

## **Social and cultural values and impacts of nature-based solutions and natural areas**

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## List of Abbreviations

CICES	The Common International Classification Of Ecosystem Services
EC	European Commission
ES	Ecosystem Services
EU	European Union
IUCN	International Union For Conservation Of Nature
MA	The Millennium Ecosystem Assessment
NATURVATION	Nature Based Urban Innovation Project
NBS	Nature-Based Solutions
TEEB	The Economics Of Ecosystems And Biodiversity



## 1. Introduction

Societies around the world are under pressure due to the interacting forces of global and local environmental change. Climate change is already affecting ecosystems across Europe, with consequences for biodiversity and the functioning of ecosystems and people who depend on them (Naumann et al., 2014) (Eggermont et al., 2015) (Kabisch et al., 2016). While climate change and other aspects of environmental change are pervasive and affect societies in different ways in many different contexts, the impacts are often multiplied in urban areas (Kabisch et al., 2016). Taking into consideration that around 75% of the EU population is currently living in urban areas (European Environment Agency, 2017), innovative approaches to overcome these challenges should be a priority. Continuing urbanisation could weaken quality of life in urban areas, stifle economic growth and affect resource availability (European Commission, 2015).

In this context, "nature-based solutions" (NBS) are *"seen to hold significant promise in enabling the urban transition to sustainability"* (Bulkeley, 2016, p.3) and address urban challenges by exploring nature's features (Bulkeley, 2016). The NBS concept is currently used to reframe climate change mitigation and adaptation strategies and to address biodiversity conservation (Potschin et al., 2014). In addition, the European Union (EU) also intends to tackle some socioeconomic challenges by investing in NBS under the Horizon 2020 Framework Programme for Research and Innovation and fund comprehensive projects of concrete nature-based solutions that aim at increasing the overall welfare in a sustainable and cost-effective manner (Maes and Jacobs, 2015).

This literature review will focus on the benefits provided and values hold by NBS in the social and cultural dimensions. The present literature review is part of a working package of the NATure based URban innoVATION (NATURVATION) project: a four-year research project funded by the Horizon 2020 program. Concerning the structure of this review of literature, it is structured in five main sections, as follows:

- Context: the conceptual context of NBS is presented (sub-section 1.1.), the main goals and benefits of NBS are observed (sub-section 1.2.), values and benefits are defined for the purpose of this literature review (sub-section 1.3.) and the social and cultural values and benefits categories used in the research are identified in this sub-section and defined (sub-section 1.4.);



- **Methods:** in the third section the methods of the process of selection of relevant articles is revealed (sub-section 3.1.) as well as the analysis process (sub-section 3.2.), the evaluation methodologies used in the studied literature are also presented (sub-section 3.3.) as well the limitations of this research work (sub-section 3.4.);
- **Results:** this section is divided in two main parts, in which the first part corresponds to the statistical assessment (4.1.2 -4.1.3) and findings (4.1.4) of the social and cultural values of Nature and NBS (4.1.); while the second part is the statistical assessment (4.2.1 – 4.2.3) and presentation of the main findings (4.2.4) of the social and cultural benefits of NBS (4.2.) covering ecosystem services as well (4.2.3.);
- **Conclusions:** in this section the main conclusions of this review of the literature are presented as well as future research directions.

## **2. Context**

The aim of this study is to integrate and present the state-of-the art knowledge regarding the concepts of nature-based solutions and nature, associated social and cultural values as well as the social and cultural benefits of nature and nature-based solutions with a focus on urban environments. For this purpose, in this section we define and conceptualise NBS and the social and cultural values and the social and cultural benefits that can be linked to NBS.

### ***2.2 Conceptual context of nature-based solutions, origins and definitions***

Within the scientific literature, the concept of NBS appeared in the early 2000s as a means to solve agricultural problems. In 2009, term was associated with the subject of climate change resilience and mitigation (Potschin et al., 2014). Since then, the concept of NBS has been progressively developed by the European Commission (EC) with programmes such as the Horizon 2020, and the 2013-2016 Programme of the International Union for Conservation of Nature (IUCN) in which NBS was one of the three main areas of work (Cohen-Shacham et al., 2016).

The definition of the NBS has been presented and applied in a different manner across the literature, although both the EC and IUCN definitions share the vision of tackling key societal challenges through an efficient use of ecosystem services (Cohen-Shacham *et al.*, 2016). In the final report of the Horizon 2020 expert group on “Nature-Based Solutions and Re-Naturing Cities”, NBS are presented as “*nature-based solutions aim to help societies address a variety of environmental, social and economic challenges in sustainable ways. They are actions inspired by,*



*supported by or copied from nature; both using and enhancing existing solutions to challenges, as well as exploring more novel solutions"* (European Commission, 2015, p.24). The 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"* (Cohen-Shacham *et al.*, 2016, p.5). The first definition by the EC places weight on solutions that use nature as well as are inspired and supported by nature, while the second definition by the IUCN places importance on the necessity to have sustainable actions that manage and restore ecosystems as a priority for NBS interventions (Cohen-Shacham *et al.*, 2016).

According to the NATURVATION project, NBS are *"deliberate interventions that seek to use the properties of nature to address urban challenges"* (Bulkeley, 2016, p.8), which have the ability to be cost-effective and provide benefits (environmental, social and economic) while supporting resilience building (Bulkeley, 2016). Generally, the concept of NBS promotes the preservation and restoration of biodiversity and ecosystems, increases human well-being by a sustainable and efficient management of natural capital and ecosystem services (Potschin *et al.*, 2014). Although, since the term "nature-based solutions" is a relatively recent term, other related concepts can include "green infrastructure", "nature-based climate adaptation", "nature-based climate change mitigation" and "ecosystem-based adaptation" (Naumann *et al.*, 2014) (Kabisch *et al.*, 2016).

## **2.2 Goals and benefits of nature-based solutions**

The EC expert group on "Nature-Based Solutions and Re-Naturing Cities" identified four overarching goals believed that NBS can meet: (1) improvement of *sustainable urbanisation* by the power of NBS to encourage economic growth, improve environmental standards and improvement of well-being; (2) *restoring degraded ecosystems* through the use of NBS to increase the ecosystems resilience; (3) *developing climate change adaptation and mitigation* and (4) *improving risk management and resilience*. These goals are seen as instruments to position Europe as a leader in the field of responsible innovation and addressing society's needs simultaneously (European Commission, 2015).

In urban environments, the NBS benefits are increasingly being acknowledged through their ability to increase the availability of urban green areas (Kabisch *et al.*, 2016), by supporting functional healthy ecosystems and their multiple environmental, social and economic benefits (Anika Terton, 2017), as well as by the virtue of connecting people with nature as a consequence





of nature's benefits to people as individuals or communities (Díaz *et al.*, 2015). The environmental benefits of urban green spaces (e.g. green walls, green roofs, urban parks, urban gardens, street trees, etc.) can include improved air quality, decline of the heat island effect, decrease of air temperature as a result of shade, assist as a defence against natural hazards and climate extremes such as flooding and hurricanes, manage water quality and protection of river banks (Naumann *et al.*, 2014) (Potschin *et al.*, 2014) (Anika Terton, 2017). Regarding the economic benefits, green infrastructure have the ability to be more cost-effective compared to grey infrastructure (Anika Terton, 2017) and there are several studies concerning the monetary valuation of NBS and ecosystem services benefits (Turner *et al.*, 2003) (Potschin *et al.*, 2014) (Díaz *et al.*, 2015).

Green infrastructure is also valued for the recreational benefits and possibility of outdoor activities provided (Özgüner and Kendle, 2006), however, perhaps evidence of cultural benefits is not so well documented although we will discuss the cultural benefits of nature in section 5. Concerning social benefits as a focus of this review, studies highlighted that urban green spaces provide both physical and mental health impacts on visitors, nearby vegetation has effects on management of main life issues, offer educational opportunities for population, encourage citizen's involvement and reinforce cultural identities (de Vries *et al.*, 2003) (Swanwick, 2009) (Hansmann, Hug and Seeland, 2007) (Kabisch *et al.*, 2016) (Anika Terton, 2017). Such benefits as well as values will be defined in the following section.

### **2.3 Defining values and benefits for the purpose of this literature review**

For the purpose of this literature review, first, we set out the conceptual distinction between values and benefits, as well as ecosystem services and provide a categorisation of social and cultural values and benefits.

Over the last decades, in the fields of environmental economics, the valuation of ecological systems has developed into a relevant area of research due to their impact on the assistance on matters of policy design and decision making practises (Turner *et al.*, 2003) (Spangenberg and Settele, 2016a). Valuation of nature has become an integral part of the decision-making process on subjects of natural resource and land use, including several value dimensions such as economic, ecological, cultural, ethical, self-interest and electoral (Jacobs *et al.*, 2017). However when discussing the valuation of nature, the term *value* can be ambiguous and not scientifically clear. According to Brown (1984) values can either be seen as (i) *held* values which include "modes of behaviour (e.g., bravery, loyalty), end-states (e.g., freedom, happiness), and qualities



(e.g., beauty, symmetry)”; or (ii) *assigned values* as “the expressed relative importance or worth of an object to an individual or group in a given context” (e.g., monetary values of goods), although the author highlighted that *assigned values* was not an ideal expression since it implies that a value is assigned to an object, when in fact, it reflects the importance or worth of the object according to the person’s *held values* (Brown, 1984). Therefore, Spangenberg and Settele (2016) reason that the term “value” should be comprehended as an “umbrella concept” that includes various types of values, given the variety of definitions and differing concepts of the term *value*.

For the purpose of this analysis, we distinguish and define social and cultural impacts as “*the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society... which also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalise their cognition of themselves and their society*” (Institute For Environmental Studies, 1995, p.11) and social and cultural benefits as a “*positive change in wellbeing from the fulfilment of needs and wants*” (Maes et al., 2013, p.48), taking into account in the context of this review of the literature the welfare gains generated by ecological functions or “ecosystem services” (TEEB, 2010) and Nature in general.

Generally, ecosystem services (ES) are considered as the “*benefits people obtain from ecosystems*” (Millennium Ecosystem Assessment, 2005, p.53), including as sources of ES both natural and human-modified ecosystems (Millennium Ecosystem Assessment, 2005). Regarding the classification of ES, three international classification systems are established in order to classify ES: (a) The Millennium Ecosystem Assessment (MA), (b) The Economics of Ecosystems and Biodiversity (TEEB) and The Common International Classification of Ecosystem Services (CICES). Mainly all are related since all systems include provisioning, regulating and cultural services (Maes et al., 2013). Since the NATURVATION project adopts the TEEB classification system (Table 1), this literature considers four types of ES: (1) provisioning services, (2) regulating services, (3) habitat or supporting services, and (4) cultural services (TEEB, 2017) and mainly focuses on the “cultural services”.



Ecosystem Services	TEEB Definitions	Examples of ES
<b>Provisioning Services</b>	"ES that describe the material or energy outputs from ecosystems. They include food, water and other resources."	Provision of cultivated crops; reared animals and their outputs; provision of surface and ground water for drinking purposes.
<b>Regulating Services</b>	Services provided by ecosystems "by acting as regulators (e.g. air quality regulation and soil regulation by providing flood and disease control)."	Mediation of smell, noise and visual impacts; filtration, sequestration and storage by ecosystems; flood and storm protection.
<b>Habitat Supporting Services</b>	or "Habitats for species (e.g. food; water; and shelter)" and "maintenance of genetic diversity"	Maintaining nursery populations and habitats; pest/ disease control; pollination and seed dispersal.
<b>Cultural Services</b>	"Recreation, mental and physical health, tourism, aesthetic appreciation and inspiration for culture, art and design, spiritual experience and sense of place"	Intellectual and representational interactions (e.g. scientific, educational, heritage, cultural); spiritual and symbolic interactions with ecosystems; physical interactions with ecosystem (e.g. whale and bird watching, snorkelling, diving, walking, hiking, climbing).

Table 1. TEEB classification system of ecosystem services (TEEB, 2017)

Research on the benefits provided by ES has been strongly studied in Europe in the last years as a result of the support from the EC through the "EU Biodiversity Strategy for 2020". Ecosystem services valuation is frequently related to the immediate economic and human well-being impacts (Eggermont et al., 2015), and through classification of the benefits that people receive from ecosystems, the research developed in the field of ES is able to link both human well-being, ecology and economy (Maes and Jacobs, 2015). ES applications already provide opportunities to promote NBS (Maes and Jacobs, 2015) such as the advantage of the ES provided by forests and wetlands as an natural solution for watershed management or the nature-based recreational activities (such as hunting and tourism related to observing wildlife) responsible for creating jobs related to biodiversity and ES (Ten Brink *et al.*, 2012). Through the provision, regulation, support and cultural services provided by ecosystems they represent a crucial component for human well-being, which can be increased by a sustainable interaction between humans and ecosystems through appropriate instruments, technology and institutions (Millennium Ecosystem Assessment, 2005). While ES valuation is related to immediate impacts, on the other



hand, NBS has a long-term approach focused on the environmental and human benefits, which takes into account sustainable solutions that address climate change long-standing effects (Eggermont *et al.*, 2015). In terms of sustainable development, NBS as a conceptual term, links and attributes even importance to environmental, social and economic scopes (Nesshöver *et al.*, 2017) and applies resource-efficient and geographically adapted interventions being able to provide benefits to human well-being as well as to biodiversity (Raymond *et al.*, 2017).

#### **2.4 Social and cultural value and benefits categories used in the research**

This review of literature leans more closely to a contextual values concept, rather than the valuation methods that imply monetary expressions of the social and cultural values recognised in nature. Studies concerning multiple types of both social and cultural values of nature (Sherrouse, Clement and Semmens, 2011) (van Riper *et al.*, 2012) (Kenter *et al.*, 2015) (Vierikko and Niemela, 2016) shaped the categories of values used in this review of literature. Based on the reviewed literature, we established six groups of social and six groups of cultural value categories. The defined social and cultural value categories are presented and defined in Table 2 and 3 respectively.

*Table 2. Social values categories definition.*

<b>Social values</b>	<b>Definition</b>
<b>Educational</b>	Values related to the use of nature according to its offer of opportunities to learn from direct contact and experience with nature.
<b>Well-being</b>	Directly connected to the therapeutic effects on mental and physical health of being in contact with nature and living in a healthier lifestyle.
<b>Life sustaining</b>	Values that acknowledge the ability of nature to provide and preserve vital goods (e.g. water and air).
<b>Social inclusion</b>	Refers to the values of social cohesion, civic engagement, communal self-reliance and community spirit.
<b>Safety</b>	Values related to the sense and perception of personal safety (e.g. feeling safe and secure).
<b>Intrinsic</b>	Values connected to the estimation of Nature itself, with people being present or not.



Table 3. Cultural values categories definition.

Cultural values	Definition
<b>Aesthetic</b>	Values related with scenic attributes, preferences and beauty of nature.
<b>Cultural heritage and History</b>	Values addressing the significance of cultural-historical traditions and sites.
<b>Biological diversity</b>	Refers to the values of biodiversity, biological richness and nature provision of fauna and flora.
<b>Recreation</b>	Activity-based values and addresses nature's ability to offer outdoor recreational activities.
<b>Spiritual and religious</b>	These values are related with spiritual connection, religious activities in nature's sacred and religious places and with experiences of fascination and connectedness provoked by a natural place.
<b>Place-based values</b>	Are linked with the sense of place within nature and of belonging in natural areas.

With regards to the benefits, during our analysis we distinguished six types of social and four types of cultural benefits based on typologies used by various studies, such as (Kabisch and Haase, 2014) (Karrasch, Klenke and Woltjer, 2014) (Camps-Calvet *et al.*, 2015) (Shackleton *et al.*, 2015) (Ribeiro and Ribeiro, 2016) (Hegetschweiler *et al.*, 2017). The identified social benefits are described in Table 4, the cultural benefits in Table 5.

Table 4. Social benefits categories definitions.

Social Benefits	Definition
<b>Well-Being Enhancement</b>	Benefits that result in improvements of physical and mental health and stress reduction;
<b>Opportunities for Social Interaction</b>	Are benefits such as the participation and integration of local communities and can result in improved sense of community and feelings of collective activity;
<b>Enhancement of Equality</b>	Represent benefits of decreased social isolation and empowerment of disadvantaged groups;
<b>Growth of Employment</b>	Are benefits which represent the development of new job positions by recreation, nature protection and nature tourism activities;
<b>Education Development</b>	Relate to the benefits of providing formal education opportunities and informal learning opportunities about nature and have the power to raise awareness on nature conservation;
<b>Safety Advancement</b>	Represent benefits of increased perception of safety and increased resilience capacities with climate change.



Table 5. Cultural benefits categories definitions.

Cultural Benefits	Definition
<b>Aesthetic Improvement</b>	Represents the enhanced visual qualities and beauty of the landscape;
<b>Spiritual Connection</b>	These benefits represent the sense of calm and the pleasure of enjoying Nature, as well as Nature ability for cultural inspiration and the encouragement of development of religious mind-sets;
<b>Preservation of Cultural Heritage</b>	Are benefits with impacts conservation or restoration of cultural and historic heritage;
<b>Recreation Opportunities</b>	Exemplify the well-being benefits provided by outdoor activities, and the recreation possibilities provided by nature;

### 3. Research Questions

To define the direction of this research work, two main research questions were raised. The first question is directly related to the social and cultural values associated with Nature and nature-based solutions, the second question to the values of Nature within urban environments, and the last question assesses the benefits delivered by nature-based solutions. The research questions were elaborated as it follows:

- Question 1a: What kinds of social values are associated with Nature and NBS?
- Question 1b: What kinds of cultural values are associated with Nature and NBS?
- Question 2a: What are the social benefits delivered by NBS?
- Question 2b: What are the cultural benefits delivered by NBS?

Even though all questions have a focus on urban areas, during the screening of abstracts some literature on rural areas was also considered for the review work presented in Section 5 of findings. For the statistical assessment, the focus was on urban studies.

### 4. Methods

To address the research questions, a systematic literature search was conducted during March 2017. Science Direct was searched for studies using combinations of keywords related to NBS and their impacts or benefits as well as their associated values with nature. Systematically, for each research question (1a, 1b, 2a and 2b) a set of keywords were identified such as physical features (e.g. "nature-based solution", "green infrastructure", "blue infrastructure", "ecosystem services", among others), combined with related keywords for "social impacts", "cultural impacts", "social values", "cultural values" as well as the "urban" spatial scale. Search strategies



were defined for each question depending on the key concepts and combinations of different terms defined for all research questions, as shown in Table 6.

Table 6. Search strategy.

Key Concepts AND Search Words			
Question	Nature	Social Values (Q1A)	Cultural Values (Q1B)
<b>1</b>			
Strategy 0	nature-based solution	Social value	cultural value
Strategy 1	green infrastructure	Social value	cultural value
Strategy 2	blue infrastructure	Social value	cultural value
Strategy 3	urban green infrastructure	Social value	cultural value
Strategy 4	ecosystem service	Social value	cultural value
Strategy 5	nature-based solution	Value	city OR urban environment OR urban area
Strategy 6	green infrastructure	Value	City OR urban environment OR urban area
Strategy 7	blue infrastructure	Value	city OR urban environment*OR urban area
Strategy 8	urban green infrastructure	Value	city OR urban environment OR urban area
Strategy 9	ecosystem service	Value	city OR urban environment OR urban area
Strategy 10	Value of nature	--	city OR urban environment OR urban area
<b>Question 2</b>	<b>NBS</b>	<b>Social Benefits (Q2A)</b>	<b>Cultural Benefits (Q2B)</b>
Strategy 0	nature-based solution	Social benefit OR social impact	cultural benefit OR cultural impact
Strategy 1	green infrastructure	Social benefit OR social impact	cultural benefit OR cultural impact
Strategy 2	blue infrastructure	Social benefit OR social impact	cultural benefit OR cultural impact
Strategy 3	urban green infrastructure	Social benefit OR social impact	cultural benefit OR cultural impact
Strategy 4	ecosystem service	Social benefit OR social impact	cultural benefit OR cultural impact
Strategy 5	climate change adaptation OR climate change mitigation	Social benefit OR social impact	cultural benefit OR cultural impact

#### 4.1 Selection of relevant articles

The scoping exercise involved 4 stages. The first stage consisted of searching scientific literature on the topic of the three main research questions, according to the defined search strategy, as previously mentioned. As a result of this exercise, the initial search exercise yielded 2630 articles. On the second stage, the abstracts of the articles discovered during the first stage were screened using the following criteria:



- Are NBS's or urban green and/or blue infrastructure or Nature features explicitly stated?
- What types of NBS are studied?
- What are the main objectives of the study?
- Are social and/or cultural impacts addressed?
- Are social and/or cultural values addressed?

This screening exercise resulted in 369 articles that were subject to a third stage of screening, based on the reading of the full text of the articles and resulted in a reduction of this number to 98 relevant articles. The identified studies were included since they provided information on social and/or cultural values of Nature, as well as social and/or cultural impacts of nature and/or nature-based solutions.

The literature was drawn primarily from empirical studies, although additional relevant articles were identified by a reading exercise from the final sample of papers. The review included exclusively literature written in the English language.

Besides the database search of scientific literature, bibliographic references were also drawn from relevant articles and included in the present literature review, as well as “grey” literature and recommended literature that was considered as an added value to this study (stage 4).

Figure 1 demonstrates the approach adopted for this literature review.

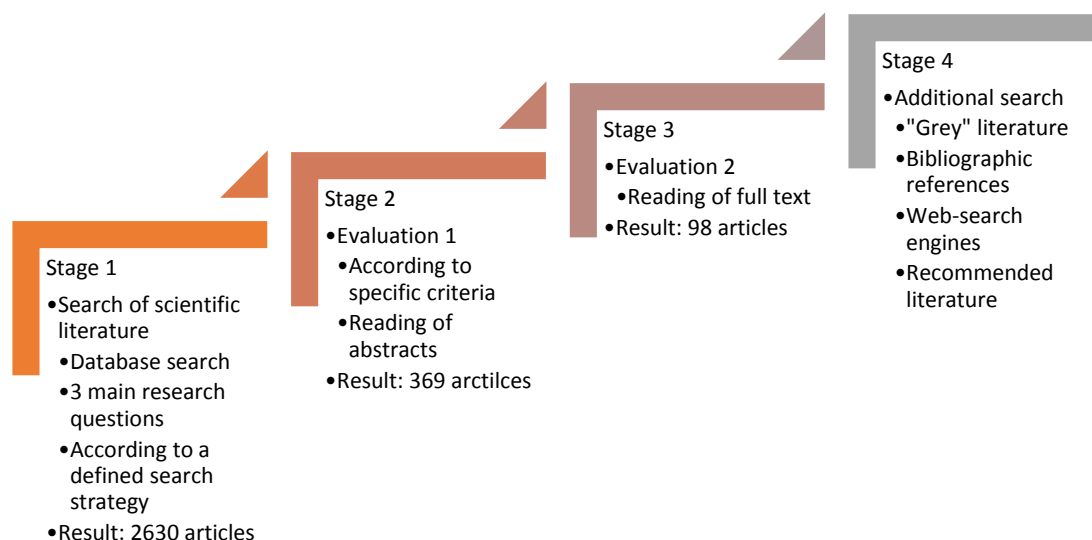


Figure 1. Graphical representation of the approach adopted for this literature review.





### **4.3 Analysis of the selected articles**

Regarding the analysis phase and based on the criteria stated before, 98 relevant studies were originally gathered into an Excel spreadsheet, in which data was identified on the topics relevant for this research, according to the following attributes:

- Bibliographic information: Article ID (numerical), authors, title, aim or purpose of the study;
- Relevance of the study: each paper was scored between 1 (low relevance) and 5 (very relevant);
- Type of infrastructure: NBS interventions examples, green infrastructure, blue infrastructure, urban green spaces;
- Specific types of NBS were recorded into different categories (ecological domains defined by the project): (1) building greens (external), (2) urban green areas connected to grey infrastructure, (3) parks and (semi) natural urban green areas, (4) allotments and community gardens, (5) green indoor areas blue areas, (6) green areas for water management, (7) derelict areas.
- Ecosystem services addressed: provisioning services, regulating services, habitat and maintenance services, and cultural services;
- Spatial scale of the assessment or the NBS intervention and identified groups of beneficiaries;
- Social values: (1) educational, (2) well-being, (3) life sustaining, (4) intrinsic, (5) safety, (6) social inclusion;
- Cultural values: (1) aesthetic, (2) cultural heritage and historic, (3) biological diversity, (4) recreational, (5) spiritual and religious, (6) place-based values;
- Social benefits: (1) well-being enhancement, (2) opportunities for social interaction, (3) enhancement of equality, (4) growth of employment, (5) education development, (6) safety advancement;
- Cultural benefits: (1) aesthetic improvement, (2) spiritual connection, (3) preservation of cultural heritage, (4) recreation opportunities;

The revision of every article identified by the previously described search strategy was conducted according to the above-mentioned attributes and its results are presented under Section 4. Under stage 3 and after stage 4, based on a primary analysis of the type of values and benefits mentioned in these articles, a list of categories of values and benefits (identified in subsection 1.4) was produced and used to register the types of social and cultural values and benefits identified in each article analysed during this review of the literature.



#### **4.4 Evaluation methodologies used in the studied literature**

The values and benefits (sub-section 1.4), identified from our final sample of literature were assessed through qualitative and quantitative data by various methods (e.g. household surveys, in-depth interviews (Shackleton et al., 2015), in-person questionnaires (Casado-Arzuaga, Madariaga and Onaindia, 2013) and empathy-based stories (Mesimäki et al., 2017)). Sherrouse et al. (2011) developed an approach to discuss social values with a geographical information system (GIS) application, by deriving a non-monetary value index.

The review however has not distinguished between literature that took a normative position about what NBS ought to be able to produce and that produced evidence of the ways in which NBS had generated these values. According to Kenter et al. (2015b), the concept of social values can either address the specific values of a community, society cultural values, or the public interest and values derived from social processes. The studied articles also provided a good sample of groups of beneficiaries. With regards to the studied beneficiaries, the focus was the urban population, although some groups were specified, such as residents and communities (Casado-Arzuaga, Madariaga and Onaindia, 2013) (Vollmer et al., 2015) (Rall et al., 2017), homeowners (Uren, Dzidic and Bishop, 2015) and visitors (van Riper et al., 2012).

Some articles focused their sample of respondents to specific profiles of experts, such as school administrators (Iojă et al., 2014), teachers, university researchers and students, public-administration technicians and the staff of environmental associations, (Casado-Arzuaga, Madariaga and Onaindia, 2013), and gardeners (Camps-Calvet et al., 2015). Disadvantaged groups were particularly mentioned in some studies, such as older population that recognise trees as “living entities” which represent a distinct psychological influence in their lives, and represent their personal spiritual and cultural beliefs (Shackleton et al., 2015). Shackleton et al. (2015) studied the values and benefits of trees in urban environments in South Africa and concluded that residents value trees in different degrees. Low-income population categorised by high poverty, unemployment and illiteracy, outcomes indicate that such social group of residents appreciate benefits and values of trees for benefits such as products (e.g. firewood, fruit, medicine), regulating services (e.g. shade, windbreaks), as well as less tangible social (e.g. aesthetic) and cultural (e.g. spiritual, historical) values, being these values stressed by the older generations. (Shackleton et al., 2015). Some results suggest that low-income population rely upon and value more urban gardens than higher-income people due to their easy access to recreational features of nature (e.g. private gardens, tourism) (Camps-Calvet et al., 2015).



#### 4.5 Limitations of the Research

As a result of our search, results seem to suggest that studies focusing on the social and cultural dimensions of values and impacts have increased over the past decade (Figure 2). Although we should take in consideration as a limitation, that according to our search strategy we found ourselves with a limited time coverage regarding the publication dates of our final sample of articles for the review of the literature (1991-2016), which its outcomes are presented on Section 4 (results).

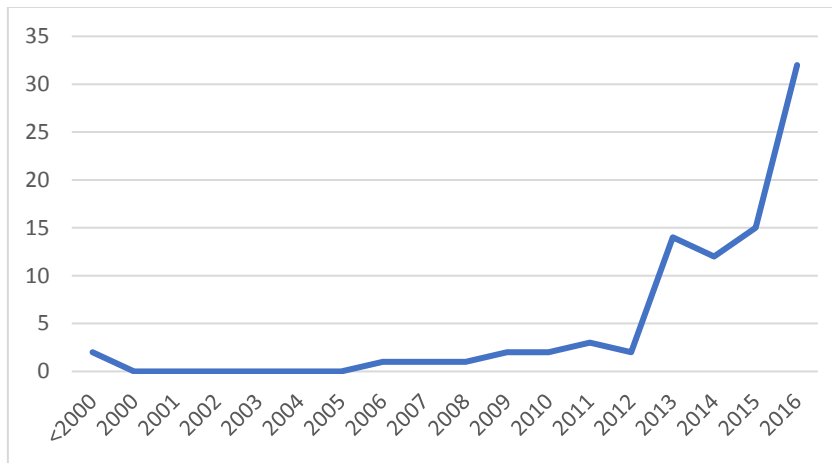


Figure 2. The reviewed studies on the social and cultural dimensions of values and benefits of Nature and nature-based solutions, published between 2000 and 2016.

The studies from <2000 were published in 1999 and 1991, and 12 articles are from 2017 (until March 2017).

In addition, some structural boundaries have also presented during the research. In the first search of the scientific literature (stage 1), among the resulting selection sample of articles were reviews of literature studies that were analysed (stage 3) alongside the other articles. This might have resulted in double counting of information on the analysis of results, since these articles (reviews of literature) may include content of other studies that were analysed in our review.

During the analysis of the articles (stage 3), the identification and the counting of the values and benefits was conducted in a matter that numerical values were attributed as either “1” in the case where that specific value/benefit was mentioned, and “0” if that value/benefit wasn’t mentioned. Which resulted in not addressing the exact number of different types of values/benefits addressed for each specific category (e.g. multiple types of outdoor activities were attributed with the value “1” under the “recreation”, as well as in the cases in which only one outdoor activity was identified).



## 5. Results

In this section, we summarise the results of the literature review related to social and cultural values of Nature and NBS; the identified social and cultural benefits and impacts of NBS, as well as the identified ecosystem services provided by nature. The results obtained from the search of the literature in terms of the final sample of articles included in the present review can be consulted in Appendix 1.

Figure 3 shows the total number of articles covered (98 articles) and the number of articles dealing with the social and cultural values, and the social and cultural benefits of NBS, respectively. From this 98 articles, 42 specifically addressed values of NBS, in which 35 articles focussed on social and 38 on cultural values. 65 articles addressed the benefits of NBS, out of which 49 dealt with social and 37 articles with cultural benefits.

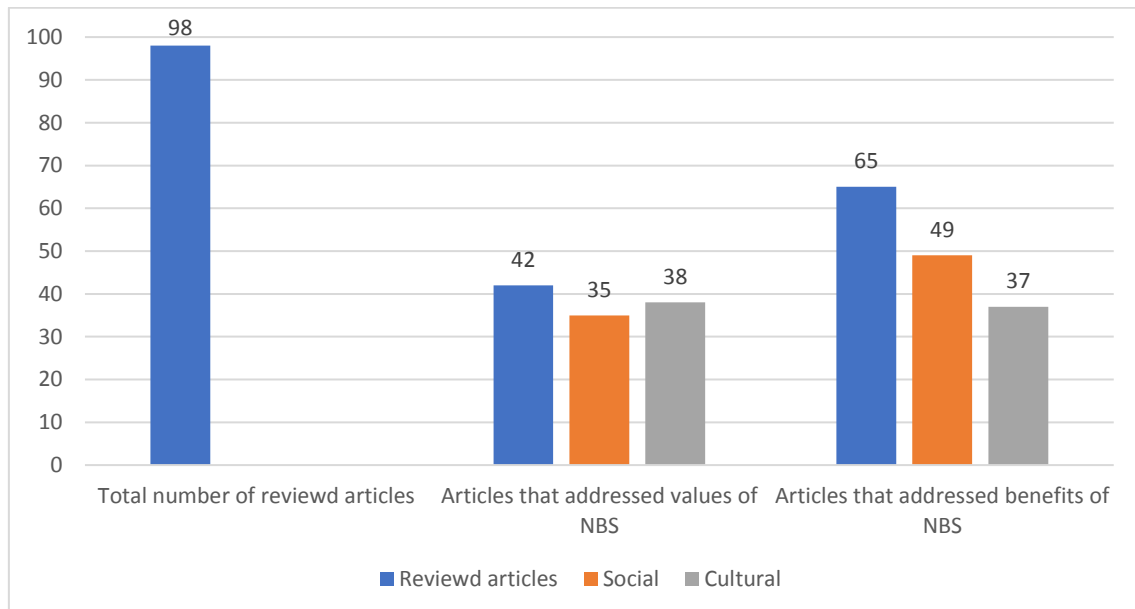


Figure 3. Number of articles which addressed NBS values (social and cultural) and benefits (social and cultural), from the total number of articles used in this review of the literature.

### 5.1 Values of Nature

The discourses on the value of nature are complex and multidimensional that span multiple disciplines concerned with environmental science and management (Turner *et al.*, 2003), as well as the social sciences and humanities (Kenter *et al.*, 2015). It is important to note the difference between values and valuation. Valuation most commonly refers to concepts and practices related to the establishment of economic or other more tangible values of nature and the goods and services it provides. These usually rely heavily on market valuation, but fall short of incorporating intangible values and dimensions such as place-based appreciation, heritage,



social capital and cohesion, neglecting the social and cultural dimensions (Chan, Satterfield and Goldstein, 2012). In the context of this review, the focus is on the social and cultural dimensions.

### 5.1.1 Statistical assessment of the identified values of nature

From the final sample of 98 articles, 54 addressed the social and 54 the cultural values of nature. Although the number of identified articles is the same, this doesn't mean that the same articles addressed both types of values. Based on a primary analysis of the type of values mentioned in these articles, a list of value categories was identified (presented in sub-section 1.1.) and used to categorize the articles. Concerning social values, six main groups were recognised: (1) educational; (2) well-being related; (3) life-sustaining; (4) social inclusion; (5) safety; and (6) intrinsic (Sherrouse, Clement and Semmens, 2011) (van Riper *et al.*, 2012) (Kenter *et al.*, 2015) (Vierikko and Niemela, 2016). Figure 4 provides an overview of the different types of social and cultural values referenced.

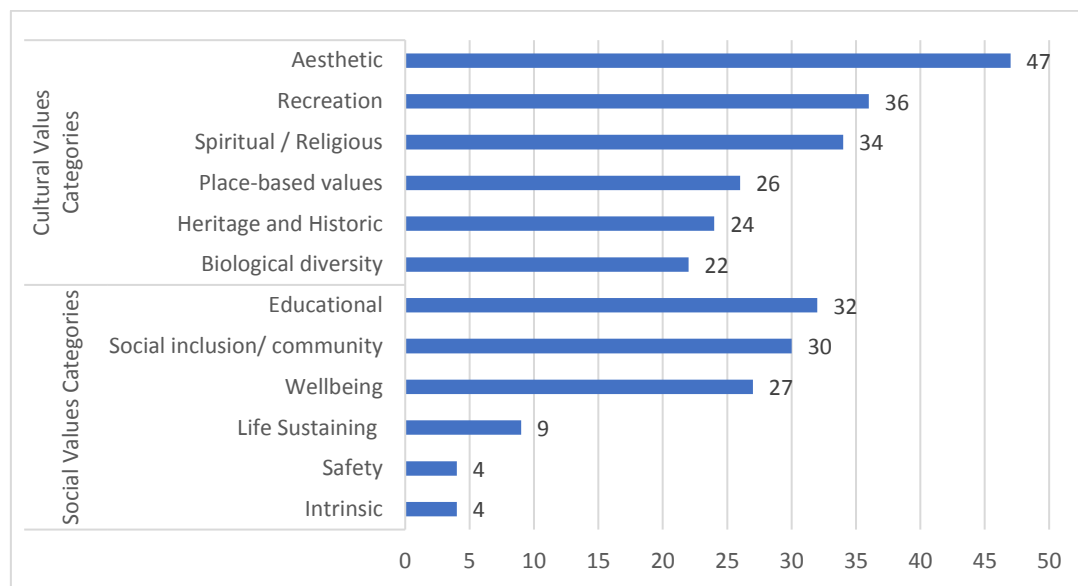


Figure 4. Graphical representation of the number references of the different types of social and cultural values.

As shown, the most frequently mentioned social values (32 references) were educational. Within this category, some of the examples identified were “environmental protection and awareness activities”, “opportunity to learn about the environment by observation or experimentation” and “learning from direct experience of nature” (Özgüner, Kendle and Bisgrove, 2007) (Sherrouse, Clement and Semmens, 2011) (Langemeyer *et al.*, 2015). The second most referred were “social inclusion values”, with 30 references, which were discussed in terms such as “social cohesion” or “civic engagement” and often referred by feelings of “community” and “social harmony” (Graham *et al.*, 2013) (Dieleman, 2015) (Vollmer *et al.*, 2015) (Matthew



Dennis and James, 2016) (Fish, Church and Winter, 2016). The third biggest group (27 references) were “well-being values” that refer both to the “mental and physical well-being”, as well as “therapeutic recovery” and “relaxation and stress reduction” (Bieling *et al.*, 2014) (Kenter *et al.*, 2015) (Bryce *et al.*, 2016). The other cultural values categories are reported in Table 3, with the number of references as well as some examples found in the literature shown.

Regarding cultural values, six core categories were identified: (1) aesthetic, (2) cultural heritage and historic, (3) biological diversity connected, (4) recreation, (5) spiritual and religious, (6) place-based (Sherrouse, Clement and Semmens, 2011) (van Riper *et al.*, 2012) (Kenter *et al.*, 2015) (Vierikko and Niemela, 2016).

From the group of cultural values (Figure 3), the categories more frequently mentioned were aesthetic (47 references), which were usually related to “scenic attributes”, “aesthetical experiences” and “beauty” (Sherrouse, Clement and Semmens, 2011) (Cooper *et al.*, 2016) (Vierikko and Niemela, 2016). The second most frequent category of values were the “recreation” (36 references), mentioned occasionally as “activity-based”, referring to “outdoor activities”, “tourism”, or “recreational activities” (Vollmer *et al.*, 2015) (Matthew Dennis and James, 2016) (Fish *et al.*, 2016). The third most mentioned category of values were “spiritual and religious” (34 references), with subcategories such as “religious activities”, feelings of “inspiration” and “spiritual connection” (Özgüner and Kendle, 2006) (Dieleman, 2015) (Kenter *et al.*, 2017). Table 4 shows all cultural value categories and some of the examples.

Figure 5 shows that social value were covered by 36% and cultural by 64% of the literature. These values refer to the identification of specific categories and not to the total number of values mentioned per category, as mentioned in the research limitations sub-section. The total amount of values per category was not recorded.

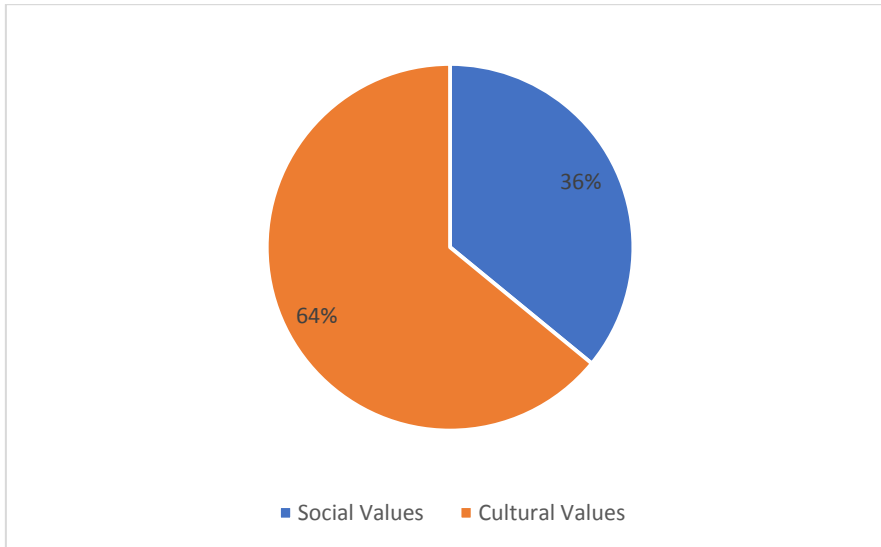


Figure 5. Percentage of the type of social and cultural values of nature and nature-based solutions identified in the selected literature.

### 5.1.2 Social Values of NBS

One of the main focus of this research was to assess the social and cultural values associated with nature-based interventions. From our final sample of articles, 42 focused on social *and* cultural and 35 to social values of NBS. Although a significant part of literature still does not focus solely on NBS interventions, it was possible to assemble a list of types of nature-based solutions related to social and cultural values.

The research built on the definition of NBS “ecological domains” by the Naturvation project. These domains are grouped into six classes of NBS interventions: (1) building greens (external); (2) urban green areas connected to grey infrastructure; (3) parks and (semi)natural urban green areas; (4) allotments and community gardens; (5) green indoor areas, (6) blue areas; (7) green areas for water management; and (8) derelict areas. As previously mentioned, NBS is a relatively recent term and throughout the literature other terms are often used to discuss nature’s values, such as “green infrastructure”, “blue infrastructure”, “urban green spaces”, “natural areas”, “naturalistic landscapes” or more specific terms such as “ecosystem services” and “cultural ecosystem services”.

As summarized in Table 7, social and cultural values were linked to different types of interventions among all the different ecological domains except for “green indoor areas” and “derelict areas”, where information wasn’t found linking them to social and cultural values.



Table 7. Number of articles discussing social and cultural values connected to different types of NBS interventions.

Ecological Domains of NBS	Building greens (external)	Urban green areas connected to grey infrastructure	Parks and (semi)natural urban green areas	Allotments and community gardens	Blue areas	Green areas for water management	Derelict areas	Green indoor areas
# NBS referring social values	2	8	16	9	9	2	0	0
# NBS referring cultural values	2	9	19	8	11	2	0	0

NBS interventions are linked to social and cultural values in several ways. Figure 6 shows the number of social values referenced per ecological domain. Social values vary by NBS intervention. “Well-being values” are most commonly mentioned with regard to the “parks and (semi)natural urban green areas” and the “urban green areas connected to grey infrastructure” domain, and are present in every group of NBS interventions, apart from “derelict areas” and “green indoor areas”. “Social inclusion” is also relevant for all domains, and particularly so for “parks and (semi)natural urban green areas”, “allotments and community gardens” and “blue areas “. “Educational values” are also relevant for all ecological domains, and particularly emphasised related to “parks and (semi)natural urban green areas”, “urban green areas connected to grey infrastructure” and “allotments and community gardens”. Information on the social value of “derelict areas” and “green indoor areas” was not found.

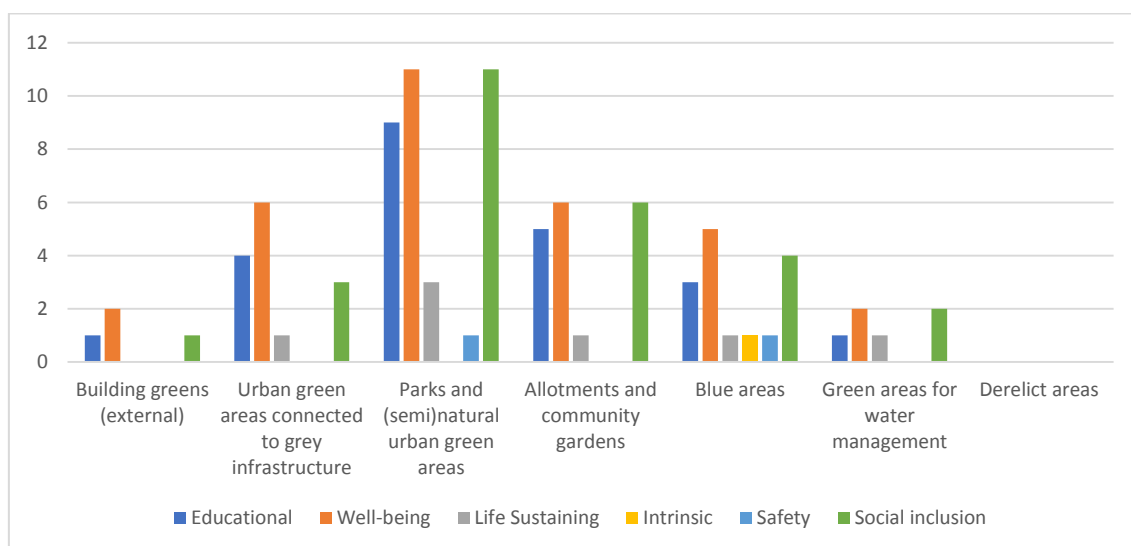


Figure 6. Number of social values identified in the literature reviewed per domains of nature-based solutions





As previously mentioned, educational and social inclusion values were the most commonly identified social values (Figure 4). Ioja *et al.* (2014) studied the importance of urban green infrastructure and green areas around schools in Bucharest, emphasizing the importance of urban green areas for educational facilities. Green areas around schools can support environmental learning of children and provide a basis for a greener school programme. The authors concluded that school green areas in Bucharest improve connectivity of green infrastructure and provide schools access to natural environments that can be used for educational and teaching purposes (Ioja *et al.*, 2014). In Barcelona Camps-Calvet *et al.* (2015) evaluated the influence of urban gardens. Their results suggest that this type of green infrastructure plays a role related to policy challenges in urban environments as well as in providing recreational opportunities that contribute to well-being, promotion of social connection and also represent important educational values. The role of fostering environmental awareness is a strong educational value that urban gardens represent and the authors suggest that has the potential to play a bigger role in Barcelona's green infrastructure policies (Camps-Calvet *et al.*, 2015).

In Helsinki a study focused on understanding how people value green roofs concluding that green roofs can improve social cohesion by posing interesting scenes as well as experiences and promoting contact with nature (Mesimäki *et al.*, 2017). Özgüner and Kendle (2006) examined community attitudes related to formal designs of urban green areas in Sheffield (having as example Sheffield Botanical Garden) in comparison with urban natural landscapes (such as a nearby public park, Endcliffe Park) and found that people experience and perceive differently the two. The results show that social values are more strongly represented in the public park than in the botanical garden. Respondents mentioned that they prefer "informal" and more "natural looking" settings that are also functional and social, where recreational facilities are available and is regarded as a space for people to socially interact (Özgüner and Kendle, 2006).

### **5.1.3 Cultural Values acknowledged regarding NBS**

From our final sample of articles 42 focused on social *and* cultural values and 38 referred cultural values of NBS. Figure 7 shows the mention of cultural values for each ecological NBS domain. The cultural values more prominent are "recreational" and "aesthetic" across most NBS groups, except for "building greens (external)" and "derelict areas". "Spiritual and religious" and "heritage and historic" values also seem to be present across most domain, apart from "building greens (external)" and "derelict areas", similarly to the situation with the "recreational" and



“aesthetic” values. Similarly to social values, no information on the cultural value of “derelict areas” and “green indoor areas” was found.

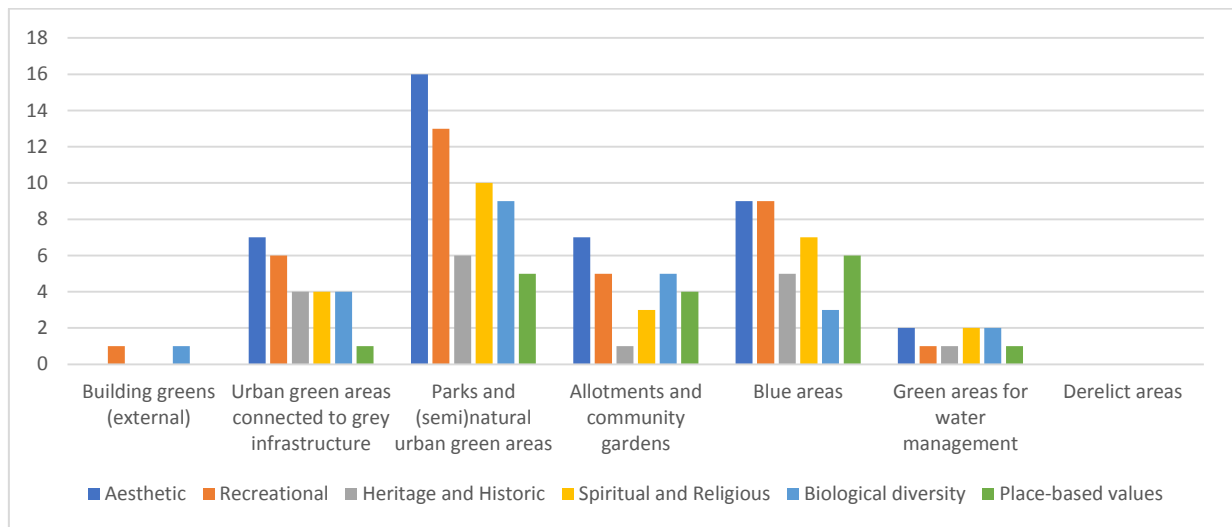


Figure 7. Number of cultural values identified in the literature reviewed per domains of nature-based solutions

According to Figure 4 (sub-section 4.1.), aesthetics were the most commonly identified cultural value, followed by recreational values. In South Africa Shackleton *et al.* (2015) studied how urban residents differentiate between the value of trees depending on whether they are found on public or private property in low-income neighbourhoods. Based on their research the aesthetic value of trees is more recognized in private spaces than in public settings, where the importance of trees is more associated with the provision of shelter and shade. In Gothenburg a study was carried out to assess the effects of naturalness, gender and age on the activities, well-being and aesthetics in urban green spaces and discovered that high levels of perceived naturalness are related with the attribution of greater aesthetic values as well as well-being by residents living near urban green spaces. Finding also indicate that women are more active in green spaces and perceive larger aesthetic values in green spaces compared to men, and that older population is more participative in nature-related activities in comparison with younger population and also acknowledge higher aesthetic values (Ode Sang *et al.*, 2016).

Bieling *et al.* (2014) aimed in their study at capturing the relations between human well-being and landscapes, with four case study areas in Germany and Austria. The authors propose that a strategy for promotion of human well-being should be built on the provision of opportunities for communities to secure contact with their natural surroundings. Their results stress the importance of recreation and they note that values (such as aesthetics, recreation, sense of place and cultural heritage) “are so closely interrelated that it is not possible to treat them as separate units” (Bieling *et al.*, 2014, p.28). Ives *et al.* (2017) also intended to capture residents’



values (e.g. aesthetic and social interaction values) of urban green spaces in Australia, and found that the proportion of mapped values marked by residents regarding green spaces of their local areas was the highest for “*activity/physical exercise (e.g. places you value because they provide opportunities for physical activity)*” (Ives *et al.*, 2017, p.34). Their paper stresses the need for land use planners to investigate which values are linked to specific landscapes and how this knowledge can assist decisions regarding urban green space planning.

### 5.1.5 Findings regarding the values of Nature

Studies concerning multiple types of social and cultural values of nature (Sherrouse, Clement and Semmens, 2011) (van Riper *et al.*, 2012) (Kenter *et al.*, 2015) (Vierikko and Niemela, 2016) informed the definition of value categories in the literature review. Table 9 provides examples for each of the six categories of social values used in our study.

Table 8. Categories of social values identified in the literature

Social Values	Examples	References
<b>Educational</b>	Opportunity to learn about the environment by observation or experimentation; environmental protection, awareness and greening activities; sharing wisdom and knowledge; research opportunities for educational purposes; formal and informal education; learning from nature; learning from direct experience of nature;	(Özgüner, Kendle and Bisgrove, 2007) (Sherrouse, Clement and Semmens, 2011) (Plieninger <i>et al.</i> , 2013) (Vierikko and Niemela, 2016) (Langemeyer <i>et al.</i> , 2015)
<b>Well-being</b>	Physical and mental health; therapeutic and recovery; access to welfare; healthy lifestyle; relaxation and stress reduction;	(Sherrouse, Clement and Semmens, 2011) (Graham <i>et al.</i> , 2013) (Bieling <i>et al.</i> , 2014) (Camps-Calvet <i>et al.</i> , 2015) (Kenter <i>et al.</i> , 2015) (Bryce <i>et al.</i> , 2016)
<b>Life Sustaining</b>	Opportunity for future generations to enjoy nature; nature’s ability to produce, preserve, purify, and renew air, soil and water;	(Sherrouse, Clement and Semmens, 2011) (van Riper <i>et al.</i> , 2012) (Graham <i>et al.</i> , 2013) (Karrasch, Klenke and Woltjer, 2014) (Uren, Dzidic and Bishop, 2015) (Vierikko and Niemela, 2016)
<b>Social inclusion</b>	Social cohesion and harmony; civic engagement; sense of community and identity; community-based activities (e.g. communal clean-up, river- bank greening and community gardening); citizen involvement, intercultural communication, communal self-reliance; community involvement; community spirit;	(Özgüner, Kendle and Bisgrove, 2007) (Graham <i>et al.</i> , 2013) (Dieleman, 2015) (Kenter <i>et al.</i> , 2015)(Vollmer <i>et al.</i> , 2015) (Fish, Church and Winter, 2016) (Matthew Dennis and James, 2016) (Vierikko and Niemela, 2016)



<b>Safety *</b>	General feeling of safety; sense of safety against natural hazards; feelings of hazard exposure, perception of personal safety; feeling safe and secure;	(Özgüner and Kendle, 2006) (Graham <i>et al.</i> , 2013) (Demuzere <i>et al.</i> , 2014) (Karrasch, Klenke and Woltjer, 2014)
	Negative aspects: elements of green infrastructure associated with crime; “trees provide hiding places for criminals”; loud and noisy disturbances; vandalism	(Plieninger <i>et al.</i> , 2013) (Shackleton <i>et al.</i> , 2015) (Mell <i>et al.</i> , 2016) (Ives <i>et al.</i> , 2017)
<b>Intrinsic</b>	Estimation of nature (e.g. forests) itself;	(Bryan <i>et al.</i> , 2010) (Sherrouse, Clement and Semmens, 2011) (van Riper <i>et al.</i> , 2012)

\*evidence of negative values found in the literature

As for cultural values, six categories were recognised as defined in section 1.4. Table 10 shows examples for each.

Table 9. Categories of cultural values identified in the literature

Cultural Values	Examples	References
<b>Aesthetic *</b>	Scenic attributes and preferences; nature’s beauty; enjoyment of sights, sound and smells; reflect personal tastes and pleasures; aesthetical experiences; naturalistic styles of landscape design;	(Özgüner and Kendle, 2006) (Özgüner, Kendle and Bisgrove, 2007) (Bryan <i>et al.</i> , 2010) (Sherrouse, Clement and Semmens, 2011) (van Riper <i>et al.</i> , 2012) (Plieninger <i>et al.</i> , 2013) (Bieling <i>et al.</i> , 2014) (Langemeyer <i>et al.</i> , 2015) (Cooper <i>et al.</i> , 2016) (Fish <i>et al.</i> , 2016) (Vierikko and Niemela, 2016)
	Negative aspects: “unmanaged nature”, “abandoned areas”, “meaningless lawns”; neglected, damaged, ugly, untidy;	(Weber, Kowarik and Säumel, 2014) (Vierikko and Niemela, 2016) (Ives <i>et al.</i> , 2017)
<b>Cultural heritage and Historic</b>	Traditions; historic importance of natural places; significance of cultural-historical values and traditions;	(van Riper <i>et al.</i> , 2012) (Graham <i>et al.</i> , 2013) (Plieninger <i>et al.</i> , 2013)
<b>Biological diversity *</b>	Biological richness; biological heritage; provision of fauna and flora; personal and community values on species, ecosystems, and biodiversity; wildlife conservation;	(Özgüner, Kendle and Bisgrove, 2007) (Sherrouse, Clement and Semmens, 2011) (van Riper <i>et al.</i> , 2012) (Laurila-Pant <i>et al.</i> , 2015)
	Negative aspects: negative attitudes towards types of vegetation; threatening biodiversity (particular species);	(John, Herbert and Paul, 1991) (Plieninger <i>et al.</i> , 2013) (Vierikko and Niemela, 2016)
<b>Recreation</b>	Activity-based values; tourism; outdoor and recreational activities; gardening;	(Bryan <i>et al.</i> , 2010) (Sherrouse, Clement and Semmens, 2011) (van Riper <i>et al.</i> , 2012) (Vollmer



		<i>et al.</i> , 2015) (Fish <i>et al.</i> , 2016) (Matthew Dennis and James, 2016) (Vierikko and Niemela, 2016)
<b>Spiritual and Religious</b>	Contact with nature; inspirational; spiritual connection; religious activities; nature sacred and religious places; experiences of fascination and connectedness which provoked a deep meaning to natural places; religious celebrations and pilgrimages;	(Özgüner and Kendle, 2006) (Sherrouse, Clement and Semmens, 2011) (Dieleman, 2015) (Cooper <i>et al.</i> , 2016) (Kenter <i>et al.</i> , 2017)
<b>Place-based values</b>	Contact with nature; sense of place within nature; regional belonging, how people feel about their surroundings, community cohesion; sense of belonging in natural areas;	(Özgüner, Kendle and Bisgrove, 2007) (Bieling <i>et al.</i> , 2014) (Karrasch, Klenke and Woltjer, 2014) (Langemeyer <i>et al.</i> , 2015) (Bryce <i>et al.</i> , 2016) (Fish <i>et al.</i> , 2016)

\*evidence of negative values found in the literature

Although the values of nature are mostly presented by the reviewed literature as positive and seen as benefits, some negative values were also identified. In some cases negative values are also seen as threats (Bryan *et al.*, 2010).

Vierikko and Niemela (2016) studied how socio-cultural values are perceived by different stakeholders and how local green and blue infrastructure could be addressed in urban planning. The results show a few interesting negative values attached to urban green and blue infrastructure, a park and a brook. These include negative values regarding water quality and flooding , including water foaming, discoloration, the presence of toxins), that lead to health concerns by locals. Negative aesthetic values were also identified such as “unmanaged nature”, “abandoned areas”, “meaningless lawns” and “closed views” of the brook by high shrubs and vegetation, as well as negative attitudes towards particular types of vegetation (Vierikko and Niemela, 2016).

Shackleton et al. (2015) studied the value of trees for urban residents in public and private spaces in low-income neighbourhoods in South Africa, where negative social values were clearly recognised. Some of the reasons why residents avoid visiting public parks and don’t allow their children to play outdoors were related to safety (e.g. “parks attract criminals”). Some elements of green infrastructure (such as trees and urban forests) are seen as associated with crime (“unsafe places because they are used for drug dealing”) and are regarded as a place of asocial



behaviour and a source of risk (e.g. trees provide “hiding places for criminals”, “locations for young men to play loud music and drink alcohol”) (Shackleton *et al.*, 2015).

Other studies also reflect on similar negatives of green space, including unpleasant feelings connected to aesthetic aspects (e.g. neglected, damaged, ugly, untidy) (Weber, Kowarik and Säumel, 2014) (Vierikko and Niemela, 2016) (Ives *et al.*, 2017), unpleasant dispositions (e.g. lack of shade or shelter, too hot or windy) (Ives *et al.*, 2017), thoughts about dangers or threats linked to urban green areas as well as noise as a form of disturbance (Plieninger *et al.*, 2013) (Shackleton *et al.*, 2015) (Ives *et al.*, 2017). Vandalism (Mell *et al.*, 2016) and concerns about potentially dangerous elements of biodiversity were also mentioned (e.g. insects, snakes, wolves) (John, Herbert and Paul, 1991) (Plieninger *et al.*, 2013).

Studies were also conducted regarding preferences of landscapes and perceptions of images of nature. Özgüner and Kendle (2006) studied the public perceptions and preferences of naturalistic landscapes in comparison with green spaces more formally designed in the UK and concluded that the public was able to clearly distinguish between the two types of landscape and recognised benefits from both. The results suggest that naturalistic settings represent greater benefits (e.g. experiencing feelings of freedom and naturalness), although in a more formal landscape design people reported safety as a better benefit (Özgüner and Kendle, 2006). Buijs (2009) studied the images of nature in the Netherlands and concluded that images of nature can be interpreted as mental notions that combine beliefs, values and value orientations. Also, five different images of nature were revealed: (1) an “wilderness image” related to the absence of human interference; (2) an “autonomy image” connected to nature’s regular processes; (3) an “inclusive image” of nature; (4) an “aesthetic image” with emphasis on hedonistic and aesthetic values; and, (5) an “functional image” regarding utilitarian values (Buijs, 2009).

## **5.2 Benefits of nature-based solutions**

While urban ecosystem services and NBS can provide significant benefits to the society, research on benefits and impacts of such solutions is often limited to monetary/economic evaluations or assessments based on self-assessed data reported by individual case-studies (Bell *et al.*, 2008) (Ordóñez Barona, 2015) (Hegetschweiler *et al.*, 2017) (Meerow and Newell, 2017). In this section, we provide an overview of various social and cultural benefits and review potential negative impacts of NBS based on the analysis of the state-of-the-art literature.



### 5.2.1 Statistical assessment of benefits of nature-based solutions

From the final sample of 98 articles, 65 described some type of social or cultural benefit of ecosystem services, natural areas and structures. The review found that while all 65 articles documented benefits related to social aspects, only 51 of these identified benefits related to cultural. Among the cultural benefits, recreational impacts were the most recognized (43 instances), followed by spiritual or religious and aesthetic (28 and 27 mentions respectively). Among the social benefits, 51 articles recognized health and well-being improving benefits and 40 found social interaction enhancing impacts. Benefits related to education were also mentioned in several articles (20 instances). Figure 8 presents the number of articles, which identified various cultural or social impacts/benefits of natural areas or nature-based solutions.

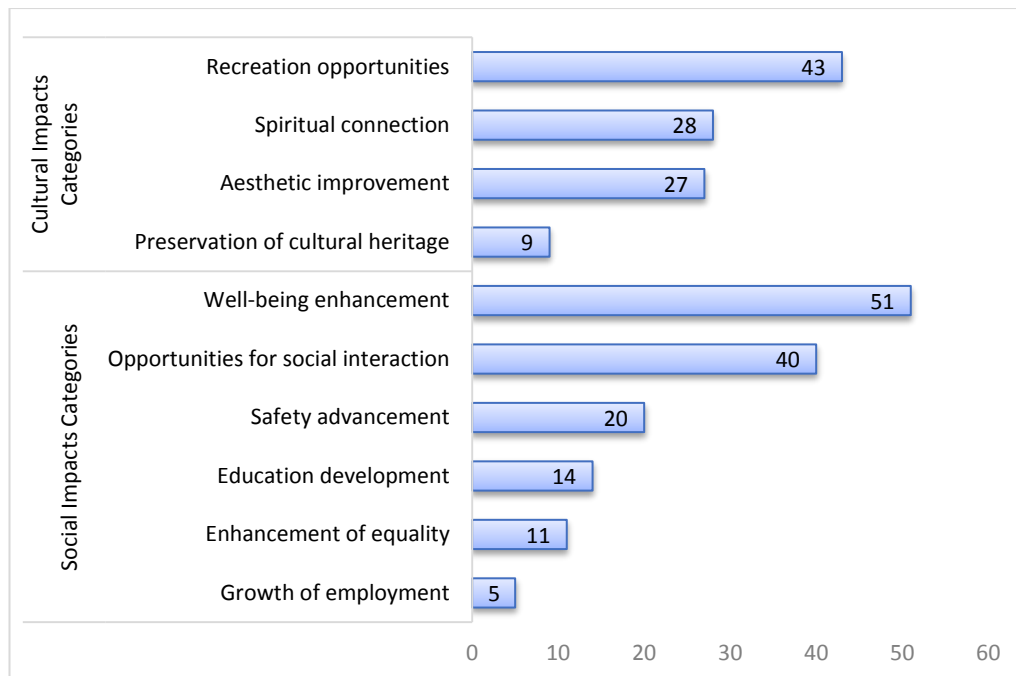


Figure 8. Number of references to various cultural and social impact in the studied literature.

As discussed in section 3.3., the majority of the articles dealt with the benefits of nature and nature-based solutions for local and often urban populations, while a few focused on impacts on more specified groups, such as residents of buildings (Madureira *et al.*, 2015) (Mesimäki *et al.*, 2017), gardeners and specialists (e.g. teachers, school administrators, researchers) (Camps-Calvet *et al.*, 2015) (M. Dennis and James, 2016) or children and youth (Iojă *et al.*, 2014). In some cases, they placed special focus on disadvantaged groups, such as the elderly, low-income people or immigrants (Demuzere *et al.*, 2014) (Vollmer *et al.*, 2015) (Heckert and Rosan, 2016). Gender and age differences were also discussed in a few cases (see (Buijs, Elands and Langers, 2009) (Ode Sang *et al.*, 2016)).



### **5.2.2 Social benefits from nature-based solutions**

Out of the 65 articles which identified social and/or cultural benefits social benefits or impacts were identified in 49 cases. More specifically, 39 articles out of 49 (almost 80%) recognised impacts related to health and wellbeing and almost 29 (60%) related to social interaction. Educational and safety impacts were recognised by 13 articles (over 25%).

While health and well-being impacts were the most covered, the lack of evidence for causal relationships between nature-based solutions and improved health were also recognized. For example, it was found that while proximity to urban parks could be helpful in motivating people to pursue outdoor activities and thus improve mental health in the short term and reduce obesity on the long run, it was also found that air pollution concentration in these areas could also be higher and thus impact health negatively (Gómez-Baggethun and Barton, 2013) (Demuzere *et al.*, 2014) (van der Hoek, Hartog and Jacobs, 2014) (Wolch, Byrne and Newell, 2014) (Vierikko and Niemela, 2016) (Hegetschweiler *et al.*, 2017). Although, more straightforward benefits were identified in connection with well-being and quality of life e.g., for handling heat stress during heat waves (Lafortezza *et al.*, 2009) (Hegetschweiler *et al.*, 2017), a study on the relationship between urban green spaces and happiness in Singapore did not find any straightforward linkages between the two and highlighted the need for additional research about the social and cultural impacts of urban parks in tropical regions (Le E. Saw, Lim and Carrasco, 2015).

The second most commonly identified benefit of green and blue infrastructure was the provision of opportunities for various social interactions. A study of green roofs in the Helsinki metropolitan area found that shared green roofs can provide a space for social interaction "*meeting friends and neighbours, having parties and cooking and eating together*" (Mesimäki *et al.*, 2017, p.594). The riverside of the Ciliwung river in Indonesia also functioned as a social space for the urban population performing domestic chores on bamboo platforms (Vollmer *et al.*, 2015). In addition, it was found that a shared, community-managed green space could also provide an opportunity for the urban population for practising participatory governance and thus increasing social inclusion (Douglas, 2016) (Vierikko and Niemela, 2016). Table 8 provides a summary of the number of articles discussing social and cultural benefits by ecological domain.





Table 10. Social and cultural benefits connected to types of NBS interventions.

Ecological Domains of NBS	Building greens (external)	Urban green areas connected to grey infrastructure	Parks and (semi)natural urban green areas	Allotments and community gardens	Blue areas	Green areas for water management	Derelict areas	Green indoor areas
# NBS referring to social benefits	7	11	23	11	12	5	2	0
# NBS referring cultural benefits	6	9	19	6	9	3	2	0

We also found some variation in the type of impacts identified by ecological domain. Health and well-being and social benefits were mentioned more frequently in connection with to green space, parks, urban forests and community gardens and less frequently related to blue spaces and integrated green-blue spaces (such as urban drainage systems). Aspects of safety, education and equality were highlighted somewhat more in connection to community gardens or allotments (in 4 out of 11 articles) than related to other types of NBS. For example, related to educational impacts, Demuzere *et al.* (2014) found that community gardens can provide “heterogeneous learning about environmental and social pressures”, while allotment gardens can open opportunities for “experimental learning”. Figure 9 shows the number of articles per domain of nature-based solution covered in this review.

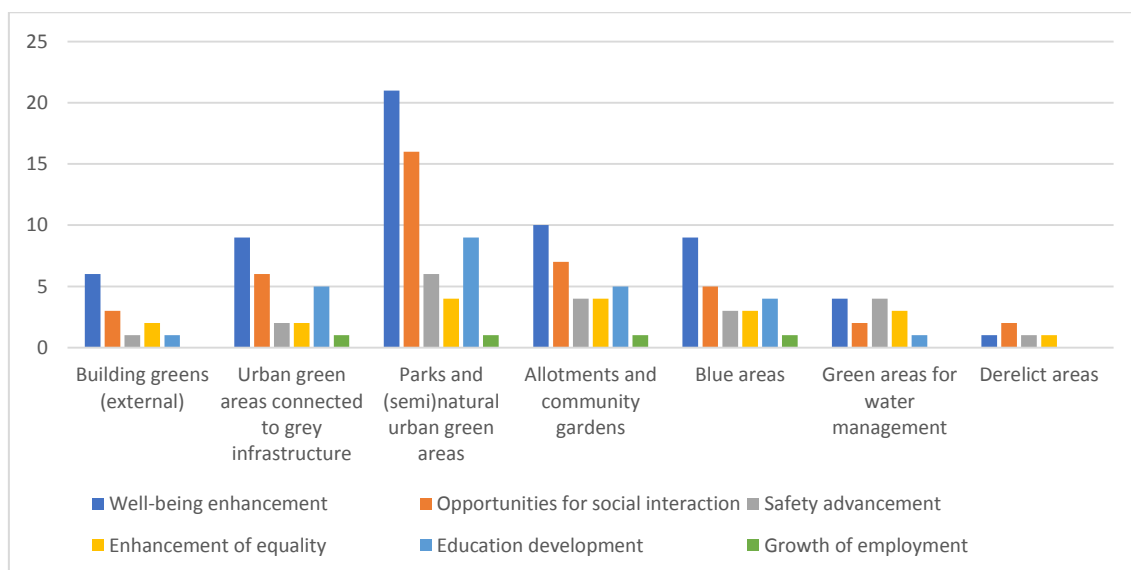


Figure 9. Number of social impacts, identified in the literature reviewed per domains of nature-based solutions.

### 5.2.3 Cultural benefits from nature-based solutions

37 of the reviewed papers identified cultural benefits of various green spaces, green or blue infrastructure elements. Recreational benefits were recognised by over 86% (32 instances), which were followed by aesthetic and spiritual benefits (19 and 17 instances, 51% and 46% of the studies, respectively).



Under “recreation” the articles meant active and passive activities, such as walking, hiking, swimming or relaxing. Several studies found that recreation was one of the primary reasons why citizens choose to visit an urban park, a community garden or a riverside (Vollmer *et al.*, 2015) (Madureira *et al.*, 2015) (Dou *et al.*, 2017). Studies also revealed that geography matters - people who live in the proximity of green or blue infrastructure are the primary beneficiaries. In the case of a green open space in Gorla Maggiore (Liquete *et al.*, 2015) found that the park is primarily visited by residents living less than 1500 m to the park. In the Berlin-Tempelhof park, which was a former city airport, a GIS based buffer analysis concluded that more than 180 000 people live within 1500 m of the park and thus can have direct access to it (Kabisch and Haase, 2014).

Aesthetic values of nature-based solutions were primarily studied in connection with green infrastructure, in many cases related to urban trees and parks (John, Herbert and Paul, 1991) (Weber, Kowarik and Säumel, 2014) (Shackleton *et al.*, 2015). In connection to roadside vegetation, a study by Weber, Kowarik and Säumel (2014) found that the citizens of Berlin and Cologne prioritized their aesthetic function, while Shackleton *et al.*, (2015) noted that the residents in low-income neighbourhoods not only appreciate the practical benefits of trees such as shade or fruits but as well their aesthetic provision. Besides their aesthetic benefits, 17 of the reviewed articles also found that green spaces or green infrastructures such as an urban forest area can offer direct contact with nature (Madureira *et al.*, 2015) and thus provide space for religious-spiritual experiences as many cultures identify these values with natural structures and the provided ecosystem services (John, Herbert and Paul, 1991) (Fish *et al.*, 2016) (Ribeiro and Ribeiro, 2016).

Cultural aspects of NBS were more difficult to capture and impacts related to safeguarding cultural and historical heritage were mentioned only by 6 articles. For example, in the coastal region of Krummhörn, Germany, it was found that land use planning approaches should consider the impact of measures on historical villages (Karrasch, Klenke and Woltjer, 2014). In Mexico, urban agriculture was found to have a positive impact on safeguarding cultural heritages and values as community gardening helped Mexicans establish connections with their historical, pre-colonial roots, providing an association to the traditional “Chinampas” or floating gardens (Dieleman, 2015). In China, urban parks provided gathering places to sing traditional Opera pieces in groups (Dou *et al.*, 2017).



With regards to the type of benefits identified and the ecological domains of NBS (Figure 10), we found the following:

- While most of the studied articles identified recreational impacts of NBS, in the case of building facades impacts were identified only in 80% of the papers.
- In the case of urban parks, fewer article identified aesthetic impacts, but more highlighted spiritual aspects.
- Aesthetic impacts of community gardens were identified in considerably fewer cases compared to other domains but all articles mentioned their recreational benefits.
- While aesthetic benefits and impacts of green infrastructure were relatively well-studied, fewer studies have noted such benefits or considered impacts in connection to blue infrastructure. See for example:(Vollmer *et al.*, 2015) (Dou *et al.*, 2017).

A summary of the mention of different types of cultural benefits by NBS domain in the papers reviewed is shown on Figure 10.

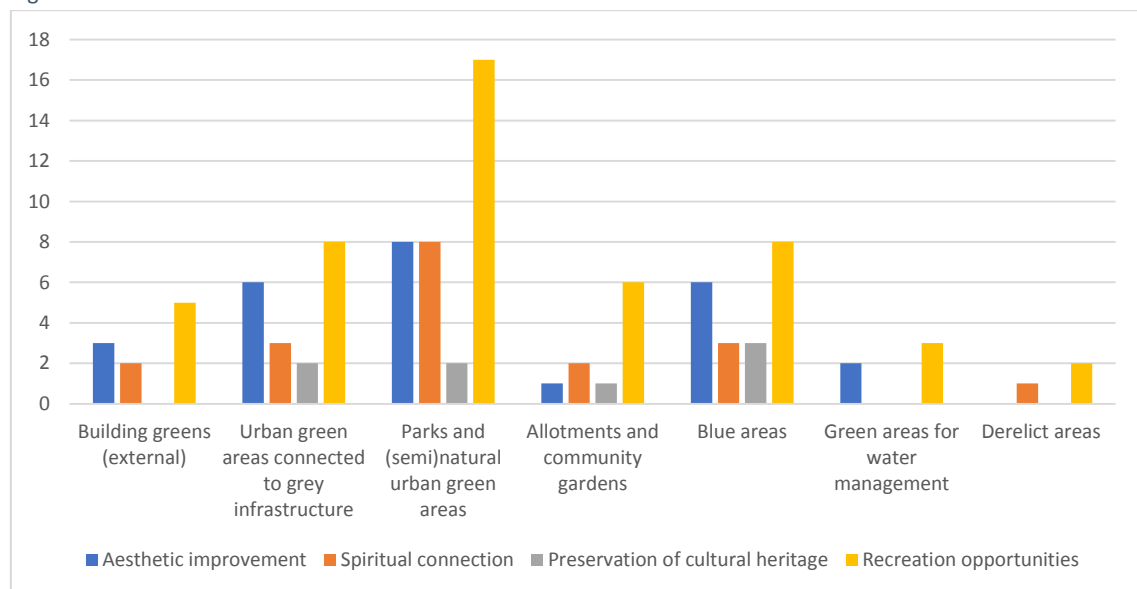


Figure 10. Number of cultural impacts, identified in the literature reviewed per domains of nature-based solutions.

#### 5.2.4 Ecosystem services as benefits provided by nature

Benefits of cultural and social services are part of the broader group of ecosystem services provided by NBS. However, given the existence of a distinct and significant body of literature discussing NBS from the urban ecosystem services point of view, the discussion of findings from this body of literature was found to deserve its own section.

As the overview diagram of the results of this review show on Figure 11, there is a slight dominance of cultural ecosystem services (38%) in this body of literature, followed by regulating services (24%), provisioning services (21%), and finishing with habitat and supporting services



(17%). According to papers that relate social and cultural values with ecosystem services, the subject of social and cultural values is directly generally associated with cultural services, including aesthetic values, place-based values, social identity and sense of community, well-being and educational values (Chan, Satterfield and Goldstein, 2012) (Gómez-Baggethun and Barton, 2013) (Oteros-Rozas *et al.*, 2017).

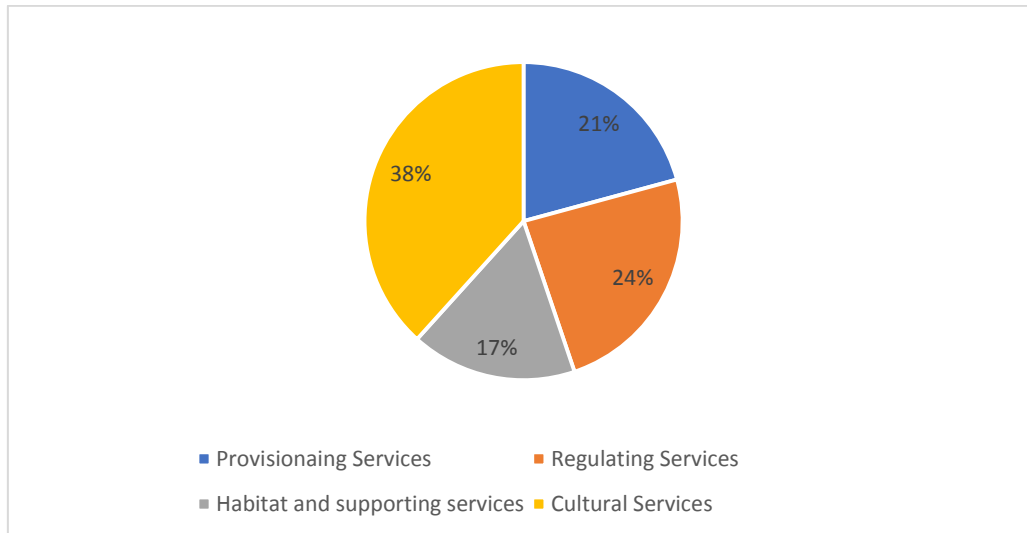


Figure 11. Percentage of different types of ecosystem services identified in the literature.

Besides delivering services, urban environments are also responsible for producing disservices, and can be particularly relevant in urban environments (Gómez-Baggethun and Barton, 2013). These are similar to negative values mentioned before. Since we are studying the social and cultural aspects of nature, disservices are presented mainly in the ES categories according to the TEEB classification, of habitat or supporting and cultural services. Disservices of ecosystems can be a result of rapid changes in ecological processes, (Lyytimäki *et al.*, 2008) and can be defined as “*functions of ecosystems that are perceived as negative for human well-being*” (Lyytimäki and Sipilä, 2009,p.311).

On the context of social and cultural services, some examples of ecosystem disservices in urban areas can be the psychological such as insecurity linked to neglected, dense and thickly vegetated green infrastructure (Saumel, Weber and Kowarik, 2015), noise and unpleasantness related to urban green space, reflecting security and damaged infrastructure ecosystem disservices (Plieninger *et al.*, 2013). Related to biodiversity and cultural heritage the risks of invasion by traditionally planted alien ornamentals can represent a cultural heritage-related ecosystem disservice (Saumel, Weber and Kowarik, 2015). This is not related to plants, as some



animals are perceived as a disservice or nuisance (e.g. rats, mosquitoes and wasps), especially where they compete for habitat with humans (Gómez-Baggethun and Barton, 2013).

Solutions for these ecosystem disservices can include the improvement of attractive streetscapes which can have the ability to promote social interaction and community cohesion as well as outdoor recreational activities that generally advocate well-being improvement. Concerning the habitat ecosystem disservices, solutions can involve habitats for aesthetically attractive species which represent vegetation of recognised regional identity. It can also involve the development of management options that involve public outreach to promote behaviour that can help accept and co-exist with indigenous ecosystem phenomena that were previously viewed as a nuisance (e.g. accepting re-wilded floodplain habitats in urban areas).

Disservices can occur in different types of public green spaces such as small groves, urban parks, private gardens and vacant lands and since these areas are shaped by social participants and multiple uses they are influenced by constant transformations (e.g. gardening and removing trees) (Shackleton *et al.*, 2015).

In the case of health-related impacts, some articles highlighted potential negative effects, such as allergies induced by wind-pollinated plants or accidents caused by falling branches (Gómez-Baggethun and Barton, 2013) (Demuzere *et al.*, 2014) (Wolch, Byrne and Newell, 2014). With regards to safety aspects, while green or blue infrastructure constructed for climate change adaptation can increase resilience and thus safety perception of communities, it was also found that the local population can feel unsafe in dark green park areas during nighttimes (Kuo and Sullivan, 2001) (Gómez-Baggethun and Barton, 2013) (Demuzere *et al.*, 2014). Lastly, in connection to aesthetics, the research found that large trees can have a negative impact on experienced scenic beauty by blocking views from buildings or by giving wild-grown vegetation can give an untidy impression to by-passers (Gómez-Baggethun and Barton, 2013) (Weber, Kowarik and Säumel, 2014)

Moreover, the indication of disservices in urban areas, particularly in green urban areas, can be perceived also as sign of overuse of some recreational service (Plieninger *et al.*, 2013). The assessment of disservices is not a straightforward practice since the valuation can be influenced by the subjective perspective evaluator. The same ecosystem function can represent for some people either a service or a disservice, underlining the recognition that ecosystem services and disservices are subjectively constructed *anthropogenic notions* (Lyytimäki and Sipilä, 2009).



### 5.2.4 Findings regarding the benefits of nature-based solutions

During our analysis, we distinguished six types of social and four types of cultural benefits defined in the sub-section 1.4. Cultural benefits categories include recreational, spiritual and religious, aesthetical benefits as well as benefits related to safeguarding cultural heritage. As for the social benefit categories, we distinguished health and well-being, social interactions, education, safety, equality and employment. Table 11 provides examples for each of the cultural and social benefits categories.

Table 11: Example of cultural and social impacts identified in the reviewed literature

Cultural Benefits	Examples of Benefits	References
<b>Aesthetic improvement</b>	Enhanced beauty Improved aesthetic quality of the landscape	(Ribeiro and Ribeiro, 2016) (Rall et al., 2017)
<b>Spiritual connection</b>	Provide sense of calm Benefits on affect and cognition Pleasure of experiencing nature Inspiration for art or culture Support exploration of religious feelings	(Fish et al., 2016) (Ordóñez Barona, 2015) (Vollmer et al., 2015) (Dou et al., 2017) (Mesimäki et al., 2017)
<b>Preservation of cultural heritage</b>	Impact on cultural-historical values Safeguarding or restoring cultural heritage	(Karrasch, Klenke and Woltjer, 2014) (Dieleman, 2015) (Ribeiro and Ribeiro, 2016)
<b>Recreation opportunities</b>	Provide opportunities for relaxation Enjoying nature Encourages physical exercise; Opportunity for outdoor activities	(Kabisch and Haase, 2014) (Liquete et al., 2015) (Dou et al., 2017) (Rall et al., 2017)
Social Benefits	Examples of Benefits	References
<b>Well-being enhancement</b>	Improve physical and mental health Increase physical activity Relieves stress	(Bell et al., 2008) (Demuzere et al., 2014) (Heckert and Rosan, 2016)
<b>Opportunities for social interaction</b>	Encourage child's play; Improved sense of community Meeting place for residents Participation and integration in decision-making processes, transparency Gender equity Feeling of collective activity	(Kabisch and Haase, 2014) (Karrasch, Klenke and Woltjer, 2014) (Dieleman, 2015) (Shackleton et al., 2015) (Vollmer et al., 2015) (Mesimäki et al., 2017) (Rall et al., 2017)
<b>Enhancement of Equality</b>	Empower disadvantaged groups Reduce social isolation	(Camps-Calvet et al., 2015) (Heckert and Rosan, 2016)
<b>Growth of employment</b>	Employment opportunities in recreation, nature protection and nature tourism	(De Vreese et al., 2016) (Mononen et al., 2016)
<b>Education development</b>	Provide formal education opportunities Provide informal learning opportunities about nature Raise awareness on nature conservation;	(Demuzere et al., 2014) (Ribeiro & Ribeiro, 2016) (Dou et al., 2017)



<b>Safety advancement</b>	Increased perception of safety Increased coping capacities/resilience with climate change	(Demuzere <i>et al.</i> , 2014) (Kabisch and Haase, 2014) (Karrasch, Klenke and Woltjer, 2014) (Heckert and Rosan, 2016) (Meerow and Newell, 2017)
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Although urban green areas are generally associated with improved well-being, this might not happen to the same extent across different climates. A study in Singapore to assess the use of natural parks by students revealed that access and use of green space did not significantly impact general well-being due to the tropical climate of Singapore. While sounding counterintuitive, the reason for this finding was that under tropical climates the shade provided by trees might not result in a cooler effect like in temperate regions due to high humidity. The authors point to the richness of biodiversity and higher availability of green space in Singapore which might not be so valued in this region with this high base as in other regions where access to green spaces is more scarce (Le E Saw, Lim and Carrasco, 2015).

## 6. Conclusions

In the literature reviewed for this paper 42 articles discussed values linked to nature-based solutions and 65 articles discussed benefits and impacts related to various types of nature-based solutions. The highest number of social and cultural values and benefits were identified for urban parks, followed by green space, community gardens and blue infrastructure. In terms of values nature and nature-based solutions, cultural aspects were identified more frequently than social aspects. As for cultural values, the highest number of references are related to aesthetics. In terms of social values of nature and nature-based solutions, educational and social interaction were identified by the highest number of articles. As for benefits, most of the social benefits and impacts discussed were related to health and social interaction. Cultural benefits were most frequently mentioned in relation to recreation.

While most of the literature identified positive values associated and benefits provided by NBS, negative aspects are also mentioned e.g. in connection to aesthetics, health and safety. Ecosystem *disservices* were also mentioned occasionally related to safety, aesthetics or health. However, we found that systematic evaluation of negative social and cultural impacts of and trade-offs related NBS has not been carried out yet and thus assessment practices of these should be developed in the future.

It also emerged from the literature review that understanding the diversity of perspectives based on the worldviews, social and cultural identities and interests of social stakeholders is an



important consideration. The values and benefits/disbenefits associated with NBS are socially constructed and embedded in complex contexts with unique socio-ecological, institutional and political realities that all shape how NBS are perceived and handled. Studying the benefits and impacts of NBS by age group, gender and by cultural groups can bring important lessons about how social position and stratification influences the valuation and management of urban nature and natural structures. Moving from case-study based, one-off evaluations to systematized, regular assessments of nature-based solutions should therefore also consider the role of different stakeholder groups.





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