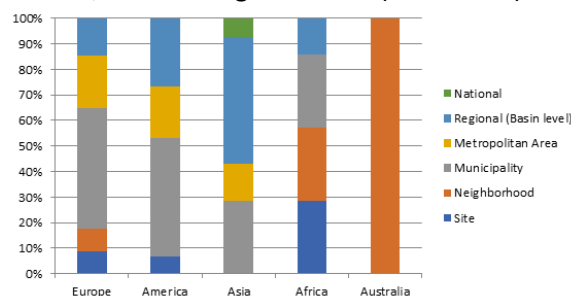


Figure 4. NbS implementation scales addressed in each continent

WATER CHALLENGES

The European Commission established the NbS priority areas as: the regeneration and well-being in urban areas, carbon sequestration, coastal resilience, watershed management and ecosystem restoration, to enhance the insurance value of ecosystems and to foster sustainable use of matter and energy (European Commission, 2015). For water challenges, the most addressed challenge is the Flood risk (which can be explicitly caused by Climate Change or not), followed by Urban water systems management (which can refer to black-, grey-, storm- and/or freshwater management). Next we found Water security (closely related to Freshwater supply) and Climate regulation (related to the capacity of water bodies to regulate micro-climate, e.g. Urban Heat Island (UHI) mitigation), as shown in Figure 5.

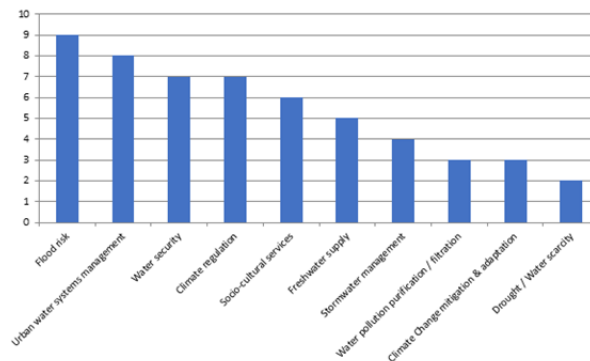


Figure 5. NbS challenges addressed in the literature

Climate Change mitigation and/or adaptation also refers to Droughts/Water scarcity and/or to Flood risk in some case studies. Stormwater management was created as a separate category to Urban water systems management due to its frequency in the case studies. The importance of stormwater management in all its ways (flood prevention, runoff control, drainage and filtration, etc.) in the urban and peri-urban environments is because urban settlements alter the water cycle by replacing the watershed's natural land cover with impervious cover, thus decreasing infiltration and increasing stormwater runoff and peak flows, as well as conveying pollutants to nearby surface waters (McFarland et al., 2019). Socio-cultural services include services such as recreational opportunities, aesthetics, human well-being, social cohesion.

NbS FOR RISK MANAGEMENT

- **Climate Change** risks relate to the challenges of Climate Change mitigation/adaptation, Climate regulation, Flood risk and Pollutants purification/filtration.
- **Flood** risks relate to these Water Challenges: Flood risk, Pollutants purification/filtration, Urban water systems, Stormwater management, Socio-cultural services, Water security, Climate Change mitigation/adaptation, Drought/Water scarcity and Climate regulation.
- **Droughts** risks relate to the challenges of Drought/Water scarcity, Water security, Urban water systems, Flood risk and Climate regulation.
- **Heatwaves** risks relate to the challenges of Climate regulation, Drought/Water scarcity and Flood risk. The risks of Earthquakes, Sea level rise and Storms are associated to the challenges of Urban water systems and Water security.
- **Pollutants discharge** is related to the challenge of Pollutants purification/filtration.

ECOSYSTEM SERVICES

The literature on cases also expose the conceptual link among Ecosystem Services (ES) and NbS (Figure 6). Following the ES categorisation among **Provisioning**, as the service of delivering food, wood, energy, materials, medicines; **Regulating**, as water purification, waste decomposition, climate regulation, pollination and illness controls and **Cultural** services, as related to aesthetic values, spiritual, enrichment of human experience and recreation. In fact, 69 percent of the case studies (24 ref.) mentioned the provision of any ES. In fact, ES as Regulating (54 percent - 19 ref.), Provisioning (43 percent - 15 ref.) and Cultural (37 percent - 13 ref.).

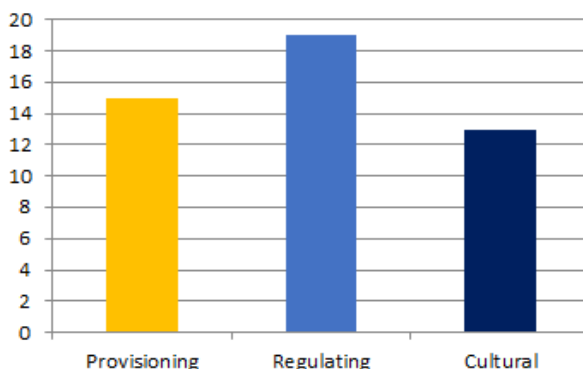


Figure 6. Types of Ecosystem Services mentioned in the literature

There are 179 matches between types of ES and types of NbS. The most common ES related to NbS types is Regulation ES (74) followed by Provision ES (58) and Cultural ES (47). It's not surprising this classification, considering NbS Types are mostly regulators of water challenges. Agroforestry, greenroofs/greenwalls, wetlands or SUDs are NbS usually used to control water pollution or water flooding, more than provide a system with other kinds of water scarcities. Despite this logical reflection, to provide pure water or potable water to communities is also a challenge that most NbS Types are solving, and that's why this is the second ES related to NbS Types. Also, NbS could be somehow understood as green infrastructure and spaces for the city - and obviously for the citizens - is obvious that these spaces generated through facing water challenges can be used as providers of Cultural ES, such as parks, wetland or agroforestry extensions or rain gardens (Figure 7).

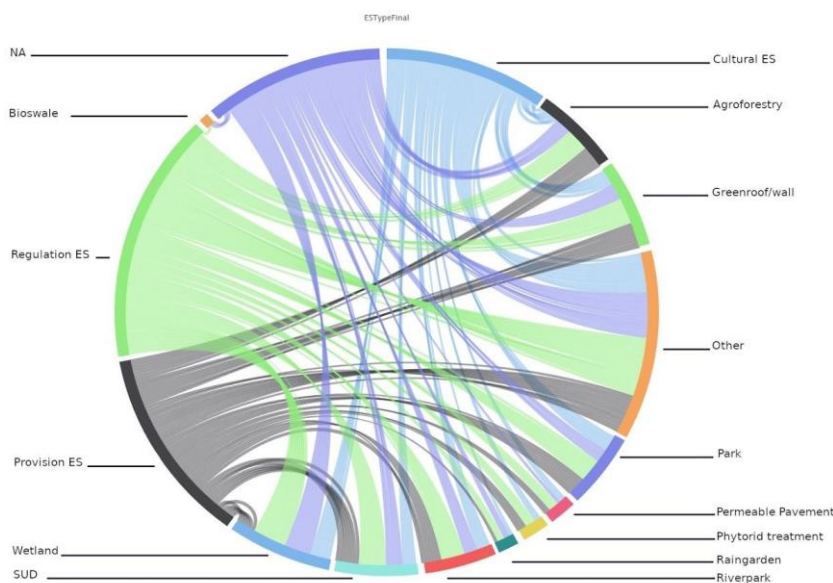


Figure 7. Ecosystem Services & NbS Types

ACTORS INVOLVED

In terms of actors the categories implemented correspond to the representatives of public authorities (GOV), academics and researchers (UNI), the business and private representatives (IND), the citizens and community, including NGO's as (CIV) and other water-related actors.

- **Public authorities** (GOV) included local governments (municipalities, planning authorities, etc.), regional governments, ministries or departments, national governments or even supra-national institutions.
- The **civil society** (CIV) included citizens' associations, community groups, advocacy organisations, environmental associations, friends groups, volunteers, NGOs, etc.
- The **academic and research bodies** (UNI) included scientific and technical experts, consultants, university departments, research groups, etc.
- **Water-related actors** included water management authorities, water utilities, hydro-geologists, water-sources investors, etc.
- Business and **private sector** (IND) included private landscapers, wastewater treatment companies, water vendors, etc.

SOCIETAL VALUES

Some case studies consider different societal and/or cultural values for implementing NbS, either before, during and/or after the NbS planning cycle.

Before and during implementing NbS, one of the societal values most referred to in the case studies is the participatory nature of the NbS implementation process. Whilst 46 percent of the case studies (16) involved the civil society, as shown in the previous section, only 29 percent of the case studies (10 references) explicitly mention processes such as participatory process (Maibrith Pedersen Zari et al., 2019); **participatory modelling** (Pagano et al., 2019); **personal interviews** followed by **collective meetings** (Belmeziti et al., 2018).

Local knowledge was slightly mentioned when it comes to educational activities (Reynaud et al., 2017) and increasing **awareness** (Liquete et al., 2016) and **bottom-up initiatives** (Mulligan et al., 2020).

Cultural values were mentioned in 40 percent of the case studies (14 references), with terms such as **recreation** (Beery et al., 2017; Belmeziti et al., 2018; C. Cortinovic et al., 2018; Dhyani et al., 2018; Langemeyer et al., 2020; Liquete et al., 2016; Reynaud et al., 2017; Riegels et al., 2020; Ronchi et al., 2020); **aesthetics** (Dhyani et al., 2018; Fung & Jim, 2020; Riegels et al., 2020); **social cohesion** (Langemeyer et al., 2020); **educational and therapeutic activities** (Jerome et al., 2017) and **cultural and historical heritage** (Ronchi et al., 2020).

Nevertheless, none of the reviewed case studies made an explicit mention to the gender perspective, which could be consider a knowledge gap when relating NbS to well-being.

POLICY INSTRUMENTS

Most case studies explicitly mentioned some kind of policy instrument for their implementation (77 percent - 27 references). These instruments can be projects, programmes, plans or any other type of regulation (e.g. supra-national regulations as the “EU Water Framework Directive (2000/60/EC)”, which is the most cited policy in the literature). Table 2 shows a list of policy instruments mentioned in the case studies.

POLICY INSTRUMENTS (projects, programmes, plans, regulations, etc.)	SOURCE
<ul style="list-style-type: none"> • "EU Water Framework Directive" (2000/60/EC) • Regional law (R.R. n.3 from 24 March 2006) • River basin management plan from "Autorità di Bacino del Fiume Po" 	(Liquete et al., 2016; Reynaud et al., 2017)
<ul style="list-style-type: none"> • Support Program for the "Natural Area of Integrated Management of Rio Grande" (ANGIRG) 	(Castelli et al., 2017)
<ul style="list-style-type: none"> • "Kibera Public Space Project" (KPSP) 	(Mulligan et al., 2020)
<ul style="list-style-type: none"> • "EU Water Framework Directive" (2000/60/EC) • "EU Flood Directive" (2007/60/EC) • NAIAD Project 	(Pagano et al., 2019)
<ul style="list-style-type: none"> • "Pacific Ecosystem-based Adaptation to Climate Change" (PEBACC) Project • "Secretariat of the Pacific Regional Environment Programme" (SPREP) 	(Maibritt Pedersen Zari et al., 2019)
<ul style="list-style-type: none"> • "Mapping and Assessment of Ecosystems and their Services" (MAES) 	(Marando et al., 2019)
<ul style="list-style-type: none"> • "EU Water Framework Directive" (2000/60/EC) • EU FP7 "Demonstrating Ecosystem Services Enabling Innovation in the Water Sector" (DESSIN) 	(Riegels et al., 2020)
<ul style="list-style-type: none"> • "EU Water Framework Directive" (2000/60/EC) • Regional law (R.R.n.3 from 24 March 2006) • River basin management plan from "Autorità di Bacino del Fiume Po" 	(Reynaud et al., 2017)
<ul style="list-style-type: none"> • "Jawaharlal Nehru National Urban Renewal Mission" (JNURM) • "Atal Mission for Rejuvenation and Urban Transformation" (AMRUT) • "Green Highways Policy (2015)" • "Sendai Framework for Disaster Risk Reduction (2015-2030)" 	(Dhyani et al., 2018)
<ul style="list-style-type: none"> • "Barcelona's Green and Biodiversity Plan (2012-2020)" • "Air Quality Plan (2011-2015)" 	(Fan et al., 2017)
<ul style="list-style-type: none"> • "WaterWorld Policy Support System" 	(Gunnell et al., 2019)
<ul style="list-style-type: none"> • "Greening the West" (GTW) initiative 	(Furlong et al., 2018)
<ul style="list-style-type: none"> • 	(Jerome et al., 2017)
<ul style="list-style-type: none"> • "Piano paesaggistico regionale" (PPR) • "Piano di governo del territorio" (PGT, 2012) 	(Ronchi et al., 2020)
<ul style="list-style-type: none"> • "Finger Plan (1947)" • "UNESCO Biosphere Reserve" protection 	(Beery et al., 2017)
<ul style="list-style-type: none"> • "Municipal Natural Assets Initiative" (MNAI) • 19 different Canadian urban or city plans 	(Thompson et al., 2019)
<ul style="list-style-type: none"> • "Joint Innovative and Technological Research Projects from the Ministry of Ministry of Science and Technology of the People's Republic of China" • "China Major Science and Technology Program for Water Pollution Control and Treatment" 	(B. Yang et al., 2019)
<ul style="list-style-type: none"> • "One Water Supply, Sanitation and Hygiene (WASH) National Programme" (OWNP) 	(Herslund & Mguni, 2019)
<ul style="list-style-type: none"> • "Italian National Plan of Adaptation to Climate Change" (PNCC, 2016) 	(Brunetta & Salata, 2019)
<ul style="list-style-type: none"> • "EU Biodiversity Strategy for 2020" 	(Capotorti et al., 2019)
<ul style="list-style-type: none"> • "Groundwater resource sustainability indicators" by the UNESCO 	(Jia et al., 2019)
<ul style="list-style-type: none"> • UN's SDG 17 	(Hazzavi et al., 2018)
<ul style="list-style-type: none"> • "EU Strategy on Adaptation to Climate Change" (2013) • "Action Plan for Adaptation to the Adverse Effects of Climate Change on Territory the Capital City of the Slovak Republic Bratislava, 2017-2020" • "Act No. 17/1992, Collection of Laws, On the Environment" • "Kyoto protocol" 	(Beičáková et al., 2019)
<ul style="list-style-type: none"> • UN's SDG 17 • "UNICEF Joint Monitoring Program" 	(Carrard et al., 2019)
<ul style="list-style-type: none"> • "Peri-urban Land Use Relationships – Strategies and Sustainability Assessment Tools for Urban-Rural Linkages" (PLUREL) • 6th Research Framework Programme of the EU • "Conservation Design for Subdivisions: A practical guide to create open space networks" • "The Woodlands" masterplan (McHarg, 1970s) 	(Kim, 2019)
<ul style="list-style-type: none"> • "UK National Ecosystem Assessment" (2014) • "River Basin Catchment Management Plans" (Jaspers, 2003) 	(Bricker et al., 2017)
<ul style="list-style-type: none"> • Multifold instruments mentioned for different cases 	(Säumel et al., 2019)

Table 2. Policy instruments mentioned in the case studies reviewed in this study

ECONOMIC ASPECTS

Regarding the financial mechanisms of the case studies reviewed in this study, almost half of them mentioned their funding sources (49 percent - 17 references), either by the public administration or by the private sector.

- Public funding proceeded mainly from local governments (municipalities), regional governments, ministries or departments from national governments or supra-national institutions (e.g. European Union).
- Private funding proceeded mainly from private foundations, non-profit organisations, private corporations, etc.

Public funding was the most frequent way of funding (40 percent - 14 references), while private funding supposes 26 percent of publications (9 references). Besides, 17 percent of the publications (6 references) mentioned some kind of partnership between the public and the private sector (Public-Private Partnership - PPP) regarding their funding sources. However, It is important to note than only half of the 35 articles mention the funding sources, thus being possible not to correspond with the actors involved, as mentioned previously, (See section **Error! No s'ha trobat l'origen de la referència.**).

Regarding the cost-effectiveness of implementing NbS, 40 percent of case studies (14 references) compare the effectiveness of NbS versus the effectiveness of conventional engineering (e.g. grey infrastructure), either by comparing **different scenarios** (Castelli et al., 2017; Dhyani et al., 2018; Fung & Jim, 2020; La Rosa & Pappalardo, 2020; Liqueste et al., 2016; Mulligan et al., 2020; Pagano et al., 2019; Reynaud et al., 2017); or by conducting **before-after simulations** (McFarland et al., 2019; Riegels et al., 2020). Despite the comparison, not all of them consider the economic dimension in their calculations, explicitly; but as some other services provided by NbS.

BARRIERS, CHALLENGES & LESSONS LEARNED

BARRIERS

Ecological Barriers	Economic Barriers	Social Barriers
<ul style="list-style-type: none"> NbS implications requires systemic considerations Ecosystem disservices as unintended side effects, are negatively perceived for human well-being NbS might not be able to meet all the needs Climate change impacts are beyond the control of NbS boundaries. Information as NbS (e.g. modelling, monitoring) might require data at territorial scales that is not yet available 	<ul style="list-style-type: none"> Resources limitations (i.e. Financial) extends to different capacities and infrastructures. Market uptake is in process and depending on legal regulations Knowledge demand for the up-take of NbS as a solution that is cost-effective. NbS is not really supported on a growth strategy for water management. The concept could be criticised as overemphasising a utilitarian perspective on nature. 	<ul style="list-style-type: none"> Fear of the unknown, uncertainty, resistance to changes Passive involvement based on 'stay and use' the NbS, questions the increase on social cohesion Uneven place-impacts (i.e. Access to nature, quality, quantity, location, usage and enjoyment) Behaviours, Socio-cultural values, traditions, perceptions (i.e. on costs, terms, benefits, impacts, access equity) have an influence on the human-nature interactions. These perceptions could be negative and related to issues on social justice, gentrification, displacement issues.

NbS CHALLENGES

Overcoming Short-term and disconnected actions	Overcoming Sectoral silos & fragmentation
<ul style="list-style-type: none"> Planning: Long Term Approach to NbS Strategic planning & scenarios Spatial & Landscape Planning Key tool: monitoring & comprehensive assessment 	<ul style="list-style-type: none"> Multidisciplinary & reflexive approach to NbS Integrative Governance Multidisciplinary, partnering & collaborative networks Community Governance and Participation Key Tool: Communication Key Tool: Creative Thinking, Research & Action

LESSONS LEARNED

NbS embeddedness calls for local adaptation	NbS is a cross/sectoral and multidisciplinary mission	Co-benefits are dynamic
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