

The power of societal stakeholders for scaling-up nature-based solutions

A case study in Spain.



Master thesis

Student: Andrea Lituma (6238343)
a.v.litumasanchezchecha@students.uu.nl
andrealituma@gmail.com

Faculty: Geosciences
Programme: Master of Sustainable Development
Track: Earth System Governance

Course: GEO4-2321 (45 ECTS)
Supervisor: Dr. Sander van der Jagt
Second reader: Dr. Hens Runhaar
Date: July 14th, 2019

Acknowledgments

Several people have contributed to the development of this thesis. First, I would like to express my gratitude to my supervisor at Utrecht University Dr. Sander van der Jagt for his time, consistent feedback and motivation. His continuous guidance and encouragement have been key to the thesis writing process.

I would also like to thank my second reader Dr. Hens Runhaar for his feedback on the research proposal and assessment of my thesis.

A special thanks to all the interviewees, for taking time from their busy agendas to participate in this research, showing enthusiasm and even suggest other relevant participants. Their input has been of most importance to this research. My gratitude goes to the Urban Ecology Agency of Barcelona, for welcoming me into their office, and allowing me to accompany them in their day-to-day activities.

Abstract

Cities are places and spaces where solutions can be created, tested, and scaled. In urban contexts, actor configurations often create innovations worth investigating, especially considering the unsustainability pressures. These stakeholders can influence the transition to more sustainable practices. Nature-based solutions offer cost-effective, innovative and responsive forms of urban management. Polycentric governance arrangements tend to enhance innovation, learning, adaptation, trustworthiness, levels of cooperation of participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales. Although asymmetric qualities of power have the capacity to affect the outcomes of polycentric governance, academic research has given more attention to the structural patterns of networked institutions in polycentric systems than the configuration of power relations across those networks.

This research aimed to further understand the extent to which the power relations between different societal stakeholder networks serve as a driver or barrier for the process of scaling-up urban NBS. This research started by drawing on the concept of power, the conditions that provide its attainment, as well as the relations between different stakeholders in polycentric networks, to later on assess their impact on the six elements of effective scaling-up. This research has focused on Spain as a case study. The data collection phase included the triangulation of desk research, in-depth and semi-structured interviews and a placement.

This methodology helped identify and analyse four polycentric networks of stakeholders, including those who are usually not associated with particular urban NBS projects. One stakeholder was present in all identified polycentric networks regardless of the city assessed: the municipality. Societal associations had presence in three polycentric networks, and findings suggest that such presence empowers the citizens, enabling them to improve both communication within the associations and participation processes with municipalities. Results have shown that the power relations exercised by a stakeholder within a polycentric network can be interpreted as a driver for the following three elements of effective scaling-up: *incorporating scaling-up considerations into project planning*, *building capacity* and *building linkages*. Two elements have been interpreted as barriers *engaging in dialogue* and *funding*.

The first barrier identified is the lack of efficient communication to engage in dialogue leading to bureaucratic constraints and delays; the second is the sporadic prioritization of the urban NBS implementation. The power relations have not been considered to have any influence on the element of *information and learning*, thus it cannot be considered a driver nor a barrier.

Key words: polycentric governance, power, scaling-up, nature-based solutions, societal stakeholders

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1. Introduction

1.1. Introducing the topic

The environmental footprint of cities extends well beyond what is sustainable. There is an urgent need for urban areas to adapt to climate change. More than half of the world's population lives in urban areas, and there is a projected urban population of 60% by 2030 (Brink et al. 2016; Camps-Calvet et al. 2016). Cities hold most of the economic assets and are responsible for most economic and institutional activity (Brink et al. 2016). Moreover, urbanisation itself is often a driver of risks (e.g. flooding and heat islands due to soil sealing) (Brink et al. 2016; Rueda 2019). The urban environment alters deeply the quality of air, soil and water, as well as the hydrological regime, facts that lead to the loss of habitats and/or accommodation of the urban species to the specific conditions of the city (Rueda 2019). Additionally, the impacts of climate change on health and wellbeing are extremely serious in cities (Moglia et al. 2018).

According to Rueda (2019), it can be affirmed that cities generate the greatest impact on the planet and, therefore, the battle of sustainability will be won or lost based on the urban organization and management that will be developed from now on. However, most response efforts by cities worldwide have focused on mitigation and much less on adaptation, leading to high social, infrastructure and economic costs of inaction (Castán Broto and Bulkeley 2013; Depietri and McPhearson 2017). In response, cities themselves have become involved, as actors, in local and international climate governance interventions, experiments and networks. This is illustrative of polycentric governance – albeit that cities and the networks they form can best be understood as units within a polycentric system (Dasgupta 2010; van der Heijden 2018). Cities are places and spaces where solutions can be created, tested, and scaled. In urban contexts, actor configurations often create new realities worth investigating, especially considering the unsustainability pressures. These actors can influence the pace of change to more sustainable practices, lifestyles and living in cities of the future (Frantzeskaki et al. 2017).

Polycentric governance arrangements tend to enhance innovation, learning, adaptation, trustworthiness, levels of cooperation of participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales (Ostrom 2010b). Therefore, societal actors, such as businesses, NGOs and individual citizens are attributed a high degree of autonomy within polycentric governance (Wurzel, Liefferink, and Torney 2019). Ostrom (2010b) characterized polycentric systems as “multiple governing authorities at differing scales rather than a monocentric unit. Each unit within a polycentric system exercises considerable independence to make norms and rules within a specific domain (such as a family, a firm, a local government, a network of local governments, a state or province, a region, a national government, or an international regime)”. Polycentric systems have considerable advantages given their mechanisms for mutual monitoring, learning, and adaptation of better strategies over time. Stemming from this mutual learning process, successful experiments can provide innovations that may be scaled-up in subsequent phases. Scaling-up, in the context of the present research, refers to adjustments in

governmental frameworks for the structural supply of money, materials or expertise, such as innovative bottom-up solutions (Buijs et al. 2018).

However, evidence from polycentric experiments in urban planning for climate change has shown that the inclusion of businesses and other potentially relevant sectors is currently not strong enough addressed in the polycentric governance approach (Morrison et al. 2017). This could be due to the role that power may play in undermining the advantages of polycentrism over other forms of governance. Finally, research has also shown how the asymmetric qualities of power, when left unchecked, can affect the outcomes of polycentric governance (Morrison et al. 2017). Therefore, the changing relationships of power at all levels (Morrison et al. 2017), as well as the capacity to execute power amongst actors and stakeholders (Buijs et al. 2016) are critical to understanding governance outcomes.

There is a growing body of research around how governments and stakeholders share and “distribute” power through multilevel governance arrangements (MacKenzie, Pearson, and Pearson 2018). Roe and Mell (2013) concluded that environmental management by stakeholders appears to be hindered by an imbalance in stakeholder power (although all stakeholders were discharging their legal obligations correctly) and, associated with this, the fact that a major stakeholder was acting in more than one role.

In order to gain further knowledge about the power conditions, this research has assessed the up-scaling capacity of successful Nature-Based Solutions (NBS). NBS *“aim to help societies address a variety of environmental, social and economic challenges in sustainable ways. They are actions which are inspired by, supported by or copied from nature (...)”* (European Commission, 2015, p. 24). In urban landscapes, the co-benefits of NBS are being increasingly recognized as a result of increased provisioning and improved availability of urban green spaces. Such benefits include, for example, improved quality of life, mental and physical health, and reinforced cultural identities, supporting a sense of belonging and place (Kabisch et al. 2016). Furthermore, it is important to mention, that for the purpose of this research, the latter definition of NBS has been complemented with the following statement: *“The emphasis is on addressing challenges (...), NBS are deliberate interventions that seek to use the properties of nature to address urban challenges”* (which have the ability to be cost-effective and provide benefits (environmental, social and economic) while supporting resilience building (Almassy, Pinter, and Rocha 2017).

The concept of NBS has recently been highlighted as a key concept in policy and management in achieving alignment of environmental and societal goals (Pauleit et al. 2017). By working with nature as a core delivery goal, rather than against it or as an afterthought, investments in NBS can offer cost-effective, innovative and responsive forms of urban management which can support a greener and more sustainable growth in Europe’s cities (GreenUP 2018). NBS include innovations in areas such as green space planning, waterfront redevelopment, neighbourhood redevelopment and more (Fan et al. 2017). They have potential to provide multiple benefits across a range of sustainability challenges facing cities – such as managing floodings, supporting improved health outcomes or create places for social interaction and recreation” (Almassy, Pinter, and Rocha 2017). Allocation of NBS projects requires a closer assessment of the specific urban

morphology and characteristic of the local population to arrive at holistic and targeted solutions. It also requires the consideration of different power structures and social inequalities (Kabisch et al. 2017).

NBS has been deemed useful for this research, given that scholars have highlighted the importance of multidisciplinary and inclusive partnerships in fostering the uptake of NBS. These partnerships can result in the creation of synergies between different actors by bringing together resources, skills and knowledge. Thus, collaborative processes with the local population, between businesses and between different policy domains is recommended as a way forward (Kabisch et al. 2017). Finally, NBS have a key role to play in achieving a future compact city that is liveable and sustainable (Emilsson and Ode Sang 2017). Given that NBS is broad in definition and scope, it can be considered as an umbrella for Ecosystem-based adaptation, Green Infrastructure (GI) and Ecosystem Services (ES). Expanding governance-based approaches for GI may also advance the development and implementation of NBS via activities initiated by civil society, and in turn, GI may benefit from closely connecting it to the NBS to re-emphasize the importance of biodiversity (Pauleit et al. 2017). This approach has not been applied to the NBS context yet, it has mainly focused on the implementation of GI; however, it could also be a helpful approach to the implementation of NBS.

1.2. Scientific & societal relevance

This MSc thesis explores the role of polycentric governance on the development, experimentation and scaling-up of NBS. It analyses how the power relations of their relevant stakeholders interact directly with civil society to achieve their own goals.

Although research has been conducted regarding the process of scaling-up of urban green infrastructure as NBS and the stakeholders involved within that process (Buijs et al. 2018), the concept of power has not yet been included within those frameworks. The scientific relevance of this research is that it can contribute to new insights and opportunities about environmental, social and economic challenges at national and municipal levels.

Furthermore, the topic of this research performs an analysis of the power relations between different stakeholders groups within polycentric governance, in order to enable more efficient scaling-up processes for urban areas to develop more sustainably, identify and implement innovative solutions that are context-specific and thus allow to adapt to the challenges of the future, as well as improve the performances of current policy measures. Future development, implementation, and practice of NBS would be enhanced by recognizing how power is mobilized to achieve goals, and in whose interest it is exercised.

1.3. Knowledge gap

Decision making in complex governance systems is inextricably linked to questions of power (Marquardt 2017). The current research and literature available on polycentric governance does not clearly address the influence of the power relations between the different

stakeholders. According to Morrison et al. (2017), polycentric governance involves both a configuration of institutions and power, the structural patterns of networked institutions in polycentric systems have received far more attention than the configuration of power relations across those structures. In addition, people in the “classical” institutions may be afraid of losing power and, therefore, oppose more polycentrism (Huiteima et al. 2009). Therefore, a more analytic interrogation of not only how power is distributed across polycentric systems but also how power is mobilized to achieve effective systems and how it affects policy and management design is needed.

By understanding how power is perceived and shared amongst stakeholders, assessing the potential consequences that shifts in power relations may have (Buijs et al. 2016), and accounting for this in policy frameworks, nature-based interventions can be made more likely to scale-up in inclusive ways. Also, according to a literature review on NBS for resilient landscapes and cities that identified five specific challenges for the future of NBS, empirical studies are needed to assess the benefits of NBS scaling-up (Laforteza et al. 2018). Additionally, by gaining further knowledge about the power relations between different stakeholders, the development of beneficial power relations could be fostered in other contexts. This could help encourage more efficient adaptation actions that would help the cities to deal with some of the unsustainability pressures.

1.4. Research objective and research questions

The research objective is to further understand the extent to which the power relations between different societal stakeholder networks serve as a driver or barrier for the process of scaling-up urban NBS and what characterizes those dynamics, by identifying and analysing different actors, including those who are usually not associated with particular NBS projects.

This research objective leads to the following main research question:

How can the power relations between different societal stakeholder networks serve as a driver or barrier for the process of scaling-up urban NBS and what kind of dynamics characterize those relationships?

To progressively build up the answer to the research question, four sub-questions (SQ) have been formulated:

1. *Which are the polycentric networks of stakeholders involved in the implementation, decision making and resource allocation for urban NBS implementation?*
2. *What kind of urban NBS are these networks currently developing?*
3. *Which types of power and interactions are exercised within the identified networks of stakeholders?*
4. *Can the identified types of power relations be interpreted as drivers or barriers for the process and outcomes of scaling-up urban NBS?*

For the main research question, scaling-up and its elements are considered the dependent variable, and the independent variables are the power conditions: exercise of power and power relations. The definition of these concepts and the conceptual framework that brings these key concepts together will be explained further in chapter 0, and the operationalization of variables in chapter 3.3.

In order to be able to assess this research objective and questions, empirical research using the case study research method has been conducted. The case study selected for this research is Spain. This selection will be further justified in the following section.

1.5. Case study selection: Spain's context

This case study is focused on Spain. Spanish city models are not different from other urban systems. Until a few decades ago they were compact cities, with a high mix of uses and functions, reasonably efficient and with good social cohesion. The countryside and the city were visualized as perfectly distinguishable and complementary entities. At this moment there is an explosive occupation of the territory, producing the dispersion of the city and, with it, the fragmentation of the natural spaces with the consequent loss of biodiversity, the impermeabilization of immense surfaces, the distortion of the water cycle, the loss of many landscape values, increasing consumption of materials, water and energy and, with it, an emission of huge amounts of atmospheric pollutants (Rueda and Perlado 2012). Given these challenges, Spain's national government, as well as several regions and cities (e.g. Barcelona, Madrid, Valencia, Vitoria Gasteiz) have taken multiple actions in the past years, that have deemed the country relevant for this research. These cities, their actions, and initiatives were identified during the literature research as relevant for the topic of this research. The information in this subsection points out the importance that urban regeneration is playing in urban development in various cities in Spain.

Spain has a predominantly Mediterranean weather, in which rainfall is scarce, and it only rains a few times a year, but this amount of rainfall conveys the risk to generate flooding if not managed appropriately (int.5, int.11, int.18). Therefore, the impermeabilization of cities exacerbates these risks. On 2012 Spain published the Green Book on Urban and Local Sustainability, with the aim of moving towards a more sustainable city model. It does not make a specific reference to GI or NBS. However, it does mention the adverse impact that fast growing cities have had on natural environments and sets objectives for more sustainable urban development; the urban environment must have a strategy of relationship with the rural environment in which the building must play an essential role as a physical support of the elements of this strategy: facades and green roofs, interior patios (Rueda and Perlado 2012).

On 2017 the "Scientific-technical bases for the State Strategy for green infrastructure and ecological connectivity and restoration" was approved, this document was prepared as a first step towards implementing the project Elaboration of the State Infrastructure Strategy Green and Ecological Connectivity and Restoration, promoted and financed by the Ministry of Agriculture and Fisheries, Food and Environment. This Strategy aims to highlight the

complete dependence that human beings have on the processes that occur in ecosystems, on biological flows between habitats and, ultimately, on biological diversity. The green infrastructure must, therefore, consider the ecological, social and cultural peculiarities of each region and at the same time ensure a sustainable development that respects the ecological processes. However, to achieve this purpose requires greater environmental awareness and a true involvement of local populations and governments in the use of the territory (Valladares Ros, Gil Hernández, and Forner Sales 2017).

The Spanish Urban Agenda was released in 2019 and is expected to have some influence over urban decision-making related to NBS (int.1, int.2). The identification and mapping of municipal green infrastructure is one of the three goals specified as part of this strategic objective. The document also refers to the National Strategy on Green Infrastructure, which is developed with input by the Ministry of Development as well as the good practice by the Network of Local Governments + Biodiversity on renaturalizing vacant land in cities (Ministry of Development 2019).

The Urban Ecology Agency of Barcelona [*Agencia de Ecología Urbana de Barcelona*] from Spain has also come up with a new city model, composed of an urban cell of 16/20ha or 3x3 blocks that is called “superblock”, that has the adequate dimensions to develop and integrate the set of principles and objectives and which arises as the basis of a new urban and functional model in the cities. It is a cell of nine blocks, defined by a network of basic roads that connects origins and destinations of the whole city. These actions liberate a considerable surface of public space, which is nowadays occupied by traffic and, at the same time, guarantee the functionality and organization of the system. As a result, the neighbourhood streets will have a significant decrease of noise or pollution, etc. and allow more than the 70% of space that is currently occupied by the through traffic for nature or movements by foot or bicycle (Rueda 2019).

Additionally, on 23rd of April 2019 the Government Department of Environment and Mobility, the Municipality of Madrid, authorized the exclusive and free use of plots of municipal ownership classified as a green area for use as an urban garden for associations or non-profit entities, in order to meet environmental, social-community, educational, healthy, identity and sense of belonging of the neighbours with the neighbourhood, and landscaping (Sabanés Nadal 2019). All of them within the framework of the objectives of education and environmental participation projects developed by the Madrid municipality. There are several compromises to be made from the citizens regarding the cultivation of the urban garden, such as organic farming. Likewise, in order to guarantee the efficiency and savings in water consumption, efficient irrigation with standardized limits has been imposed. The plots will be delivered with basic conditioning to allow the beginning of the project. These urban gardens will be equipped with basic infrastructure at the time of its transfer, consisting of land conditioning, tillage, and subsoiling in excessively compacted soils, the contribution of topsoil and manure, perimeter fencing with double-leaf access door, installation of information panel, water connection for efficient drip irrigation.

1.6. Research outline

The first chapter presents the introduction to the topic of the research, the knowledge gap to be addressed along with the research objective and the research questions, and the case study context (see Figure 1). The theoretical background of key concepts is elaborated upon in chapter 2, it also gives further explanation of the framework of analysis. This includes polycentric governance, scaling-up and lastly power and stakeholders. The elements of effective scaling-up, as well as power conditions, are explained in detail, including the assessment between different stakeholder groups power exercise and its relations (these factors have been considered the effective scaling-up variables). Second, the methodology and research strategy are explained in chapter 3. Chapter 4 provides detailed case study descriptions as the results of the research are analysed from data collected through literature analysis, interviews and placement, this is followed by an assessment of the identified types of power relations. Chapter 5 addresses the discussion and answers the central research question, elaborates on the theoretical implications, as well as the limitations of the research, and future research recommendations. Finally, chapter 6 provides a conclusion on the power relations as drivers or barriers found for the process and outcomes of scaling-up urban NBS.

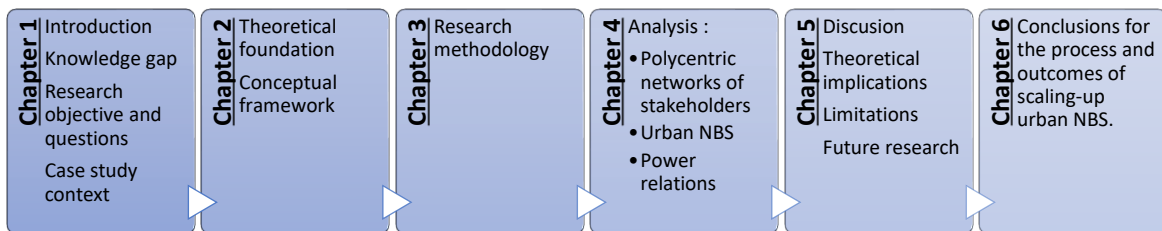


Figure 1: Research outline

2. Theoretical foundation

In order to assess the up-scaling results of successful innovations and the power relations between different stakeholder groups, this research has drawn from the following concepts and scientific aspects: polycentric governance, scaling-up, and the power of stakeholders. This section presents an overview of those concepts and finally, introduce the conceptual framework for assessing the research sub-questions.

2.1. Polycentric governance

Polycentric governance systems refer to structural arrangements of governments and non-government stakeholders that have multiple and overlapping, semiautonomous centres of authority or decision-making, within a shared system of rules (Heikkila and Weible 2018). Participants in a polycentric system have the advantage of using local knowledge and learning from others who are also engaged in trial-and-error learning processes (Ostrom 2010b). Polycentric governance systems must fulfil at least two criteria to function as such: the presence of multiple centres of decision making and coordination by an overarching system of rules (Ostrom 2010b, 2010a; Pahl-Wostl and Knieper 2014). Coordination and rules emerge from interactions rather than being imposed by one powerful actor (Pahl-Wostl and Knieper 2014). Self-organization was recognized as a fundamental basis in polycentric systems by Ostrom (Ostrom 2010a; Pahl-Wostl and Knieper 2014). Given that polycentric governance fosters the achievement of more effective, equitable, and sustainable outcomes at multiple scales (Ostrom 2010b), acquiring knowledge about their topic of interest, in this case, urban NBS implementation, can empower actors and help them to influence others. Such actions can include exposing asymmetric power dynamics through new information, advocating changes to societal norms or government and industry policies or rules, mobilizing new interest groups and coalitions, and generating other forms of countervailing power (Morrison et al. 2017). Additionally, given the configuration of polycentric regimes, one of the goals is to redistribute decision-making power to other actors and levels of government, yet this is rare in practice (Morrison et al. 2017).

Identifying relevant stakeholders at the global, the national and the subnational level as well as their interaction dynamics poses a first important step for analysing and better understanding polycentric systems. Leaders and pioneers can have an impact on other actors in polycentric governance structures in many ways i.e. exert pressure on potential followers or offer a good example for others to follow. They can thus help to spread or upscale innovations (Jordan et al. 2018).

Most definitions of GI emphasize that it was introduced as a planning concept to improve “urban green space systems as a coherent planning entity”, and it can help develop strategic approaches for systematically integrating NBS into urban development at various scales (Bissonnette et al., 2018; Kabisch et al., 2017).

2.2. Scaling-up

It is institutional in nature i.e. getting institutions to accept and internalize the underlying principles of innovation, and involves multi-actor partnerships (from the level of grassroots organizations to policymakers, donors, development institutions, and investors at international levels) (Pachico and Fujisaka 2004; Raymond et al. 2017). Social and political connectivity is crucial for active citizenship to imbue its full transformative potential (Buijs et al. 2018). Also, according to Jordan, Huitema, van Asselt, and Forster (2018), the up-scaling of adaptation policies is most likely to occur in cities and subnational units as they have more experience with this polycentric governance.

Studies of socio-technical transition have referred to scaling-up from experiments most explicitly. They generally refer to upscaling from innovation experiments or projects as not only the growing level of adoption, but also the changing social and institutional context, or the growing alignment of technologies, actors and institutions (Dijk, de Kraker, and Hommels 2018).

According to Wamsler (2018) mainstreaming strategies can complement and reinforce each other. During the mainstreaming process, it is also important to facilitate policy learning to find new ways to integrate the lessons to urban planning and policy development processes and in this way, embed innovations into urban planning and governance (Raymond et al., 2017). Some innovations can produce additional co-benefits when up-scaled. This characteristic can be used to promote scaling-up interventions and demonstrate their contribution to broader and multiple policy goals. For example, although green roofs (NBS) may be locally incentivized for their thermal benefits, when scaled-up to a catchment area, they can create additional benefits in terms of habitat for wildlife or water regulation (Raymond et al., 2017).

2.2.1. Elements of effective scaling-up

Six key strategies have been identified by Pachico & Fujisaka (2004) for scaling-up. These strategies have been identified and discussed during workshops, based on participants' experiences focused on innovations emerging from agroforestry research. They drew on case studies to identify key principles involved in spreading technical and social innovations to rural areas. The authors recognize that most innovations are more knowledge and management intensive. They require adapting knowledge and innovations to end-users, be they citizens, farmers or institutions, and to variable conditions. Similarly, they recognize that adaptation and application of innovations to different contexts requires understanding the knowledge and principles underlying the innovation, and finally, this understanding is achievable through capacity building.

This framework has been considered appropriate for the scope of this research, given that the basis of the analysis by Pachico & Fujisaka (2004) has a solid foundation on a participatory processes assessment from several innovative case studies. The implementation of urban NBS by societal stakeholders stems also from innovation processes, so although the context where these six elements were identified was related to

a different field of innovation, the basis of the framework is innovation strategies for scaling up, and thus these elements have been identified as relevant for this research.

The six strategies are detailed as follows:

1. Incorporating scaling-up considerations into project planning. To increase the impact of research, scaling-up must be considered from the beginning of the research and planning process. This implies:

- Building scaling-up strategies into the nature development process and including them in project proposals can ensure that these considerations are given full attention throughout the life of the project. There is a better likelihood of scaling-up if key opportunities and challenges are identified at an early stage, thereby allowing key channels for scaling-up research activities and development outcomes to be identified.
- Involving stakeholders as decision-makers from the beginning of the innovation process is crucial in identifying real priorities, and in developing appropriate solutions to problems. Therefore, research outputs (technologies, processes, methods) are shaped at an early stage of the project in collaboration with stakeholders and users and can subsequently be adapted throughout the project.
- Better use of extrapolation methods—linking different methods (geographic information systems [GIS], or modelling). In expanding the impacts of research outputs, it will be critical to use different methods.

2. Capacity building. In order for complex innovations to be adapted and applied in a variety of different contexts, those involved need to have a good understanding of the knowledge and principles underlying the innovation. This implies rigorous capacity building of staff in local institutions, developing skills and building the adaptive capacity mentioned above within local institutions and local communities. Basically, capacity building aims at developing capacities to empower the technician or person.

- This process often occurs implicitly in the participatory research process but needs to be made explicit in scaling-up. Capacity building is an important strategy, especially in the implementation and exit stage, to internalize new ideas within communities and institutions. This involves building the capacity to sustain and replicate the process. It is critical for stakeholders to understand that the underlying principles behind an innovation can help cope with changing environments, and in addressing arising problems. Finally, strengthening local capacities empowers local communities, and helps create broad-based support and effective local implementation of scaling-up activities.

3. Information and learning. In order to ensure informed, effective, and appropriate decision making by a wide range of stakeholders in the scaling-up process, it is important to invest in a process of documenting, drawing lessons and experiences, and also undertaking corrective measures throughout the project cycle. Learning and corrective loops should be central to scaling-up processes, in deciding what should be scaled-up and how this might be achieved, and in providing validated evidence to influence policymakers. This element focuses on the process of gathering information that can be used as indicators or impact assessment to improve the project development. This involves several aspects:

- Participatory monitoring and evaluation, which involves identifying indicators of change and building a process to monitor and evaluate change, and to measure the impact and process of scaling-up

- Effective impact assessment will also be necessary in order to learn from, and gain credibility on, the effectiveness and extent of the impact of innovations, and to provide validated evidence to influence decision-makers at different levels.

4. Building linkages. Developing partnerships and strategic alliances with other stakeholders (private sector, NGOs, governmental organizations [GOs], communities) is one of the essential strategies for successfully scaling-up innovation. This will increase pathways through which the innovation can be scaled-up, and thus leverage scarce resources to achieve greater impacts. This can involve several strategies, such as developing partnerships and strategic alliances and linking with other stakeholders (private sector, NGOs, GOs, communities). Interinstitutional collaboration and coordination are not only important, but it is also crucial, and a prerequisite for maximizing impact.

5. Engaging in dialogue. It is necessary for the interested stakeholders to engage in dialogue with policymakers, as well as with the other stakeholders not only to gather support for innovations and projects, but also to create the right institutional environment for innovations to be scaled-up.

6. Funding. For the process to be sustainable requires reliable funding. Thus, donors need to be lobbied to obtain long-term flexible funding, which allows for a learning process to take place. Appropriate mechanisms also need to be developed to sustain the capacity for expansion and replication. This involves paying special attention to mechanisms for self-financing, input/output markets, capacity building, and local and regional networking.

2.3. Power and stakeholders

Power can be defined by several different concepts, diverse theories and different interpretations, therefore it has not been yet possible to develop an all-encompassing approach for its analysis (Marquardt 2017). One of the identified definitions has been provided by Avelino and Rotmans (2009) as “the ability of actors to mobilize resources to achieve a certain goal”. This concept of power can be used to understand both the internal dynamics of the ‘regime’, as well as how this ‘regime’ interacts with other forms of power that exist within society. The regime is defined as the most ‘dominant’ configuration of actors, structures and practices; it dominates the functioning of the societal system and defends the status quo. Avelino (2011) has also defined four conditions for the exercise of power, these are access to resources, strategies to mobilize them, skills to apply those methods, and the willingness to do so (see

Figure 2) (Avelino 2011). Resources are in themselves ‘power neutral’; they only become power-laden when they are mobilized by actors to reach a certain goal (Avelino 2011; Avelino and Rotmans 2009).

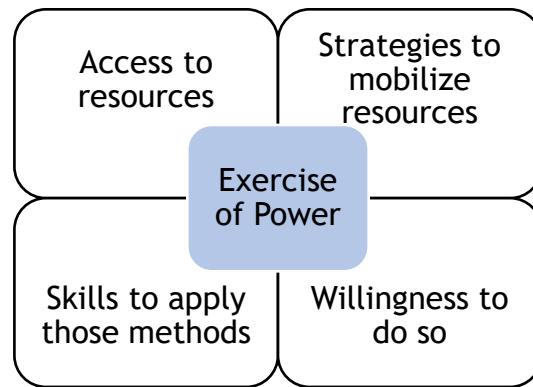


Figure 2: Exercise of Power conceptualization (Source: Avelino, 2011)

All four conditions depend to a large extent on having or gathering knowledge, which makes knowledge (on how to exercise power) a ‘meta-condition’ for the exercise of power. It is also necessary to add that knowledge is in itself produced, shaped, and constituted by the exercise of power (see Figure 3):

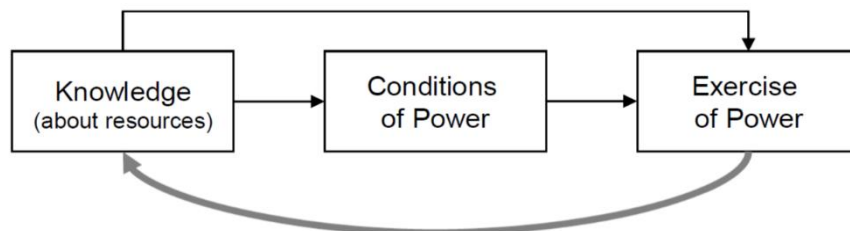


Figure 3: Recursive relation between power & knowledge (Source: Avelino, 2011)

When comparing actor categories in terms of how much power they exercise, it is crucial to be specific in the categorization of actors and the level of aggregation. Avelino and Wittmayer (2016) argue that the analytical frameworks of power and actor dynamics need to allow for the possibility of shifting power dynamics, especially because there seems to be an increasing role for civil society and grassroots innovation in sustainability transitions research.

Empowerment is another concept that needs to be taken into consideration when analysing power in transition studies. It refers to the process of gaining power (Avelino and Wittmayer 2016) and can be defined as the attainment of resources, strategies, skills and willingness. It can take place, regardless of whether or not one can influence the willingness of actors to exercise power to reach a specific goal (Avelino and Rotmans 2009).

Avelino and Wittmayer (2016) have also coined a Multi-actor Perspective (MaP) as a heuristic framework for specifying different categories of actors at different levels of aggregation. The MaP serves to explore the political implications of sustainability transitions, in terms of shifting power relations between and within sectors, organizations and individual actors. The MaP distinguishes among four sectors: state, market, community and third sector, and between actors at different levels of aggregation: (a) sectors, (b) organizational actors, and (c) individual actors. The third sector is conceptualized as an intermediary sector in between the three others. It includes the ‘non-profit sector’ that is formalized and private, but also many intermediaries, organizations that cross the boundaries between profit and non-profit, private and public, formal and informal. As such, the Third Sector includes phenomena such as social entrepreneurship, ‘not-for-profit’ social enterprises, and cooperative organizations. While sectors themselves can be viewed as ‘actors’, they can also be seen as specific ‘institutional contexts’ or ‘discursive fields’ in which organizational or individual actors operate and with which they interact (see Figure 4 & Figure 5). These sectors are not fixed entities: rather, the boundaries are contested, blurring, shifting and permeable, and they provide sites of struggle and cooperation between different actors (Avelino and Wittmayer 2016).

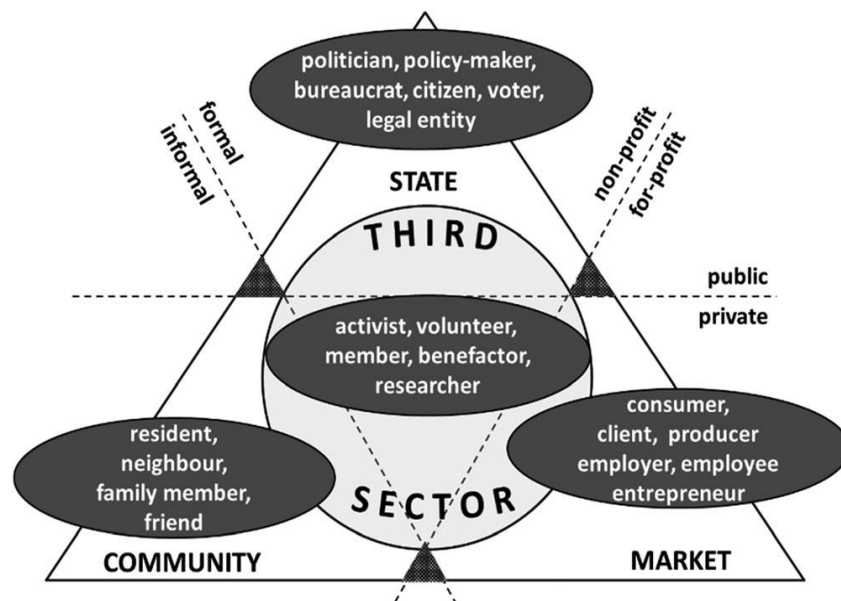


Figure 4: MAP: level of individual actors (Source: Avelino & Wittmayer, 2016)

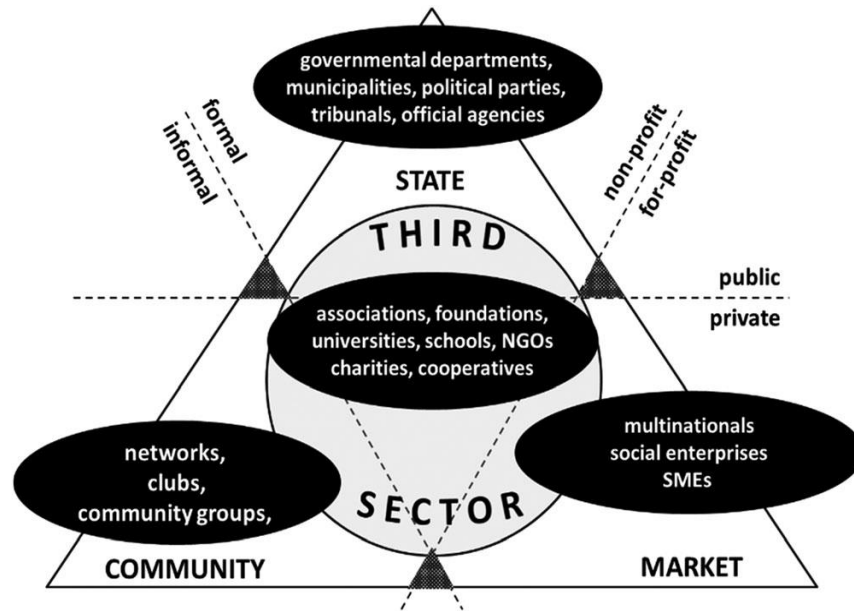


Figure 5: MAP: level of organizations (Source: Avelino & Wittmayer, 2016).

Lastly, Avelino & Wittmayer (2016) propose a power typology that distinguishes between three types of power relations to analyse different kinds of power that are exercised by different actors at diverse levels, and the multiple forms of interdependencies and interactions between these actors: 1) A exercises power 'over' B, 2) A exercises 'more' power in comparison to B, or 3) A exercises a 'different' power than B. These different relations of power may coincide, but one does not necessarily follow from the other. If A exercises 'more power' in comparison to B, it does not necessarily mean that A has power 'over' B (see Table 1) (Avelino 2011; Avelino and Rotmans 2009; Avelino and Wittmayer 2016).

Type of relation Manifestation of power relations			
Power 'over'	A depends on B but B also depends on A => A and B have power over each other	A depends on B but B does not depend on A => B has power over A	A and B do not depend on each other => A and B have no power over each other
	mutual dependence	one-sided dependence	independence
'More / less' power to	A exercises more power than B, but A and B have similar, collective goals	A exercises more power than B, while A and B have mutually exclusive goals =>	A exercises more power than B, A and B have independent co-existent goals
	cooperation	Competition	co-existence
'Different' power to	A's and B's different power exercises enable and support one another	A's and B's different power exercises restrict, resist or disrupt one another	A's and B's different power exercises do not (significantly) affect one another
	Synergy	Antagonism	neutrality

Table 1: Typology of power relations (Source: Avelino, 2011; Avelino & Rotmans, 2009; Avelino & Wittmayer, 2016)

Moreover, each of these types of power relations can have various manifestations, ranging from mutual dependence, one-sided dependence and independence, to cooperation, competition and co-existence. This third type of power relation tends to be forgotten in discussions about power. This has implications for discussing the role of different actors. Rather than only discussing which actors have more or less power, or who has power over whom, the question also becomes how different actors exercise different kinds of power at different points in time in different roles (Avelino 2011; Avelino and Rotmans 2009; Avelino and Wittmayer 2016).

2.4. Conceptual framework

The following figure provides further details on how the theoretical concepts explained in sections 2.1 to 2.3 come together within this research, for the assessment of societal stakeholders' power for scaling-up NBS.

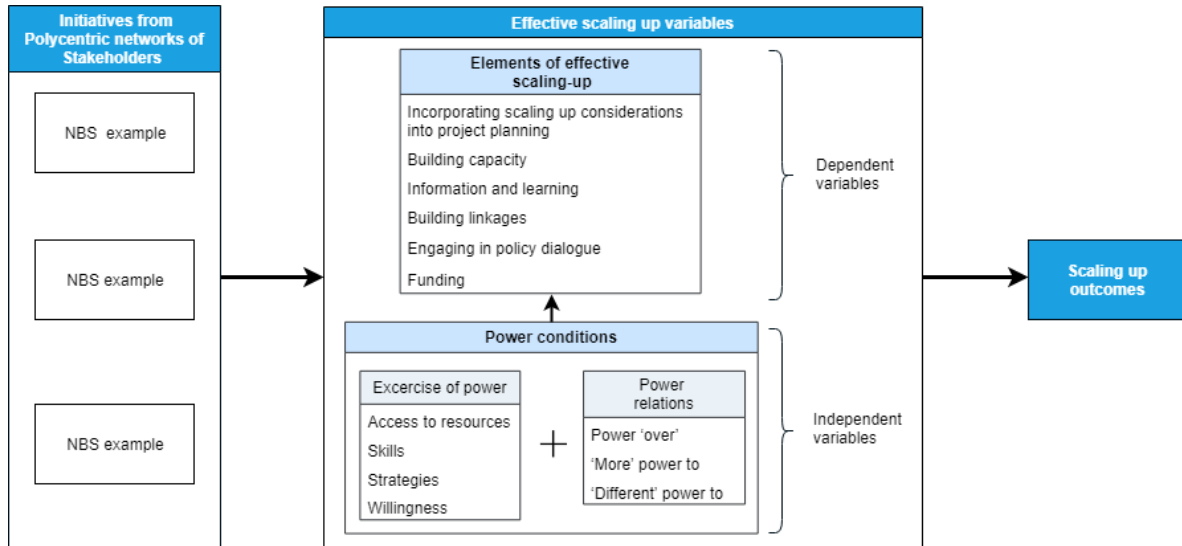


Figure 6: Visualization of the conceptual framework.

Scaling-up and its elements are considered the dependent variable, and the independent variables are the power conditions: exercise of power and power relations. These variables, their indicators and their description have previously been detailed and explained in section 2.2 and 2.3. The results from the operationalization of these variables have helped identify the possible divers and/or barriers for the process of scaling-up. The operationalization of the variables is explained in section 3.3.

3. Research methodology

3.1. Case study justification

The research strategy applied was the holistic method of the single case study (SCS), comparative qualitative case study design (Yin 2009). The focus required to answer the RQ is on depth rather than breadth. Depth is realized by using various and intensive methods for generating data. This also contributes to the triangulation of sources. Another characteristic of SCS is that a strategic sample is taken instead of a random sample.

Given that Spain has relevant initiatives in several cities, the strategic sample is based in Spain. This country is the focus of this SCS as the unit of analysis, the context supporting this selection has been detailed in section 1.5. Several categories of actors have been chosen for assessment, given their relevance to bottom-up societal stakeholder initiatives, i.e. decision-makers, civil society, financiers and other actors, such as academic researchers, lobby groups, NGOs, associations representatives, and activists amongst others. Alongside these relevant actors, associated practices concerned with the regulation and planning of cities, as well as institutional practices concerned with the provision of infrastructures in the built environment have also been assessed.

3.2. Research strategy and data collection

Several sources have been used for this research (source triangulation). The first part of the research was desk research. This included materials from grey literature (e.g., regulations, strategies, action plans), as well as policy evaluation, influential reports, consultancies, forms of knowledge and tools and assessment studies, legislation. The latter was identified by browsing through google and google scholar search engines and the Ministry of Ecological Transition website. Terms used were: NBS, GI, IV [*infraestructura verde* - Spanish for GI] and SBN [*soluciones basadas en naturaleza* - Spanish for NBS]. Based on the findings, specific municipalities websites were also consulted, using the same terms for the query. These documents and NBS presence in several cities of Spain were studied to get a clear picture of the case study and to prepare for interviewees selection.

The second part of the desk research was the selection of key organisations for interviews, this provided the relevant stakeholder groups for interviewing. To ensure that a broad overview of barriers and drivers for the process and outcomes of scaling-up of urban NBS was recognized and assessed, the case-study strived to include a variety of actors/actor groups and organisations concerned with the implementation of urban NBS, as well as those who are not usually related to it. Relevant actor groups or categories vary, and sometimes they can be involved in the implementation as well as the planning. It was the intention of this research to cover all relevant stakeholder groups, i.e. at least one interview for each identified group, private, public and societal. The categories aimed to be included in the research were: national government, regional and local government, government agencies, lobby groups, politicians, development companies, architects & landscape designers, utilities (e.g., waste, water, energy), transport infrastructure providers (rail, highways, canals), knowledge institutes, academia, neighbourhood associations, urban garden

associations. Some interviews provided further suggestions on documents to be assessed, also whilst researching examples given during interviews, further documents were identified. The literature review was meant to further refine the analytical framework and to understand the contexts of the selected cities. In total 22 official documents were analysed. A document list can be found in appendix 8.1.

Several stakeholders in different cities were selected based on the results of the desk research. All interviewees were approached via email for the interview coordination and interviewed in person, by telephone or skype. They were subject to the informed consent, prior to the beginning of the interview (see appendix 8.2). Without permission, the interview was not recorded, but if the participant still wished to give the interview, the data has been used. Only 2 participants declined the recording, notes were made in such cases to structure the quotes or notes from that interview. Transcriptions and written notes (summaries, interview notes) of each interview were kept and subsequently transcribed and translated to English (if required). A bottom-up perspective was generated through field research in the form of 26 in-depth and semi-structured interviews of approximately one hour each.

Respondents were officers of various government levels and relevant departments at the local, regional or national level, complemented with some representatives from private companies or societal stakeholders. Several other respondents were identified based on suggestions made by interviewed experts (i.e. the snowball method). Appendix 0 gives an overview of the respondents, codes for in-text referencing (e.g. int.4), the key category they have been allocated to, their institutions, their functions, and the Spanish city where they are located. Finally, appendix 8.4 contains the semi-structured interview guide, to give an idea of the set of questions and topics which were used to steer the conversations.

In addition to stakeholder interviews, a placement in a relevant agency was done, as a complementary source of data. The duration of this placement was four days. This agency was identified during the desk research, and the relevance was further confirmed by the interview of the director (int.11). The agency is the Urban Ecology Agency of Barcelona [*Agencia de Ecología Urbana de Barcelona*]. This placement served to observe day-to-day decision-making and practices that sustain existing conditions and how urban NBS might challenge these practices. This included, but was not limited to, the following activities: attending staff and external meetings about current projects, visiting superblocks, as well as a presentation on the technical software used for project assessment. Guidelines for the placement are included in Appendix 0

Regarding the data transcripts, storage, and availability, primary data (e.g. transcripts and audio recordings from interviews) have been stored on the author's individual computer and on the Utrecht University cloud service. In this Master Thesis, quotes (translated into English) have been included under different sections, when relevant to a research question in order to illustrate some key points or claims. These quotes have been improved, without changing their essence, in order to facilitate understanding by the reader. Literature gathered, information and interviews conducted were analysed and systematically coded for further analysis using NVivo software. This software supports qualitative and mixed methods research by helping to organise, analyse and find insights in unstructured, or qualitative

data. The data was coded corresponding to each of the four elements of power conditions, (see

Figure 2) to determine the power relations and the six elements of effective scaling-up. This enabled to find topics that could provide further insight into the research.

After collecting and processing the data, the results of the proposed research were assessed and discussed. The triangulation of research methods and sources has increased the internal validity of this research in terms of the trustworthiness of conclusions. These results offer a context-specific overview that could broaden the scope of the current approaches towards improving the scaling-up process and thus the cities.

Finally, it's important to add, that this research has been conducted in association with the EU NATURVATION project. The collected data are also used as part of the NATURVATION project in a cross-case comparative analysis.

3.3. Operationalization of variables

As per detailed in section 2.4, scaling-up has been considered the dependent variable and the independent variables are the power conditions: exercise of power and power relations. Power is a resource the stakeholders can have. The results from the operationalization of these elements have helped identify the possible divers and/or barriers for the process of scaling-up. The following Table 2: Operationalization of variables Table 2 explains how each variable has been be operationalized.

Type of variable	Variable	Indicators	Description of operationalization	Source
Independent	Exercise of power	Access to resources	Possibility of attaining resources or information about resources (capacity of creation, localization, ownership).	Avelino, 2011
Independent	Exercise of power	Skills	Competences necessary to apply strategies to exercise power (disciplinary training such as legal or financial education, language and computer skills, public speaking, writing, rhetoric, argumentation, rationalization, improvisation).	Avelino, 2011
Independent	Exercise of power	Strategies	Methods applied to exercise power (e.g. propaganda, lobbying, networking, protesting, experimenting, ceremonial activities, voting, prohibition, subsidies, contests, business models, debate). Ways in which actors combine different types of power exercise in reaction to the (combined) power exercise of others, i.e. what kind of power relations they engage with.	Avelino, 2011

Type of variable	Variable	Indicators	Description of operationalization	Source
Independent	Exercise of power	Willingness	Willingness to exercise power for a specific goal includes the will to gain resources.	Avelino, 2011
Independent	Power relations	Power 'over'	Mutual dependence, one-sided dependence or independence between actors.	Avelino, 2011; Avelino & Rotmans, 2009; Avelino & Wittmayer, 2016
Independent	Power relations	'More' power to	Cooperation, competition or coexistence between actors.	Avelino, 2011; Avelino & Rotmans, 2009; Avelino & Wittmayer, 2016
Independent	Power relations	'Different' power to	Synergy (different types of power enable and support one another), antagonism (different types of power disrupt and restrict one another) or neutrality between actors.	Avelino, 2011; Avelino & Rotmans, 2009; Avelino & Wittmayer, 2016
Dependent	Scaling-up	Incorporating scaling-up considerations into project planning	Involving stakeholders as decision-makers from the beginning of the innovation process.	Pachico & Fujisaka, 2004
Dependent	Scaling-up	Building capacity	Developing skills can empower local actors and help with effective local implementation (can include skills in consulting and collaborating with stakeholders, skills in working across disciplines).	Pachico & Fujisaka, 2004
Dependent	Scaling-up	Information and learning	Participatory monitoring and evaluation.	Pachico & Fujisaka, 2004
Dependent	Scaling-up	Building linkages	Developing partnerships and strategic alliances with other stakeholders (private sector, NGOs, governmental organizations, communities).	Pachico & Fujisaka, 2004
Dependent	Scaling-up	Engaging in policy dialogue	Engaging in dialogue with policymakers and other stakeholders not only for gathering support for innovations and projects but also, helps create the right institutional environment.	Pachico & Fujisaka, 2004
Dependent	Scaling-up	Funding	For the process to be sustainable requires reliable funding, i.e. if it involves donors, they need to be lobbied to obtain long-term flexible funding.	Pachico & Fujisaka, 2004

Table 2: Operationalization of variables.

4. Analysis

To analyse the data collected for this Spain case study, first, there is a focus on the identification of the polycentric networks of stakeholders who are involved in the development of urban NBS, followed by an identification of the urban NBS projects being developed by those networks. This identification has been completed based on the results of the desk research, interviews and the placement carried out during the data collection phase in Spain. Subsequently, the power conditions for the identified stakeholders within each of their own networks have been assessed. This chapter has then been finished by providing an analysis of the effects these identified power conditions may have in the six elements of effective scaling-up, and lastly determining whether they can be interpreted as drivers or barriers for the process and outcomes of the scaling-up of urban NBS.

4.1. Polycentric networks of stakeholders involved

The general characteristics and roles of the polycentric networks identified are explained in detail in this section, along with a stakeholder map (see Figure 7) and an overview table with the main stakeholder's characteristics (see Table 3). Furthermore, a more detailed explanation of the stakeholders and their characteristics identified is presented in Appendix 0. The following section provides answers to the first sub-question. In order to have an overview of the identified categories of stakeholders and their levels of aggregation, positioning of the identified stakeholders within the Multi-actor Perspective (MaP) is presented as well (see Figure 8). This chapter concludes with the explanation of the polycentric networks in which these identified stakeholders participate, along with their roles, characteristics and affiliations within their networks. Each explanation includes a table to summarize the network.

Several polycentric networks of stakeholders have been identified to be involved in the development of urban NBS in Spain. Polycentric governance comprises a group of interconnected stakeholders as centres of decision making, their different types of authority and their interactions, being coordinated by a shared and co-developed system of rules. The stakeholders within the identified networks have different roles and levels of involvement within them.

According to van der Heijden (2018), by involving a wide range of stakeholders in the development of governance instruments, their knowledge can be used. This should be fostered by the stakeholders with the most interest to develop said instruments. This is expected to result in instruments that are better than those developed by somewhat distant bureaucrats. Also, by involving a range of stakeholders, instruments can be developed that allow for deeper reflection on the advantages and disadvantages of the instrument for the various parties involved.

The desk research led to the identification of four cities where societal stakeholder involvement was relevant for this research: Barcelona, Madrid, Valencia, and Valladolid.

However, during the in-depth analysis which included the interview results, it was not identified that the societal stakeholders in Valencia had polycentric arrangements relevant for the development of urban NBS. Therefore, the analysis does not include Valencia.

4.1.1. Relevant stakeholders identified

The interviews and the placement have resulted in the identification of seventeen diverse stakeholders and networks thereof. The following stakeholder map gives an overview of the identified stakeholders for the three assessed cities in Spain (see Figure 7).

The justification for positioning the citizens in the inner circle is twofold: depending on their capacity or interest they can be related to any stakeholder; and second, the stakeholders identified are, regardless of their societal role, affiliation, or participation in a network, still citizens. The second layer includes the active stakeholders for the implementation of urban NBS within their networks. The third layer includes only the municipality because it is the public body in charge of the regulation or implementation of the urban NBS in the cities, therefore they tend to be the most important and most advanced regarding the development of green infrastructure strategies relevant to urban NBS (int.1, int.2). At this level, the Department of Environment or similar is at responsibility to define, implement, or finance them. However, every municipality is at liberty of choosing the best organizational form for their governance period. Further detail is given on this when explaining its functions (see Appendix 0).

The outer layer has the secondary stakeholders, those who do not directly interact with the societal stakeholders for the implementation of urban NBS; however, do have some level of influence e.g. National Government. It is responsible for decreeing laws that will have an impact on all the lower levels of government, as well as those required to comply with EU Communications. In that sense, the Ministry for the Ecological Transition [*Ministerio para la Transición Ecológica*] is the most relevant ministry for urban greening. This Ministry is currently responsible for developing the National Strategy on Green Infrastructure (int.1, int.2), they do not currently hold a specific policy or strategy on NBS. Hence, despite not having a direct interaction with the active stakeholders, other than the municipality, they are involved in the regulation of all urban NBS implementation.

Given that some stakeholders are specific to a specific case study city, those have a different colour and an annotation for differentiation purposes. The identified stakeholders are explained following a clockwise order in the layers, and from the core outwards.

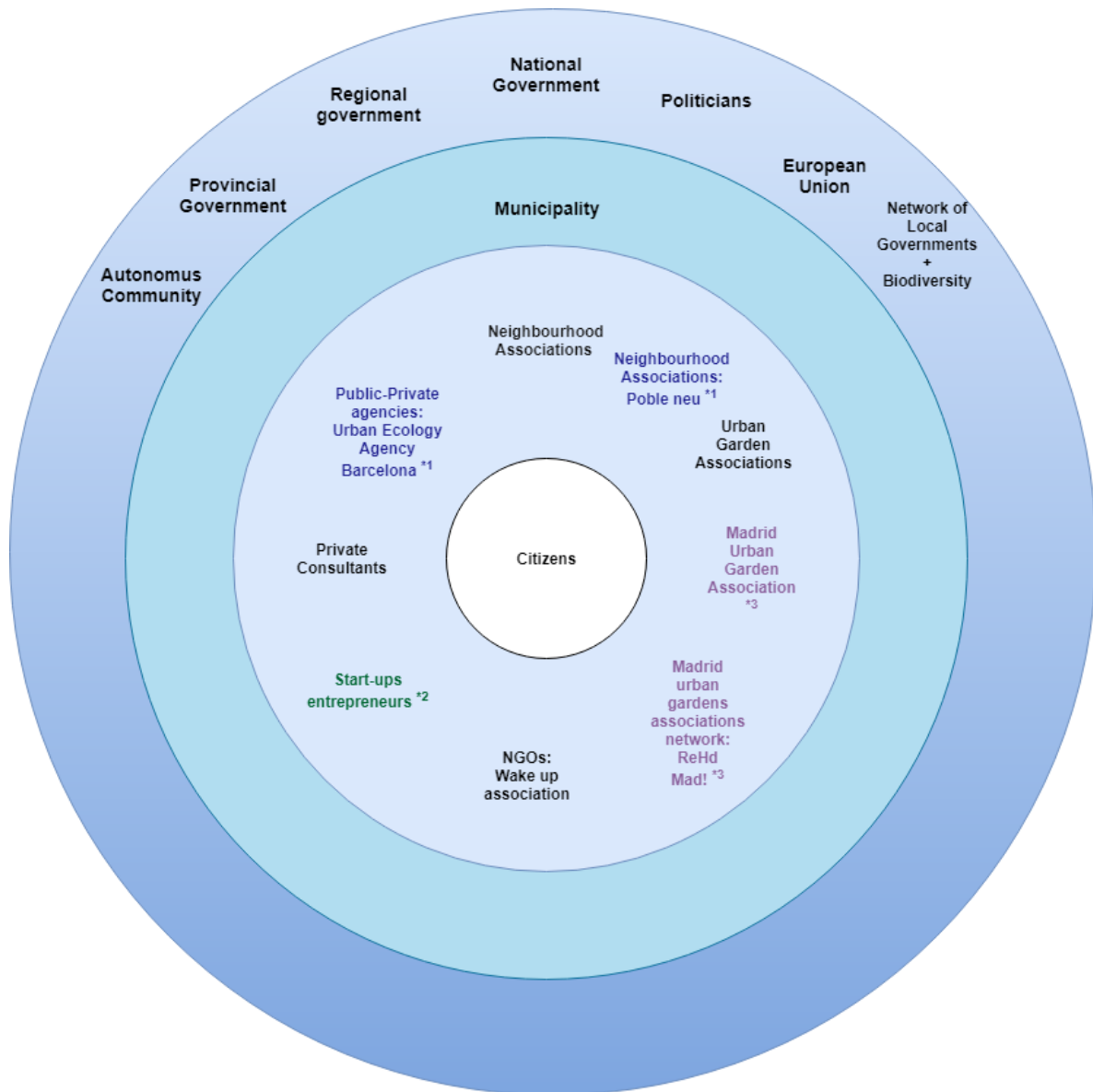


Figure 7: Relevant stakeholders for NBS implementation in Spain, the annotations are for specific stakeholders per cities: *1 - Barcelona (blue), *2 Valladolid - (green), *3 - Madrid (purple).

Although some stakeholders identified may be positioned in the same layer of the stakeholder map, they convey different activities and thus have a different role within their polycentric network. The following Table 3 provides an overview of the main stakeholder's details and main activities.

Nº	Stakeholder	Type of stakeholder	Main activities / relevance for Polycentric Network	Sector
1	Citizens	Active	Lobbying	Community
2	Neighbourhood associations	Active	Lobbying	Third sector
3	Poble neu Neighbourhood Association	Active	Lobbying	Third sector
4	Urban Garden Associations	Active	Lobbying and urban garden implementation	Third sector
5	Madrid urban gardens associations network: ReHd Mad!	Active	Lobbying, urban garden knowledge development and dissemination	Third sector
6	Cultural association Wake up [Despierta]	Active	Lobbying and Knowledge dissemination	Third sector
7	Start-up entrepreneurs' companies	Active	Knowledge development, implementation	Third sector
8	Consultants	Active	Knowledge development	Private company
9	Urban Ecology Agency of Barcelona	Active	Knowledge development	Private company
10	Local government - Municipality	Active	Regulation, financing, implementation	Government
11	National government	Secondary	Regulation	Government
12	Regional government	Secondary	Regulation	Government
13	Provincial government	Secondary	Regulation	Government
14	Autonomous communities	Secondary	Regulation	Government
15	Politicians	Secondary	Lobbying and Regulation	Government
16	European Union (EU)	Secondary	Financing	Government
17	Network of Local Governments + Biodiversity	Secondary	Knowledge development and dissemination	Third sector

Table 3: Summary of stakeholders' activities and sector

After describing the main activities of the stakeholders identified, the following overview of a MaP has been generated. These identified stakeholders have been grouped in the four categories identified by Avelino and Wittmayer (2016) as explained in detail in section 2.3, to have an overview of the relevant stakeholders involved in the development of urban NBS in Spain, more specifically, in the three cities assessed. These four categories are community, third sector, market (private companies) and state (government). More specifically, the third sector includes NGOs, associations, foundations, academia, cooperatives and charities, these stakeholders share a common goal, which is to give a voice to the civil society from a non-state and non-market platform.

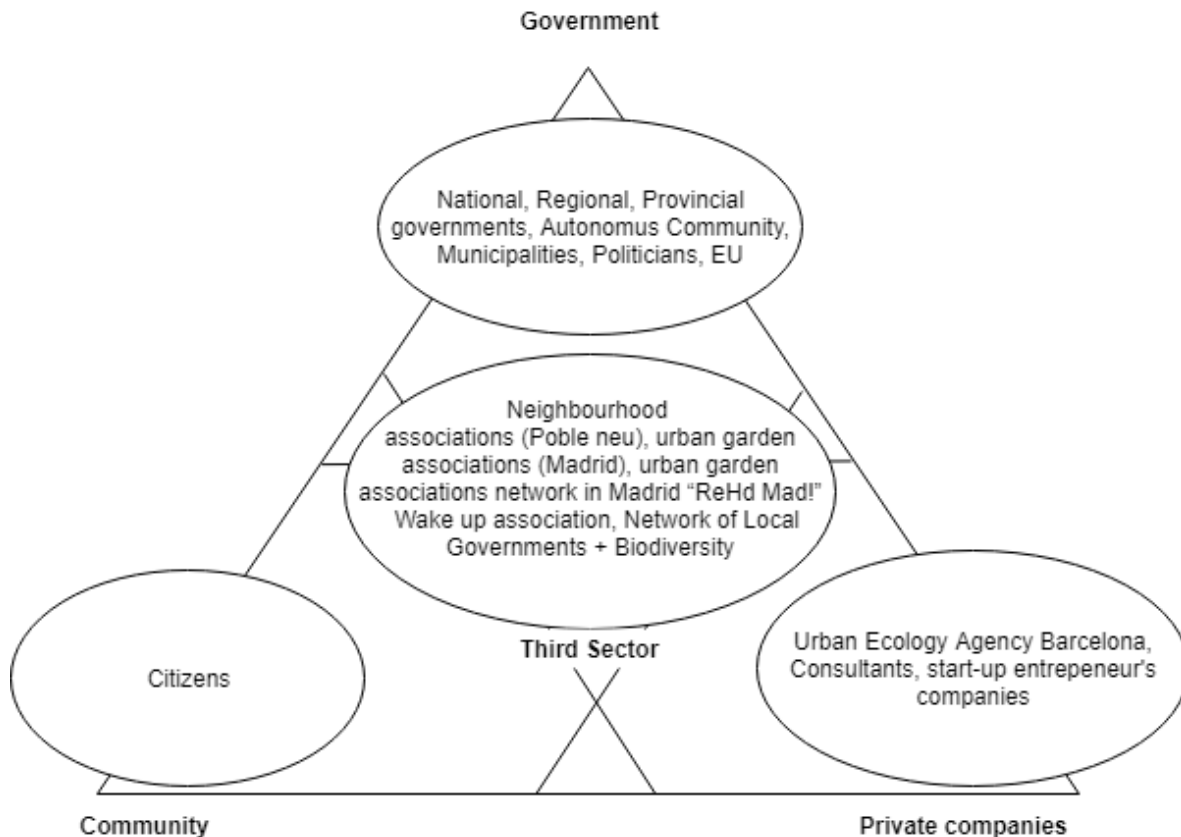


Figure 8: Multi-actor perspective overview for Spain

4.1.2. Polycentric networks of stakeholders' description

This section elaborates on how the previously identified stakeholders come together to constitute each of the polycentric networks identified for the three cities in Spain: Barcelona, Madrid and Valladolid. The explanation of the polycentric networks includes the characteristics of the polycentric network and its aim, to provide more detail on the rationale for the formation of that polycentric networks. Codes have been assigned to each polycentric network (e.g. PN1).

In order to organize the coming explanations of the identified urban NBS in Spain as well as the stakeholder power conditions assessment within their polycentric networks, the following Table 4 has been generated with the summary of the polycentric networks codes, the aim of the polycentric network, the stakeholders involved, and the city where the innovation is being implemented.

Code	Aim	Stakeholders involved	City
PN1	Superblock	Municipality, citizens, neighbourhood association (Poble neu), Urban Ecology Agency Barcelona	Barcelona
PN2	Open yard schools	Municipality, consultants, citizens, neighbourhood associations, EU	Barcelona
PN3	Urban gardens	Municipality, urban garden associations, urban garden associations network "ReHd Mad!"	Madrid
PN4	Circular economy projects	Municipality - innovation agency, start-ups and entrepreneurs	Valladolid

Table 4: Identified polycentric networks codes, their aims, stakeholders involved, and their city of action.

In general, it is important to highlight that the societal networks of stakeholders involved within the development or the regeneration of the city are well organized and have demands for improvement or innovation that are although not specific, relevant to urban NBS (int.10). The four polycentric networks identified have some degree of interaction with the municipality, it can be for approval or legitimation of their initiatives or funding allocation. Hence, in spite of the fact that the municipality is not the main driver of the urban NBS it has a representative role.

The first polycentric network identified is in Barcelona, it includes the municipality, the citizens, a neighbourhood association and the Urban Ecology Agency Barcelona (PN1). Although neighbourhood associations are very common throughout Barcelona, for this analysis the research focuses on the Poble neu neighbourhood association. The four stakeholders started working together with the aim of implementing a superblock in Barcelona. This new urbanization model was not precisely requested by the neighbourhood association or citizens; however, they did call upon the municipality for the pacification of the streets, reduction of pollution and increase of public space. The implementation of a superblock 'liberates' around 70% of the intersections from traffic, therefore there is a lot of free space that can be used for different activities, (i.e. public space, greening the city, playgrounds, sports courts) (int.6, int.11, int.15). This is a holistic solution; it takes the surroundings and mobility into consideration. The interactions between these four stakeholders have been catalogued as polycentric because each stakeholder has the capacity to make decisions that have an impact on the city development. As explained before, urban planning and urban greening is a competence of the municipality. The citizens

and the neighbourhood associations have the capacity to identify and decide what improvements or innovative projects they would like to develop in order to improve their surroundings and they submit those ideas as proposals to the municipality, and lastly the Urban Ecology Agency Barcelona has done relevant research on how to improve the urban spaces in benefit of the citizens, and in some cases the research has pointed out solutions to the same problems that the citizens wanted to solve, i.e. more open spaces, green areas, better air quality, wider streets.

The second polycentric network in Barcelona is formed by the citizens, the neighbourhood associations, the municipality and the EU (PN2). The goal of this polycentric network is to develop open yard schools. This initiative is being developed by the Municipality of Barcelona as pilot projects. This project was conceptualized because the city is very dense and lacks green spaces in order to comply with the recommended 9m² of green space per capita by the World Health Organization (Pafi et al. 2016). There are 70 schools in the city, which open their yards during the weekend and the summer, so people can have an open space, and the current EU funded initiative is to turn them into climatic shelters. Similarly, to the previous example, the citizens through the neighbourhood associations decide what kind of renovations they would like to see implemented in their neighbourhoods or streets, and they take that joint decision to the municipality for approval. The municipality has a participatory budget where it calls for public participation for innovations in the city. Then, if the municipality considers it feasible (time, budget, coherence) it can be implemented. Also, the municipality takes upon themselves to apply for EU funding, as a way to increase their budget as well as to learn new innovative practices. They do so, with the advice from private consultants, that have experience in this task. It currently has funding from the EU to implement this innovative urban NBS in the city. The role of the EU is to provide funding for this type of projects that meet certain standards of quality, societal impact and innovation. In this case, it has been granted for urban NBS innovation.

One polycentric network was identified in Madrid. It includes the different urban gardens associations coming together on a voluntary basis to form the urban garden associations network in Madrid "ReHd Mad!" (PN3). The community gardens in Madrid have come together to form a very active network of urban gardens associations: "reHd Mad!". The urban gardens associations started taking the spaces or allotments without formal permission from the owners (private or municipal lots) in 2010, because there were several open lots and abandoned spaces in the city, and they needed open space for recreation, and outdoors activities, as well as nature contact. They started conversations with the municipality to legitimize their occupation and in 2015 a municipal ordinance was published. Therefore, this network interacts directly with the municipality, in order to achieve common benefits to all urban garden associations in Madrid. At the time of its establishment, perhaps two or three gardens were connected to each other and linked to environmental groups or to neighbourhood groups. Later, at the beginning of 2011, there began to be connections between some of the people who were participating in these urban gardens. It was around 2013 - 2014 that the urban gardens network's representatives started to meet with Environmental Service representatives from Madrid Municipality's Environment Department,

and in 2015 the regulation of the urban gardens was agreed upon and that legal concept appeared in the municipality's regulations (int.24).

“We (Madrid urban garden association members) were people who did not know a lot about urban gardens, but we did know a lot about social movements. So, we had many networks which we succeeded in involving to first work with the neighbourhood’s social fabric to involve the neighbours in the process. (For us) it did not make sense to create an urban garden from the top down but from the bottom up. I mean you needed to know, to a greater or lesser extent, that you had some neighbours interested in that initiative and interested in that it be there. You do not create the urban garden for yourself. You do it for the neighbourhood. Then, we also had contacts to search for people who knew how to design benches or select crops, but they did not necessarily know how to do it themselves. What they had was the ability to find people” – (int.24)

It is also part of the Madrid urban garden association culture, to relate with other networks, such as the gardener’s associations or environmental activists, in order to foster the knowledge exchange. Currently, the municipality provides them with services such as water and fences (int.24). This started when the number of implemented gardens were growing and at the same time, the neighbours who were not always part of these gardens learnt about joint activities being carried out in these areas, so the urban gardens associations started coordinating some activities within the urban garden, or with other urban gardens (e.g. annual meetings with workshops and games, training, seed exchange, large-scale purchases of materials, meet-greet the neighbours), this helped improve and strengthen the network and the urban garden itself (int.24). New people approached and asked for help from more experienced people. Mostly they are people, families who just want a space. There is a continuous exchange of knowledge with the municipality, there are services. The associations receive free plants and information from the municipality (int.24).

Finally, one polycentric network was identified in the city of Valladolid. This network includes the innovation agency of the municipality and start-ups and entrepreneurs (PN4). The stakeholders from this polycentric network come together while searching for solutions to the rising issues in the city, such as lack of greening or heat island, while also trying to develop a business. As previously explained, the citizens themselves do not call for specific urban NBS implementation, but for a solution to issues that affect them in a direct way. The start-ups propose project initiatives based on circular economy, given that it is a more efficient business model, and in some cases, those businesses include urban NBS implementation that can also help solve some of the issues raised by citizens. The role of the innovation agency from the municipality in this specific case is to manage the budget for start-ups and citizen initiatives specific to circular economy. The interest in funding small start-ups through a contest process, is to use those experiences as pilot projects, given that they help them identify corrections in the projects if needed. However, this agency does not call for specific urban NBS projects, nor does it provide technical support or supervision, but they do hope that in time if proven successful, these initiatives can be upscaled as part of

the Municipality's urban planning (int.8). Lastly, the results show that Valladolid is such a small municipality and city (in comparison to Madrid and Barcelona), that the municipality officials are closer to the community and citizens in general. They recognize the climatic challenges and are aware that NBS can help improve those challenges (int.8). In that sense, the requests or demands by citizens are very easily transmitted to the municipality for consideration. It also helps the process of project and innovations development, the fact that in Valladolid, the project planning structure of the Municipality and organization is simpler. If the relevant departments agree on a solution, it is introduced along with the technical issues, there are less bureaucratic constraints or delays.

“In fact the politicians are citizens, we are quite close to the people, I'm not a politician but this is a small, it's not a small town but it's not so huge, the relationship between the politicians and the citizens is close because the politicians talk with the people and they have regular meetings with stakeholders or the commercial associations or the neighbourhood associations, about what they need and the politicians then consider their options. But as far as I know, there is not any regular mechanism for the communication apart from participating in the general, having meetings with the councillors, for instance, or these participatory budgets.” – (int.8)

Finally, Spain has a Network of Local Governments + Biodiversity, it is a network that includes a representative from each municipality from Spain, regardless of their size and it works on a voluntary basis, not mandatory from the National or Regional government. In April 2019 this network published a Municipal Green Infrastructure Guide, which aims to become a reference document for projects of design and implementation of green infrastructure strategies in different types of cities. It includes a large number of national and international examples that can be used as a reference for the particular needs of each municipality interested in developing GI and NBS. The decision-making within this network is through a participatory process and later consensus on the proposals brought forward by participants. The presence of this network has been considered relevant given they foster knowledge sharing among municipalities, empowering them. However, this network is not directly involved in the development of any projects. Therefore, it has not been considered for further analysis.

4.2. Identifying implemented urban NBS in Spain

The previous section elaborated on the polycentric networks of stakeholders that are involved in the implementation, decision making and resource allocation for urban NBS in three different cities: Barcelona, Madrid, and Valladolid. This section explains the urban NBS initiatives that those identified polycentric networks are currently developing, providing answers to the second sub-question. By completing this step of identifying and exploring the current initiatives being undertaken by the polycentric networks of stakeholders, it has been possible to assess the power conditions for each of the relevant stakeholders' groups

identified, and the effect of this on the process and outcomes of scaling-up urban NBS (see section 4.3).

In order to identify the urban NBS being developed by the polycentric networks of stakeholders in Spain, several initiatives throughout the cities were assessed. However, the following section only expands on the initiatives carried out by polycentric networks, which hold relevance for this research, i.e. initiatives carried out by networks with multiple centres of decision making, being coordinated by a shared and co-developed system of rules.

Before presenting the identified examples, several relevant considerations regarding NBS implementation are addressed. These have been brought to light during the interviews. In Spain, there are conceptual differences between the terms used to regenerate the cities. For example, the word 'sustainability' is not necessarily used, however 'conceptually', restoration projects say that they are working for climate change, to reduce the impact, or fight against inequality and against climate change (int.11, int.14, int.21). Another important term is ecosystem-based urbanism (int.11) which is a new approach to urban planning fostered by the Urban Ecology Agency of Barcelona and being widely used by the municipality and other urban regeneration companies, that considers the impacts (constraints, benefits and indicators) that urban development imposes on the environment (green space, etc.). It considers the characteristics of each urban system as well as their potential for sustainable and efficient living.

Another very important consideration is that although the term NBS is widely known and accepted, the results show that the most common term used to address these solutions is Green Infrastructure (int.8, int.14). However, and as the following examples illustrate, this does not imply that this type of NBS is implemented more often than other types.

“... the municipality, the autonomous community, and the provincial government, are trying to promote ... not the concept of NBS, because there are very few who are using that term explicitly, but the concept of GI or move to a more functional green, more focused on the well-being of people, to be able to tackle challenges such as climate change.” – int. 14

A third element recognized in several interviews for the selected urban NBS to work properly is the context (int.5, int.7, int.12, int.16, int.20, int.21, int.25). Not every solution can be replicated in different environments. Developers and experts are aware that different cities have different climatic conditions and therefore require that the solution be adapted to that specific context.

An important consideration identified throughout the cities is that the urban greening should not use drinking water for irrigation, but greywater from the ground. Furthermore, the interviewees recognize that innovation is important because the current city model as such does not work, new innovative solutions are the way forward (int.5, int.6, int.8, int.11, int.12, int.15).

4.2.1. Identified urban NBS

The implemented NBS projects have been categorized within the typology classification from Almassy et al. (2017) from the project NATURVATION. It has been selected, given the relevance said project gives to innovation in NBS. These examples have been identified through the literature review and further confirmed or expanded through the information gathered in the interviews and placement. The most predominant typologies found are the *urban green areas connected to grey infrastructure*, *community gardens* and lastly *external building greenery*. The examples identified for each typology are presented in the following lines. These examples are being presented and referenced to the polycentric network that is responsible for its implementation by referencing the codes provided in Table 4.

One of the best-represented typologies is the category of *urban green areas connected to grey infrastructure*, such as superblocks and school playgrounds or “open yard schools”.

The first example of the urban green areas connected to grey infrastructure type of NBS are the superblocks. This is being developed by the PN1, furthermore, the Urban Ecology Agency developed this concept. The implementation of the superblocks, since their theoretical conception, took quite some time because in the beginning there was no software or technology that could provide technical backup for the allocation of budget or empirical proof of generated benefits to gain political traction (int.11). Until now, there are five implemented superblocks in Barcelona. The first superblock was implemented around 2010, it was partly possible because the agency was able to demonstrate the projected benefits that this development would bring. Barcelona’s urban design is very geometric, like a grid. One of the positive examples of superblocks in Barcelona is the San Antoni market, neighbours are very enthusiastic about its benefits. However, there is also an example of poor implementation, Poble-neu (see Figure 9). It was developed without proper public consultation or communication. In the beginning, the neighbours and people in surrounding buildings such as offices turned against it (int.6, int.15). That had several errors of participation and budget investment (int.15). However, during the interviews conducted for this research, the Poble neu neighbourhood association representative was interviewed, and from his perspective, the aforementioned issues have now been overcome, the municipality is often having participation workshops, and the decision-making process for the improvements is being carried out together. An interesting fact that has come as result of the recent success from this superblock and its active neighbourhood association is that they were invited to Zaragoza by neighbourhoods associations, to share their experiences, and as result of these knowledge exchange, the citizens have asked the municipality for the implementation and now the municipality of Zaragoza has allocated budget for superblocks development (int.26).



Figure 9: Poble neu superblock

The second important urban NBS falling within the category of *urban green areas connected to grey infrastructure* are open yard schools (PN2). This means that the selected schools for the pilot project (to be determined yet at the time of data collection), will be open during the summertime and will also be aquaparks. This requires some infrastructure transformation, that is being managed by the municipality. There need to be changes in three main infrastructure axes: blue, green and grey. Given that this will be a project for citizens, they have been participating in public consultation processes, to gather their preferences regarding the infrastructure changes. As Barcelona has water limitations, the process must be carried out in a sustainable way. One of the options is to pump water from the sea into the schools that are nearby the coastline. Another option is to make deposits under the yard of the school with Sustainable Urban Drainage Systems – SUDS, to collect rainwater (int.6, int.15). These options are still undergoing technical evaluation, and the most cost-effective will be selected.

A very broadly represented urban NBS initiative developed by polycentric networks are the *community gardens*. They are being developed in Madrid as a result of the citizens deciding to occupy the empty spaces in order to have recreation open spaces (PN3). These started as neighbourhood movements, that were later on formalized and also included within the municipality's plans, so much so that they have now budgets in order to cover small

expenses from the gardens, such as water, fencing, workshops and sometimes they can even have materials donations (see Figure 10).



Figure 10: Urban garden "Esta es una plaza" in Madrid

NBS classifying as *external building greenery*, i.e. green roofs, green walls or green balconies, are deemed very appealing in general to the citizens; however, they have only been identified as a polycentric network initiative in Valladolid (PN4). There is one start-up working alongside the municipality, i.e. taking incentives, on a project that uses wool waste as organic soil to grow plants, and subsequently using this product to implement a green wall in a private building, which is being tested as a pilot project. It is important to note that the municipality only provides the funding but do not check on the technical details. No other examples for this typology have been found. One reason behind this finding can be that the sites for these are private and they require a constant budget for maintenance i.e. watering systems and plant reposition if necessary, and this requires a higher level of commitment throughout time (int.8). There is also a general concern for the load-bearing capacity of the current buildings (int.25). Some are not precisely new and would require investment first to improve the structure, and then the implementation of the greens. Given these concerns, the green roofs or green walls are mostly implemented in new or privately-owned buildings.

The identified urban NBS seem to require a stronger societal participation in order to get started. These also include the knowledge exchange between stakeholders from the same network and thus might be contributing to scaling-up of those innovations or similar ones that may share some commonalities regarding the implementation. Although several examples of innovation projects that have been identified across several cities have been presented; there is still the general opinion by different stakeholders from the local governments, private consultants and academia, that there has not been a significant amount of implementation because there is a lack of municipality interest on these initiatives (int.5, int.8, int.15, int.25). Several NBS from the typology classification used for this research (Almassy, Pinter, and Rocha 2017) have not been identified as being developed by polycentric networks, i.e. *parks and (semi)natural urban green areas, green areas for water management, green indoor areas, blue areas and derelict areas*. It is possible that these categories of urban NBS would not necessarily require the participation of bottom-up initiatives involving societal stakeholders, whereas they can be implemented freely by the

municipality by contracting a private company e.g. *green areas for water management, SUDS*. The lack of *blue areas* implementation can have a more financial reason, such as lack of government incentives for private companies or citizens to do so.

4.3. Stakeholder power conditions assessment: power exercise and relations

The past sections have laid out the networks of stakeholders involved in the development and implementation of urban NBS in Spain, and determined their roles in several examples, revealing certain characteristics that have facilitated the types of power and interactions within the networks. The power assessment is presented per polycentric network of stakeholders (see Table 4 for a summary), based on their codes. The power relations are determined, supported by the exercise of power, as previously explained in section 2.3 and operationalized as explained in section 3.3. The results of this assessment answer the third sub-question.

Given that power has been defined as “the ability of actors to mobilize resources to achieve a certain goal”, it has been conceptualized as an ability of actors. The following four conditions have been assessed for each of the polycentric networks previously identified in section 4.1.3, in order to determine their *exercise of power*: access to resources, strategies to mobilize them, skills to apply those methods, and the willingness to do so (see

Figure 2). It is possible for a stakeholder within a polycentric network to exercise one or more of these four conditions.

The power relations can have three possibilities: *power over*, *more power to*, *different power to*. Although the theory presented in section 2.3 has dwelled into various manifestations of these three power relations, such as mutual dependence, one-sided dependence and independence, to cooperation, competition and co-existence; this research only addresses the categories of *power over*, *more power to*, and *different power to*. These three manifestations can give a clear insight into the power conditions within a polycentric network, enough to assess how these power relations interfere with the elements required for effective scaling-up. A summary table on the power relations of each polycentric network precedes the explanations. The table displays the power relationship that stakeholders in line A have with stakeholders in corresponding columns.

Rather than only discussing which actors have *more* or *less power*, or who has *power over* whom, the question also becomes how different actors exercise different kinds of power at different points in time in different roles (Avelino 2011; Avelino and Rotmans 2009; Avelino and Wittmayer 2016). This assessment shows that the types of mobilized resources differ between stakeholders in networks, and subsequently, the types of *power relations* have also been identified to be different from the same stakeholder but in different polycentric networks (i.e. the municipality).

4.3.1. PN1

Having assessed the different roles for the exercise of power of the stakeholders in this polycentric network, it can be stated that the municipality has *power over* the neighbourhood association Poble neu and citizens, given that they depend to some extent on the municipality's planning, approval and/or funding processes to have the project implemented. In the same way, the municipality exercises *more power* than the Urban Ecology Agency Barcelona, nevertheless both stakeholders have similar and collective goals, i.e. to regenerate the city. The neighbourhood association Poble neu has *more power* than the citizens, and *different power* than the Urban Ecology Agency Barcelona. Although the municipality plays a central role within the network by centralizing the demands and communications of the citizens and the neighbourhood association Poble neu, the specific power relations between the stakeholders from this polycentric network can be identified in the following summarizing table Table 5.

PN1 power relations	Municipality	Neighbourhood Association Poble neu	Urban Ecology Agency Barcelona	Citizens
Municipality		Power over	More power	Power over
Neighbourhood Association Poble neu	Less power		Different power	More power
Urban Ecology Agency Barcelona	Less power	Different power		Different power
Citizens	Less power	Less power	Less power	

Table 5: Power relations in PN1.

For this polycentric network, the condition of *access to resources* is executed by all the stakeholders. The municipality, in the sense that they have the capacity to identify knowledgeable institutions or companies and in this case, reach out to the Urban Ecology Agency Barcelona and coordinate the implementation of innovative solutions, such as the Superblocks; the citizens through the neighbourhood association Poble neu can take part in participatory processes and so communicate their concerns and demands to the municipality, thus they have access to effective communication platforms. The Urban Ecology Agency Barcelona has access to a different sort of resources, such as academic knowledge, technicians and technologies that allow them to generate more knowledge. By attaining the knowledge required for the project development, they show that they have the required *skills*. The citizens have the *skills* to bring together people with the same concerns and interests in order to form neighbourhood associations. It is noteworthy to mention that knowledge (on how to exercise power) is a 'meta-condition' for the exercise of power. Given that the Urban Ecology Agency Barcelona is partly a public agency and has developed plans

related to urban regeneration, they have better recognition and access to working alongside the municipality, this constitutes their condition for *strategies to mobilize resources*.

Regarding the *willingness to do so* condition, the neighbourhood associations are constituted of restless people. They are more aware of everything that is going on in their surroundings and they do not need technical knowledge per se to have such awareness. These are the same people who generally demand things or actions from the municipality (int.16). So, despite not having many more resources, they do have the ability to communicate their demands in a way that can be recognized and taken up by the municipality. The municipalities have *willingness* to develop projects that will help attain local and national goals; however, those goals are not always set by technicians, but also by politicians who sometimes lack a broader technical view. This can lead to investments that are not the best in a technical aspect. Although the technicians may be aware of this, their willingness to change projects or goals is not enough without political support (int.5).

4.3.2. PN2

The overview of how the four stakeholders in this polycentric network exercise power, has helped to determine that although the municipality has *power over* the citizens and neighbourhood associations regarding the implementation of urban NBS, the EU has *power over* the municipality. The citizens and neighbourhood associations depend on the municipality for the sustained urban NBS implementation of their choice, whereas the municipality can decide to implement any type of urban NBS without citizen participation if the public participation policies were not in place. As for the EU, it can be said that it is in the best interest of the municipality to gain access to those extra funds for urban regeneration, but also for the EU to help address “societal challenges in sustainable ways, providing business opportunities and positioning Europe as a leader in world markets”, as stated in their Final Report of the Horizon 2020 Expert Group on 'Nature-Based Solutions and Re-Naturing Cities' (European Commission 2015).

Regarding the neighbourhood associations, those have *more power* than the citizens, which can be shown by the empowerment that belonging to such an association brings. Finally, the consultant has a *different power* than the municipality, shown by its ability to successfully prepare grant participation applications and thus enabling the municipality to gain access to the EU funding, and without which the municipality can probably not acquire the EU funds. Inferring from the previous power relations, and although the EU and the consultant have no direct interaction with the citizens, the neighbourhood associations and the consultant, their power relations have been identified.

PN2 power relations	EU	Municipality	Consultant	Neighbourhood Associations	Citizens
EU		Power over	Power over	Power over	Power over
Municipality	Less power		Different power	Power over	Power over
Consultant	Less power	Different power		Different power	Different power
Neighbourhood Associations	Less power	Less power	Different power		More power
Citizens	Less power	Less power	Different power	Less power	

Table 6: Power relations in PN2.

The following lines presents the different conditions for power exercise in order to support the power relations presented in Table 6 above. *Access to resources* is again practised by the four stakeholders in this polycentric network. The municipality does not have all the financial resources in place, they do possess budget plus the competences to supervise and regulate the urban NBS implementation; however, sometimes the allocated budget is not sufficient. Therefore, it has developed the *skills* to reach out to the EU for budget allocation. Given that this allocation stems from a contest-like process, the municipality has the need to allocate a specialized consultant who is trained in such type of grant proposal preparation. Thus, for these two stakeholders, their *skills* would be, the capacity to find the appropriate specialized consultant who can guarantee the grant from the EU as well as well trained technicians capable to implement urban NBS, and the capacity to prepare a grant-winning innovative project proposal, correspondingly. The EU *access to resources* is the funding capacity. Their *strategy to mobilize resources* constitutes the high standards set for the open contest processes by which they decide to whom the funding is granted. The citizens and neighbourhood associations *access to resources* is similar to the previous PN, and thus also their *skills* and *willingness*. The citizens through the neighbourhood associations can take part in participatory processes and so communicate their concerns and demands to the municipality. Again, they do not need technical knowledge per se to acquire or develop such awareness.

The information collected has shown that big municipalities such as Barcelona have the necessary competencies to implement different *Strategies to mobilize resources*. However, given their size, sometimes this is also difficult because there are too many different technicians involved in one single process and thus too much bureaucracy. Finally, the municipality has the *willingness* to develop projects that will help attain goals; however, those goals are not always set by technicians, but also by politicians who sometimes lack a broader technical view (from municipal or higher levels of government, i.e. regional or national). This can lead to investments that are not the best in a technical aspect. Although

the technicians may be aware of this, their willingness to change projects or goals is not enough.

4.3.3. PN3

In this specific case, the municipality has *power over* the urban garden associations, urban garden associations network “ReHd Mad!”, given that they control the legitimation of the urban garden spaces, additionally the municipality can help with resource allocation such as water, energy and supplies. The urban garden associations network “ReHd Mad!” has *more power* than the urban garden associations, given they have similar collective goals, but the communication with the municipality is more effective if coming from “ReHd Mad!”. These power relations (Table 7) are further supported by the assessment and interpretation of the four conditions for the exercise of power.

PN3 power relations	Municipality	Urban Garden Associations	Urban Garden Associations network “ReHd Mad!”
Municipality		Power over	Power over
Urban Garden Associations	Less power		Less power
Urban Garden Associations network “ReHd Mad!”	Less power	More power	

Table 7: Power relations in PN3.

The *access to resources* within this polycentric network goes as follows, the municipality has the ability to regulate and legitimize the use of the empty spaces as well as the provision of water, energy and other supplies. The urban garden associations have access to the empty or abandoned spaces within the city. The urban garden associations network “ReHd Mad!”, as well as the urban garden associations have the *skill* to mobilize people to achieve a certain goal. The majority of the people involved at the beginning of the movement belonged to ecological or social movements (int.24). They were people who had a profile of fighting for a cause. It can be recognized that starting an urban garden in a place where it “cannot” be done requires a certain activist profile. There were also some people who had a certain connection or a lot of interest in the agronomic aspect of urban gardens. They all have in common the idea of transforming the city from their own platform, and according to the available resources. The *strategy* used by the urban garden associations and urban garden associations network “ReHd Mad!”, was to engage in conversations with the municipality of Madrid in order to share, impulse and justify the presence of the urban

gardens, by sharing knowledge regarding benefits and awareness (e.g. improvement of heat island conditions). These conversations are usually channelled through “ReHd Mad!” (int.16, int.24, int.25).

In this case, the urban garden associations, urban garden associations network “ReHd Mad!” have the *willingness* to develop projects that will help attain goals personal and collective goals.

4.3.4. PN4

For this polycentric network, the municipality has *different power* than the start-ups and entrepreneurs. Both stakeholders have an interest in providing the city with tangible improvements; however, their different power enables and supports the other. It may be possible that the start-ups and entrepreneurs can find financing elsewhere, but it is in the municipality’s best interest to provide it, given they can learn from those implemented “pilot” projects, and later on, replicate them and thus those projects could be upscaled. The following Table 8 shows a summary of the power relations within this polycentric network.

PN4 power relations	Municipality - innovation agency	Start-ups and entrepreneurs
Municipality - innovation agency		Different power
Start-ups and entrepreneurs	Different power	

Table 8: Power relations in PN4.

The exercise of power conditions for the fourth polycentric network has some similarities to the previous polycentric networks, specifically regarding the *access to resources* from the municipalities. The municipality, through its innovation agency, has funding available for the start-ups and entrepreneurs. The resources of the start-ups and entrepreneurs are the innovative business plans, based on circular economy. The *skills* of the start-ups and entrepreneurs can be constituted by their ability to develop a circular profit-based business plan, which is what the municipality is aiming to give funds for. Finally, the municipality’s *strategies* to provide the funding for these projects gives them the power to decide which initiatives get selected and therefore have more opportunities of having their projects implemented, and later on, potentially used as pilot projects for Valladolid’s urban regeneration.

The main target of private companies is profit; therefore, they consider what is the best way to engage in different tendering processes in order to achieve this goal. Regarding this type of projects, the municipality states the requirements in the tender. These include the project’s

requirements, but also give extra points when providing social or environmental benefits. Therefore, bidding companies must take this into account and allocate a portion of the budget to this (int.16). The municipality's *willingness* to fund these initiatives relies on having the opportunity of developing such pilot projects, whereas the start-ups and entrepreneurs rely on developing a successful business model to achieve profitability with their projects.

4.4. Power relations interpretation

Lastly, an assessment of how the power relations identified influence the process and outcomes of urban NBS scaling-up has been conducted. The results of the seven power conditions assessed within each polycentric network in the previous section, have helped to determine if the elements of effective scaling-up are sensitive or not to the power relations of the identified stakeholders, and thus to determine if the power relations act as driver or as barrier for the process and outcomes of urban NBS scaling-up. These elements, as per described in section 2.2.1 and operationalized in section 2.3, are: *incorporating scaling-up considerations into project planning, building capacity, information and learning, building linkages, engaging in dialogue: civil society and policymakers* and lastly *funding*. These elements are shortly introduced and then an explanation on their sensitivity to the identified power relations are given, followed by an exemplification of the impact the power relations have on it. The codes of the polycentric networks (see Table 4) have been cited to illustrate some examples during the explanation of the elements (e.g. PN1, PN2, PN3, PN4). These results address the fourth and final sub-question.

The analysis of this section has identified that five out of the six elements of effective scaling-up can be influenced by the power relations exercised by the stakeholders in the four polycentric networks assessed. Results have shown, that regardless of the type of power relation, one element is not sensitive to power. This element is *information and learning*. The influence of power relations on the other five elements has the capacity to act as a driver or a barrier for that element. The influence on the following three elements has been interpreted as a driver: *incorporating scaling-up considerations into project planning, building capacity, building linkages*. Two barriers were identified within this research, and it relates to the elements of *engaging in dialogue* and *funding*. The first barrier identified within this element is the lack of efficient communication to engage in dialogue, and the second is the sporadic prioritization of the urban NBS implementation. Findings have established that although the municipalities have a budget that can sometimes be somewhat limited, they have enough resources to develop and implement urban NBS if there is political will, and thus prioritization.

These findings are further explained in the following paragraphs. Some elements can be influenced to a higher extent than others; however, this quantification has not been the focus of this research. The identification of influence or lack thereof has led to establishing if the appropriate conditions for scaling-up are met within the context of the case study in Spain. The following Table 9 shows a summary of the findings:

Elements of effective scaling-up	Incorporating scaling-up considerations into project planning	Building capacity	Information and learning	Building linkages	Engaging in dialogue	Funding
Power relations influence	Yes	Yes	No	Yes	Yes	Yes
Influence interpretation	Driver	Driver	None	Driver	Barrier	Barrier

Table 9: Power relations influence on the six elements of effective scaling-up.

According to the literature (Pachico and Fujisaka 2004), in order to increase the impact of the research or project implementation, *scaling-up considerations* must be incorporated into the project planning process. The stakeholders that have shown to have power relations *power over* or *more power*, such as the EU, municipalities and the Urban Ecology Agency Barcelona (PN1, PN2, PN3) do have the capacity to incorporate scaling-up considerations into the planning of their different projects. The municipality determines the funding allocation and prioritization, and therefore influence the outcomes of the project implementation. The Urban Ecology Agency Barcelona has the power and access to knowledge resources, being able to determine and influence the project planning. Given the results of the research, these stakeholders have shown interest in the replication of the successful initiatives.

In the case of the municipality of Valladolid with the start-ups and entrepreneurs (PN4), the type of power relations is *different power*, thus both stakeholders have the capacity and the will to incorporate scaling-up considerations into project planning. The entrepreneurs and start-ups because they are proposing the project itself, and the municipality in the sense of fostering replicability by funding those type of initiatives as pilot projects. The municipality's initiative of handing out subsidies in order to develop the basis for the upscaling of those projects if proven successful is what can be influenced by the power that the start-ups and entrepreneurs have (i.e. by having adequate knowledge to prepare successful innovation projects). As previously explained, the municipality is interested in this investment because it needs to demonstrate the usefulness and/or effectiveness, in order to be able to justify the future budget allocation (int.8).

The results from the four polycentric networks assessed have shown that the power of the stakeholders within a network does have an impact on the incorporation of scaling-up considerations into project planning. It can be acknowledged that if there is a type of power relation of *power over*, *more power* or *different power*, then the scaling-up considerations from that powerful stakeholder are more likely to be upheld and included. The considerations from the stakeholder of whom power is held on, are less likely be considered.

The *building capacity* condition involves developing a specific set of skills that can help sustain and replicate the process of innovation. It is critical for stakeholders to understand the underlying principles behind an innovation (i.e. specific or technical knowledge). Having *more power* leads to having more capacity to attaining knowledge and thus building

capacity. Therefore, the more power one stakeholder has, the more capacity building they could achieve. Several interviewees have agreed that there is enough technical capacity for the implementation of the urban NBS (int.16, int.11, int.19, int.25).

Providing urban green in Barcelona is technically difficult (PN1); to make nature fit, the municipality has to rethink how the city is being developed (int.12). The municipality has *more power* than the Urban Ecology Agency Barcelona; however, they have collective aligned goals, and therefore they work together to develop the skills of the technicians that can help with the aforementioned collective goals. Also, the Barcelona municipality has several training courses around the year with many technicians from different municipalities to share knowledge and foster replication (int.3). The municipality's technicians' awareness and technical capacity can always be useful because an initiative can grow from the bottom up and perhaps in the future a decision will be made to allocate a budget for it (int.25).

Regarding the situation of the urban gardens in Madrid (PN3), part of the collaboration scheme between the municipality, the urban garden associations and urban garden associations network "ReHd Mad!", is to provide workshops and technical knowledge. The urban garden associations network "ReHd Mad!" also has this compromise with the urban garden associations. This stems as part of the good relations these stakeholders have, and as part of the negotiation process, in which the most important element was knowledge exchange. This is possible given that the power relations for these stakeholders is *power over* and *more power* accordingly, therefore their skills get complimented and augmented. These examples show that the building capacity element is sensitive to the power conditions executed by some stakeholders; moreover, they show that the power relations effect on the *capacity building* element presented can be interpreted as drivers for the process and outcomes of scaling-up urban NBS.

The element of *information and learning* addresses the presence of participatory monitoring and evaluation of innovation projects, which involves identifying indicators of change, as well as measuring impacts. This will be necessary in order to learn from, and gain credibility on, the effectiveness and extent of the impact of innovations, and to provide validated evidence.

Just as in the previous section of building capacity, it could be stated that the more power one stakeholder has, the higher its capacity to invest resources into monitoring. One type of learning measure possible is pilot projects. They are recognized as very eye-catching, especially for gaining the attention of the politicians; however, this requires financing (int.25). For the coordinator of EU projects for urban Ecology in the Municipality of Barcelona, it is very important to implement pilot projects and demonstrate that the project works and is efficient towards the proposed targets (i.e. be aware of that climate change, raise awareness by education), before replicating more of the same project.

The example of the open yard schools (PN2) and the superblocks (PN1) have provided evidence that the EU has *power over* the municipality, and the municipality has *power over* or *more power* than the other actors, respectively. This, however, has not been proven influential in the participatory monitoring and evaluation of the projects. It is in the best interest of all stakeholders involved, to measure impacts that enable the learning process, ultimately, they have similarly aligned goals to regenerate the city. These stakeholders also

consider that providing an evaluation of the impacts can be a way to legitimize their actions. The possibility of limited resources towards this element's implementation exists; however, it is a barrier that they try to overcome, given the benefits of the learning process and the identification of impacts, regardless of their positive/negative outcomes.

In Valladolid, this element is not easily met, (PN4) there is a lack of technology, that prevents obtaining measurable benefits of pilot projects, for example air quality, is not measured locally in one specific point next to the NBS, so the measurements will not be representative of those green walls or a green roof, but for a general area (int.8). This technical issue would require financial resources to be solved, but because the required technology is quite expensive, and therefore out of reach for such a municipality. Thus, in this example, power relations do not play a role. Finally, the results for the assessment of the element *information and learning* have provided insight into the fact that the power conditions have no influence on the element of information and learning towards effective scaling-up. There is no power struggle between stakeholders to implement this condition.

As per described by the name, *building linkages* references to developing partnerships and strategic alliances with other stakeholders, is one of the essential strategies for successfully scaling-up innovation. The research has identified the following linkages within the identified and previously described stakeholders. It is important to mention again, that the power relations, can influence the capacity of stakeholder to develop linkages and networks.

The linkages built can be in a horizontal level, (i.e. between urban garden associations) or in a vertical level (i.e. bottom-up or top-down). All stakeholders in the polycentric networks assessed have recognized the intrinsic value of networking, as it makes implementation processes more efficient and inclusive. This includes the cooperation between citizen groups and local government and or private companies. In this regard, many respondents seemed to think that a step forward has been made in the country (int.16, int.20, int.21, int.24, int.25).

The local government and the urban gardens or neighbourhood associations (PN1, PN2, PN3) work together and make progress together. This stems from the participatory processes and is communicated to society and when society is more aware, then it feeds back with more pressure so that active groups go further, and local governments contemplate going further as well. The municipalities are also obliged to address the issue raised by societal stakeholders to a certain extent. However, this does not necessarily mean that people are very aware of urban NBS issues and mobilised. So, despite the *power over* relations the municipality has over the other stakeholders mentioned, they do engage actively in building linkages.

There is the definite need to create synergies among all the stakeholders involved (PN4), when working with more than one department within the same municipality, in order to make the development process more efficient. The main way to overcome this is to have informal meetings or communications, whereas the formal one is through decrees or formal procedures of sharing the information. Given that the municipalities, as institutions, usually exercise *more power* than other stakeholders, it is important to have an approachable way to get all the relevant technicians involved. The power relations have some degree of

influence in the element of *building linkages*. If the stakeholders are in the same network, then it is more convenient for the stakeholder holding less power to reach out to the more powerful one in order to build linkages, given that this approach can empower the less powerful stakeholder. In this sense, the power relations can be interpreted as a driver, that would help scale-up the urban NBS innovations when all stakeholders from a polycentric network work together.

It is necessary for the interested stakeholders to *engage in dialogue* with civil society, as well as policymakers not only to gather support for innovations and projects but also to create the right institutional environment for innovations to be scaled-up. In the case of the urban gardens of Madrid (PN3), the urban garden associations network “ReHd Mad!” and the municipality engaged in dialogue resulting in the formalization of occupied spaces, this process had a duration of about 5 years (int.24). Currently, there is no need to achieve any regularization process. So, in that sense, the engagement in dialogue between policymakers and citizens has decreased. Given that in this polycentric network the municipality has *power over* the urban garden associations and the urban garden associations network “ReHd Mad!”, it can be recognized, that the process of engaging in dialogue has taken quite some time and effort, mainly lobbying from the “ReHd Mad!” and the urban garden associations; however, it has been successful.

In the municipality of Valladolid (PN4), this kind of process is quite simple, given that it is a small team. According to an interviewee, the municipality technicians and representatives are basically neighbours of the people implementing the initiatives, therefore the dialogue process is not so difficult as in bigger municipalities (int.8). It is important to mention that the power relation in this polycentric network is *different power*, therefore, by empowering the start-ups and entrepreneurs, the municipality is, in turn, aiming to potentially get better results.

“Before, talking to somebody at the municipality seemed inconceivable. You needed appointments and such. Now, it is like something that happens at very different levels. There is no need to go to the municipality.” (int.25).

The element of *engaging in dialogue* for effective scaling-up is influenced by the power conditions of the stakeholders, given that in general the stakeholders involved in urban NBS innovation have the same ultimate goals. However, some difficulties arise for the process of dialogue between stakeholders, those are attributed to bureaucracy and not precisely because of a lack of will. Given these conditions, the power relations played an important role in determining the prioritization of topics within the municipality, mainly as a barrier.

Finally, the last element for effective scaling-up processes is reliable *funding*, in order to be sustainable throughout time. Therefore, the donors or providers need to be lobbied by the interested parties to obtain sufficient long-term flexible funding. In Spain, about ten years back, the different levels of government had a big funding reduction, because of the country’s economic crisis. This has in the last two years started to bounce back, but the budgets are still not back to their previous amounts. The Regional Council had a cutback in

the case of environmental policies, of about 80%. In municipalities, the reduction was as big, but the budget was already very stressing in terms of so many competencies and required services to be provided for citizens (int.3). The municipalities funding for investment in urban NBS comes directly from the government. In general, if it's a government priority the budget gets increased. The main issue is that the municipality prioritises different tasks or projects within their limited budget (int.11).

An important consideration is that the shift towards naturalization does not necessarily save the budget, but it does save expenses (int.5). In that sense, the implementation of urban NBS is not considered less expensive by the municipality of Barcelona (PN1, PN2), because more knowledge, more monitoring and technicians are needed to manage these new solutions (e.g. presence of butterflies, vertebrates, air or soil conditions). There is a lack of willingness to take responsibility for new urban NBS, and this stems from the lack of budget allocation. Additionally, there is a kind of silo work culture within the municipalities, especially the big ones such as Barcelona (int.5, int.25). In the aforementioned polycentric networks, the power relations executed by the municipality was *power over* the involved stakeholders, except for the EU. Therefore, if the municipality does not have enough resources allocated it is considered a barrier for the upscaling of the innovation project.

"If saving the city €50m in problems involves me spending €1m from my budget, I'm not going to get any recognition for it or any more resources, I cannot do it because I'm giving €1m for free, I stop doing other stuff, other people are going to claim credit or the problem is not even going to happen so ... it is very difficult humanly and from the point of view of justifying the investment, unless you have the politicians saying, "This has to go the other way" and politicians, quite honestly, they have not got down to this level yet"
- (int.5).

Given the European Union power relation has resulted in having *power over* different stakeholders (PN2), and that their funding represents a small part of the general budget within the municipalities, but it is also useful from a strategic point of view (int.6, int.15), it is considered to have an impact on the upscaling element, by playing a clear role in the funding allocation. There are nonetheless some difficulties regarding the funding available from the EU (PN1), given that the funding is meant to increase the implementation of innovations, a project to scale-up the superblocks, i.e. develop 100 superblocks in Barcelona, was presented for funding from the EU by the municipality of Barcelona. The idea was to change the model of the mobility of the entire city, prioritize changes in traffic routes throughout the city. The funding was not granted, because the superblock initiative was "not innovative", given it was built before. However, the innovative challenge from that initiative's proposal was the scaling-up, to make a functional city with 100 superblocks (int.6, int.15), thus making the lack of financial input from the EU a barrier towards the upscaling of urban NBS.

According to one respondent, the biggest financial barrier is how the local governments execute the contracts and the budget allocation for consultancies. From her perspective, many municipalities procedures are slow in paying out the contract. In order to work with

municipalities and local governments, private companies must pay in advance for the implementation of the project, which is very hard for small companies (int.21).

“In Valladolid, we do not have subsidised innovation around particular types of NBS like green roofs. We could do it, in fact, we have the power to do it but we do not have any specific initiative so far. The reason is that we are not developed enough, after Urban GreenUP Project when we show to the citizens what can be done, what are the benefits, we can spread the word about what we are doing with the public buildings, then we can help to push.” – (int.8)

The financing provided by the Valladolid municipality started in 2017 and is open to any type of circular economy projects (PN4). The start-ups, the entrepreneurs, the associations that need or want to continue with activities, ask for those grants (int.8). Given that the municipality of Valladolid has *different power* to the entrepreneurs and start-ups, their power exercise is influential in the budget allocation; however as previously explained, it is in the municipality's best interest to develop several different pilot projects. After the analysis of the power relations in the four polycentric networks, it has been determined that not only the power relations have an influence in the elements of effective scaling-up, but also this influence can be interpreted as a barrier.

5. Discussion

This chapter discusses the results from this research, while also elaborating on the theoretical implications for the process and outcomes of scaling-up urban NBS. It does so by identifying and analysing different actors, including those who are not usually associated with particular NBS projects. This discussion addresses the interpretation of power relations between different societal stakeholder networks to explain further their role as a driver or barrier for urban scaling-up process and outcomes. Finally, and taking the results into consideration, this chapter also elaborates on the limitations of this research and lists recommendations for future research.

First, the analysis of the results of the desk research, interviews and the placement carried out during the data collection phase in Spain helped to define four polycentric networks involved in the development of urban NBS initiatives in Barcelona, Madrid and Valladolid. These polycentric networks are constituted by several different types of stakeholders from the government, the third sector, community and private companies. These stakeholders also have different aims to create: superblocks, open yard schools, urban gardens and lastly circular economy projects (see Table 4). These examples are included within the following NBS typologies from Almassy et. al. (2017): *urban green areas connected to grey infrastructure*, *green areas for water management*, *external building greenery*, and lastly *community gardens* accordingly. Findings from Spain are aligned with the literature review, which states that NBS include innovations in green space planning and neighbourhood redevelopment (Fan et al. 2017). Furthermore, all the innovations identified have potential to provide multiple benefits for a range of sustainability challenges facing cities; such as supporting improved health outcomes or create places for social interaction and recreation as stated by Almassy, Pinter, and Rocha (2017).

Results suggest that private companies, societal stakeholders' representatives and finally government representatives and technicians appropriately understand the importance of urban NBS, despite the absence of mandatory ordinances or laws dictating the implementation of such innovations. Although the most common term used is GI and not NBS, this finding does not point towards the lack of NBS implementation. Additionally, these results offer a context-specific overview that broaden the scope of current approaches towards improving the scaling-up process and thus the cities.

One stakeholder was present in all identified polycentric networks regardless of the city assessed: the municipality. This can be explained by its exclusive competence and responsibility regarding urban planning and urban greening of the city. All actions regarding urban NBS need to be legitimized, approved, financed or implemented by them. Another stakeholder present in three polycentric networks is societal associations: neighbourhood and urban garden associations, along with the urban garden associations network ReHd Mad!. Although the polycentric networks had different aims, i.e. superblocks, open yard schools and urban gardens, the presence of the associations empowered the citizens, enabling them to improve both communications within the associations and participation processes with municipalities.

Several stakeholders were involved in the development of the four identified typologies; however, private companies are the least represented group. This indicates that private stakeholders such as development or infrastructure companies are the least involved group in polycentric arrangements for urban NBS implementation in Spain. Given that, in theory, these private stakeholders have access to financial resources as well as strategic and technical knowledge, they may not need to rely on the empowerment that polycentric networks bring to different stakeholders, that is the advantage of using local knowledge and learning from others who are also engaged in trial-and-error learning processes (Ostrom 2010b).

Ostrom (2010a) also stated that how diverse polycentric institutions help or hinder the innovativeness, learning, adaptivity, trustworthiness, levels of cooperation of participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales should be addressed. This has been covered in this research by assessing the power conditions of the polycentric networks, with diverse results obtained.

According to academic literature, the changing relationships of power at all levels, as well as the capacity to execute power amongst different stakeholders, are critical to understanding governance outcomes (Buijs et al. 2016; Morrison et al. 2017). The assessment of the four identified polycentric networks have shed light on some generalities between them. The societal stakeholders have different conditions for exercising power: they have access to different types of resources; others have better networking skills. However, they all share the willingness to see their NBS initiative succeed and positively impact their city. An identified problem for the implementation of urban NBS is not the lack of knowledge, but instead, the different kinds of powers and interests that different stakeholders hold, i.e. different economic interests at hand to develop the same city. This supports the statement by Morrison et al. (2017), who argue that the asymmetric qualities of power, when left unchecked, have the capacity to affect the outcomes of polycentric governance.

An important finding is that the citizens associations sometimes lacked (technical) knowledge; however, one of their strengths was also having the skills to be able to resource the lacking knowledge, as confirmed during the exercise of power assessment. In all cases where citizens are involved, their initiatives have been proposed as a way to generate changes. Moreover, two or more different stakeholders from the polycentric network can be associated for a project development, complementing and empowering each other.

Lastly, the national government has power over the lower levels of government, and thus acted as a secondary stakeholder. This curtailed communication from the municipalities to the national government. Nonetheless, as previously explained, municipalities have certain degree of autonomy regarding urban NBS implementation. Therefore, this is the main reason why the national government has not been identified in any polycentric network. Additionally, if the relationship between the national level and the municipalities was more cooperative, the municipalities could provide the national government with successful innovation projects information that could help improve and speed up the upscaling process

of urban NBS at a national scale, given that the trial and error phases would already have been overcome at a municipal level.

The results also showed that in all the polycentric networks where the municipality was present it had *power over* or *more power* than the other stakeholders in that network. Only one exception was identified, the PN2, that also included the EU. In this case, the EU had power over the municipality, while the municipality still had *power over* the neighbourhood associations or the citizens, or *different power* than the consultant. The citizens were always the group with the least power; however, their grouping into a neighbourhood association or an urban garden association proved to be empowering, and thus having more impact in the communications with the municipality.

This research strived to fill one knowledge gap: although decision-making in complex governance systems is inextricably linked to questions of power (Marquardt 2017), the current research and literature available on polycentric governance does not clearly address the influence of power relations between different stakeholders (Morrison et al. 2017). In that sense, the scaling-up of urban NBS has been used as a subject to assess the effects of power conditions within polycentric networks.

The results of the power relations assessment for all polycentric networks (see Table 9) have shown that only one element was insensitive to the influence of power relations, i.e. *information and learning*, thus it cannot be considered a driver nor a barrier. This conclusion was reached given that it is in the best interest of all stakeholders in a polycentric network to engage in a learning process, regardless of their power relations. The remaining five elements are sensitive to the power relations; furthermore, *incorporating scaling-up considerations into project planning*, *building capacity* and *building linkages* have been identified as drivers. This interpretation has been reached given that a stakeholder's power positively correlates with its likelihood to be included in project planning. Having more power also drives the processes of *building capacity* and *building linkages*. Two elements were interpreted as barriers, *engaging in dialogue* and *funding*. These barriers are related to bureaucratic constraints and delays, as well as to budget allocation and prioritization, correspondingly. The first barrier of bureaucracy is linked to what Marquardt (2017) suggested: the more jurisdictions are involved decision-making, the higher the costs for coordination. Both barriers are also related to the stakeholders with the most power in the polycentric networks. This result is aligned with the conclusion by Roe and Mell (2013) that the environmental management by stakeholders appears to be hindered by an imbalance in stakeholder power.

Also, according to Pahl-Wostl and Knieper (2014), performance improved with increasing polycentricity of the governance system, defined as having a distribution of power along with effective coordination structures. This statement can be further supported by the results of this research as larger networks were more efficient and inclusive.

According to the literature, by understanding how power is perceived and shared amongst actors, assessing the potential consequences that shifts in power relations may have (Buijs et al. 2016), and accounting for this in policy frameworks, nature-based interventions can be designed to scale-up in more inclusive ways. Given that the results have shown that the

most powerful stakeholder is generally the municipality and that both barriers for scaling up urban NBS are also related to it, the policy frameworks could be improved to overcome these barriers. Results could be explored in more depth to empower certain stakeholders, such as societal stakeholders, to improve the imbalance of powers and in this way help them create the right institutional environment for innovations to be scaled-up. This would help tackle the barrier found within the *engaging in dialogue* element.

Municipalities' mindset should change from contractor to private/public partnership because of the important levels of investment needed for climate change adaptation and mitigation. This could be achieved by considering NBS that would improve long-term sustainability and foster knowledge exchanges. Additionally, private companies could be offered incentives for participating to enhance their interest. This policy suggestion would tackle the second barrier found regarding the *funding* allocation.

Finally, polycentricity requires a finetuned and dynamic balance between top-down and bottom-up governance (Pahl-Wostl and Knieper 2014). This statement can be further supported by the results of the studied polycentric networks. Three polycentric networks have societal stakeholders' presence, as neighbourhood associations or urban garden associations. Although these networks are not all necessarily bottom-up initiatives, they do include the input of citizens and their associations via the participatory processes that the municipality holds.

5.1. Limitations

The first limitation is the external validity of the information gathered by the interviews. Some interviewees may have been biased against the implementation of urban NBS, and the efforts each of the municipalities were making towards their implementation. Another factor that may have an impact on the reliability of this research, is the assessment or the interpretation of the results by the researcher. Therefore, as an effort to overcome these types of limitations, a broad number of interviews was conducted for each city, as well as thorough document analysis and placement, gaining multiple perspectives and in-depth observations.

A second limitation is the validity of the results of the four cities assessed to be extrapolated to the country level. This research strived to undertake and analyse as many interviews as possible within the time frame for this research. Given the results of the triangulation of sources, results seem to point out that findings from Barcelona, Madrid and Valladolid are indeed representative of the country's situation.

Finally, a third limitation is that no answer was received from the representatives of Victoria Gasteiz for interviews, although several attempts were made to reach out to them. This city has been a pioneer in urban NBS implementation and therefore was identified during the desk research phase as relevant; moreover, it was mentioned in several interviews as a very relevant example of urban NBS innovations.

5.2. Recommendations for future research

The results of this research have shed light on some topics that should be addressed for further research. These topics are presented in the following lines:

- Increase the number of assessed cities within Spain to confirm the findings of the present research: three drivers (incorporating scaling-up considerations into project planning, building capacity and building linkages) and two barriers (engaging in dialogue and funding). This can help obtain a higher validity when extrapolating the results to country scale.
- Participatory processes are part of Spain's governance system, stemming from cultural tradition. This governance arrangement may not necessarily be institutionalized in different countries; therefore, undertaking another research with similar research goals using different countries as case studies can be helpful to determine the consistency of the power relations found in the present research.
- Adopt the identified drivers and the possible ways to mitigate the two barriers for effective scaling-up: 1. empower certain stakeholders, such as societal stakeholders, to improve the imbalance of powers, 2. change the municipalities' mindset should from contractor to private/public partnership given the important levels of investment needed for climate change adaptation and mitigation; to foster the upscaling of the current adaptation actions to bolster cities deal with urbanization pressures.

6. Conclusions

Previous research has given more attention to the structural patterns of networked institutions in polycentric systems than the configuration of power relations across those networks. Given that polycentric governance involves both a configuration of institutions and power, this research has addressed the following research question:

“How can the power relations between different societal stakeholder networks serve as a driver or barrier for the process of scaling-up urban NBS and what kind of dynamics characterize those relationships?”

This question has been answered by focusing on Spain as a case study. The data collection phase included: desk research, interviews and a placement. These actions helped identify and analyse four polycentric networks of stakeholders, including those who are usually not associated with particular urban NBS projects, e.g. societal associations. One stakeholder was present in all identified polycentric networks regardless of the city assessed: the municipality. Societal associations had presence in three polycentric networks, and suggested that such presence empowered the citizens, enabling them to improve both communication within the associations and participation processes with municipalities. Results have shown that the power conditions exercised by a stakeholder within a polycentric network can be interpreted as a driver for the following three out of the six elements of effective scaling-up: *incorporating scaling-up considerations into project planning, building capacity and building linkages*. Two elements we identified as barriers: *engaging in dialogue and funding*.

The first barrier identified, is the lack of efficient communication to engage in dialogue leading to bureaucratic constraints and delays; and the second is the sporadic prioritization of the urban NBS implementation. The power conditions have not been considered to having any influence on the element of *information and learning*, thus it cannot be considered a driver nor a barrier. The way these elements of effective scaling-up can be identified as a driver or barrier, is determined by the stakeholder who exercises *power over, different power or more power*. In general, the municipalities are the decisive stakeholder regarding the urban NBS implementation, therefore both barriers are related to it.

Finally, the main contribution of this research is the development of a relevant framework that merges the research of power relations to assess scaling-up outcomes as a new approach that can help determine in future situations which stakeholder should be further empowered to achieve a certain goal.

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8. Appendix

8.1. Overview of relevant policy documents revised

N°	Policy document	Link
1	Law on Natural Heritage and Biodiversity (2007)	https://www.boe.es/buscar/pdf/2007/BOE-A-2007-21490-consolidado.pdf
2	Ministry of Agriculture and Fisheries, Food and Environment. Third Work Programme of the National Plan for Adaptation to Climate Change 2014-2020	https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/3er_programa_trabajo_pnacc_tcm30-70400.pdf
3	Ministry of Agriculture and Fisheries, Food and Environment (2016). Climate Change Adaptation Strategy for the Spanish Coast	https://www.adaptecca.es/sites/default/files/editor_documentos/Estrategia_Adaptacion_al_CC_de_la_Costa_Espanola_2016_Aprobada.pdf
4	Spanish Office of Climate Change, Ministry of Agriculture, Food and Environment (2015). Guide to creating local climate change adaptation plans.	https://www.researchgate.net/profile/Carlos_Tapia_11/publication/308652841_Guia_para_la_elaboracion_de_Planes_Locales_de_Adaptacion_al_Cambio_Climatico_Volumen_II_Bloque_3_Herramientas_y_metodologias/links/57ea47a008aeb34bc092b6be/Guia-para-la-elaboracion-de-Planes-Locales-de-Adaptacion-al-Cambio-Climatico-Volumen-II-Bloque-3-Herramientas-y-metodologias.pdf
5	Royal Decree on flood risk assessment and management (2010)	https://www.boe.es/buscar/doc.php?id=BOE-A-2010-11184
6	MINISTRY OF THE ENVIRONMENT and rural and marine environment (2011). Spanish Strategy for Urban and Local Sustainability	https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/medio-ambiente-urbano/EESUL-290311-web_tcm30-181850.pdf
7	Barcelona Municipality (2013). Barcelona's green infrastructure and biodiversity plan	http://w110.bcn.cat/MediAmbient/Continguts/Documents/Documentacio/BCN2020_GreenInfraestructureBiodiversityPlan.pdf
8	Barcelona Municipality (2012). Citizen commitment to sustainability	http://www.sostenibilitatbcn.cat/attachments/artic/e/413/Commitment_22_UK_web.pdf
9	Ministry for the ecological transition (2006). Spanish National climate change adaptation Plan	https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/plan-nacional-adaptacion-cambio-climatico/

N°	Policy document	Link
10	Ministry of Agriculture, Food and Environment and the Urban Ecology Agency of Barcelona (2012). Green book of urban and local sustainability in the information era	https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/medio-ambiente-urbano/Libro%20Verde%20Final_15.01.2013_tcm30-181854.pdf
11	Barcelona Municipality (2014). Barcelona Urban Mobility Plan for 2013-2018	https://www.barcelona.cat/mobilitat/sites/default/files/1_pdfsam_PMU_BCN_2013-2018_definitiu2.pdf
12	Barcelona Municipality (2015). Guide to living terrace roofs and green roofs	https://bcnroc.ajuntament.barcelona.cat/jspui/bitstream/11703/98795/5/Guia%20de%20terrats%20vius%20i%20cobertes%20verdes%20angl%C3%A8s.pdf
13	Barcelona Municipality (2013). Barcelona Green Infrastructure and Biodiversity Plan 2020.	https://climate-adapt.eea.europa.eu/metadata/case-studies/barcelona-trees-tempering-the-mediterranean-city-climate/11302639.pdf
14	Barcelona Municipality (2017). Technical Plan for the Use of Alternative Water Resources of Barcelona in 2017.	https://bcnroc.ajuntament.barcelona.cat/jspui/handle/11703/112398
15	Barcelona Municipality (2017). Program for the Impulse of Urban Green Infrastructure.	https://bcnroc.ajuntament.barcelona.cat/jspui/bitstream/11703/104927/1/esp_Mesura%20de%20govern%20increment%20verd_08_06_2017.pdf
16	Barcelona Municipality (2018). Climate Plan 2018-2030.	http://lameva.barcelona.cat/barcelona-pel-clima/sites/default/files/documents/eng_climate_plan_def.pdf
17	C40 Cities: Case study: The implementation of the Superblocks programme in Barcelona: Filling our streets with life.	https://www.c40.org/case_studies/barcelona-superblocks
18	FEMP, Spanish Federation of Municipalities and Provinces (2019). Guide of the Municipal Green Infrastructure.	http://www.redbiodiversidad.es/gesti%C3%B3n-de-infraestructuras-verdes
19	Madrid Municipality (2017). Madrid + Natural.	https://www.madrid.es/UnidadesDescentralizadas/UDCMedios/noticias/2016/11Noviembre/08Martes/NotasdePrensa/M%C3%A1s%20natural/ficheros/M+N_dossier.pdf
20	Ministry of Development (2019). Spanish Urban Agenda.	http://www.aue.gob.es/sites/aue/files/aue_doc_completo_22_02_19.pdf

N°	Policy document	Link
21	Ministry of Agriculture, Food and Environment, and the Urban Ecology Agency of Barcelona (2012). Green Book on Urban and Local Sustainability.	https://ovacen.com/wp-content/uploads/2013/11/libro-verde.pdf
22	Ministry of Agriculture and Fisheries, Food and Environment. (2017). National Strategy for green infrastructure and ecological connectivity and restoration.	https://www.miteco.gob.es/es/biodiversidad/temas/ecosistemas-y-conectividad/basescientifico-tecnicasseeivcre_tcm30-479558.pdf

8.2. Informed consent for interviews

(Taken from NATURVATION project (van der Jagt et al. 2017)).

This form is to make sure that you have been given information about this research project. It is to confirm that you know what the project is about and that you are happy to take part.

Please check the boxes you agree with below and delete as appropriate where * is indicated:

- I know what the project is about.
- I wish/ do not wish to have my anonymity protected.
- I confirm that the interview/meeting/discussion can be recorded, and an anonymous/ non-anonymous* record can be securely kept for future reference.
- I understand the terms under which this record and any additional information I provide will be stored.
- I am aware that I do not have to answer all the questions that I am asked, and I reserve my right to refuse or cease participation in the interview process, and to request keeping certain materials confidential.
- I would like/ would not like* to take part in this research project.

Please sign below to confirm the information given above is correct:

Research Participant:

Name(s):

Signature:

Date:

8.3. Interviewee table

Interview code	Key category of actor	Name	Organization	Function/Job Title	City
1	National government	Tania López-Piñeiro Perez	Ministry of the Environment, Rural and Marine Affairs	Head of the Strategies and Conservation Area	Madrid
2	National government	María Pita Fernández	Ministry of the Environment, Rural and Marine Affairs	Green Infrastructure Specialist	Madrid
3	Sub-national government (regional, urban)	Carles Castell Puig	Barcelona Regional Council	Green Infrastructure Planning Expert	Barcelona
4	Sub-national government (regional, urban)	Toni Pujol	Barcelona Municipality	Environment Officer	Barcelona
5	Sub-national government (regional, urban)	Gabino Carballo	Barcelona Municipality	Support to the Conservation and Biodiversity Department	Barcelona
6	Sub-national government (regional, urban)	Enric Cremades	Barcelona Municipality	Coordinator European Projects for Urban Ecology	Barcelona
7	Sub-national government (regional, urban)	Luis Tejero, General	Municipality of Madrid	Directorate of Sustainability and Environmental Control	Madrid
8	Sub-national government (regional, urban)	Alicia Villazán	Valladolid Municipality	Urban Green UP Project Manager	Valladolid
9	Sub-national government (regional, urban)	Carlos Sánchez Cerveró	Valencia Municipality	Managing Director of Valencia Climate and Energy	Valencia

Interview code	Key category of actor	Name	Organization	Function/Job Title	City
10	Politicians	Roberto Jaramillo Martinez	Valencia Municipality	Councilor for Innovation, Renewable Energy and Climate Change	Valencia
11	Ecological Restoration company	Salvador Rueda	Urban Ecology Agency of Barcelona	Director of the Urban Ecology Agency of Barcelona - Biologist	Barcelona
12	Policy advisory organisations (e.g. knowledge institutes)	Roberto Soto Fernandez	Projects and Works Management, IMU	Architect	Barcelona
13	Policy advisory organisations (e.g. knowledge institutes)	Pedro Calaza		Consultant for Municipal green infrastructure management	Madrid
14	Policy advisory organisations (e.g. knowledge institutes)	Francesc Baró	Autonomous University of Barcelona	Environmental Scientist, ICTA (Institute of Environmental Science and Technology)	Barcelona
15	Policy advisory organisations (e.g. knowledge institutes)	Maria Ramos Sanz	Aresta Engineering	GIS Specialist	Barcelona
16	Development companies	Roser Campeny	Minuartia	Expert in ecological connectivity, conservation strategies, and biodiversity monitoring	Barcelona
17	Development companies	Clara Rovira	Suez Biodiversity Spain manager	Biodiversity manager	Madrid

Interview code	Key category of actor	Name	Organization	Function/Job Title	City
18	Development companies	Sara Perales	Civil Engineer/SUDS specialist - GreenBlueManagement	GreenBlueManagement Manager, engineer of Roads, Canals and Ports.	Valencia
19	Development companies	Valentin Alfaya	Ferrovial Construction company	H&S, Quality and Environment Director	Madrid
20	Architects and landscape designers	Elena Albareda	Polytechnic University of Catalunya / Ciclica founding partner	Architect, ecological urbanism, landscape ecology and sustainable land management	Barcelona
21	Architects and landscape designers	Pilar Diaz Rodriguez	Paisaje Transversal	Architect, sustainability expert, citizen participation and housing energy rehabilitation	Valencia
22	Ecological Restoration company	Adrián Mohmed	Creando Redes - Ecological Restoration company	Biologist, expert in technical training for the private and public sectors	Madrid
23	Lobby groups/Trusts /Charities	Ángel Cano	Climate Reality Spain and Responsible for Despierta Association	Director of communication (NGO)	Madrid
24	Lobby groups/Trusts /Charities	Aida Rodriguez Garcia	Urban garden network of Madrid	Urban garden activist	Madrid
25	Policy advisory organisations (e.g. knowledge institutes)	Francesca Olivieri	E.T.S Architecture - itdUPM, Polytechnic University of Madrid	NBS specialist	Madrid
26	Lobby groups/Trusts /Charities	Martí Ballada	Poblenou Superblock Association	Superblock activist	Barcelona

8.4. Semi-structured interview guide

(Taken and adapted from NATURVATION project (van der Jagt et al. 2017)).

Research topic: Elements of effective scaling-up	Guiding questions
Incorporating scaling up considerations into project planning	<p>What steps are needed to promote sustainable urban development and NBS in particular?</p> <p>Which stakeholders or actor groups could play a role in this?</p>
Building capacity	<p>What knowledge, skills, abilities, or relevant experience do stakeholders use to contribute to sustainable urban development?</p> <p>How is key knowledge and expertise acquired and shared?</p> <p>Are sustainability targets and priorities articulated by stakeholders? How do stakeholders perceive sustainability, and do they contribute to sustainable urban development? What are drivers of or motivations for prioritising (or not prioritising) sustainable urban development?</p>
Information and learning	<p>Which technologies, material features and physical geographies shape sustainable urban development, and in what way? What tools (e.g. models) structure decision-making?</p>
Building linkages	<p>Who are the key stakeholders, actor groups, organisations or networks and what are their roles and activities in the implementation of urban NBS?</p> <p>How does the governance structure and associated power relations shape sustainability outcomes?</p> <p>What is the demand for sustainable urban development? Who are the main users and customers for interventions that promote sustainable urban development?</p> <p>Is there disagreement between stakeholders about the key opportunities and challenges?</p>
Engaging in dialogue	<p>What are key government policies, regulations, strategies and visions, and associated instruments, that support or hinder sustainable urban development, and in what way? What is the objective and (potential) impact of the relevant policies?</p>
Funding	<p>What are key financial resources used for the provision of sustainable infrastructures? What are the main business models or instruments to raise capital for sustainable urban development or regeneration?</p>

8.5. Placement guidelines

(Taken from NATURVATION project (van der Jagt et al. 2017)).

A placement at key organisations is intended as a means of data collection on the day-to-day decision-making processes and practices that sustain existing regime conditions or shape urban sustainability and the ways in which the implementation of NBS challenges these conditions. This document provides guidance on what a placement is and how to use it, the selection of an organisation to host the placement and data collection during the placement.

What is a placement?

The general objectives of a placement are to observe the (regime) conditions that shape decision-making in the organisation and the domain it is part of. The duration of a placement is one week in total, yet can also be spread out in time, e.g. one day a week for a month. A placement can take several shapes. Key is that the researcher is loosely affiliated to a host organisation for about a week (e.g. during their visit to the country for interviews). The researcher can use this affiliation to arrange interviews or take part in meetings.

The minimum requirements for a placement are an entry and exit talk with a key informant in the organisation, in which the research questions and the analytical dimensions of the regime are discussed, plus one or two of the following activities (some of which may also make it more attractive for organisations to host the researcher):

- Take part in meetings
- Write a blog about an NBS related theme, e.g. the barriers for urban sustainability interventions you observe in ‘their’ domain
- Offer to be a note taker in their meetings – do make sure which part of these notes you can and cannot use for your case studies
- Join (or organize!) an excursion with staff
- Identify a project the organization is working on that is of interests to the research and offer advice/help: be a ‘NATURVATION consultant’ for a week
- Give a lunch lecture, either on NBS, our research or on your observations over the week(s) at the organization
- Question staff about their decision-making processes, networks they are involved in, etc.
- Host a focus group: share first impressions on regime structure and invite feedback
- Other: please feel free to come up with other types of affiliations to the organization that benefit the research (and potentially the organization as well)

8.6. Identified stakeholders' details

The analysis has shed light on the fact that in general, *citizens* are currently more ecologically aware than before, and appreciate how sustainability is linked to NBS. However, it is necessary to highlight that with respect to the terminology, citizens do not call out for urban NBS specifically, but for the components or the benefits these kinds of innovations would bring to them personally or their surroundings, e.g. they do call upon more green spaces in their neighbourhoods, such as street trees, or rain gardens. This is a very common practice in Barcelona (int.5, int.12). They are mainly engaged in lobbying. Also, as a general note, the term Green Infrastructure is more commonly used than NBS by citizens (int.8, int.9, int.10, int.16, int.20, int.21, int.22, int.24, int.25). This, however, does not imply that GI is more frequently observed than urban NBS.

An important link in the networks are the *neighbourhood associations*. They have been referenced by several interviewees as present in the three cities. They have been defined as groups that have a common interest and get together in order to have a more powerful voice while communicating with their municipality or local politician/representative. Their main activity is lobbying. In Spain, citizens have a very strong sense of identity; therefore, they like to get involved with the city development, especially to seek out demands from and by their local government or representatives (int. 10, int. 20, int.21, int. 25). Citizen participation has been a common practice in Spain for years, but more specifically in Catalunya (i.e. Barcelona).

Having similar attributes and objectives as the neighbourhood associations, are the *urban garden associations*. These have presence in all the assessed cities. The idea of creating urban garden associations was generated by the fact that the urban gardens were being developed in vacant lots without formal permission or license by the municipalities or lot owners, in a sense, the neighbours were taking over the abandoned space and regenerating or repurposing those areas. Therefore, they needed to have a formal organization in order to engage in dialogue with the authorities in the process of formalization. They are mainly engaged in lobbying and urban garden implementation. As one of the interviewees explained, having the constant fear that your space, effort and work will be taken away at any time, is a good reason to foster a joint movement that leads to an organized association (int.24). As far as the motivation for the citizens to join a formal urban garden association goes, they recognize it is because it is a green area within a city and thus it generates many psychological, emotional and health benefits. Many citizens also approach community gardens for training reasons, because they want to learn how to seed or how to harvest. Some retired citizens want to have a quiet relaxed place to spend their free time. There are also people who have a vision that goes far beyond urban gardens and they understand that these gardens are spaces for urban transformation, these people also have a somewhat more activist driven mindset. They involve changes in the behaviour of the individuals that participate in them. That enables interaction with people who are very different from the ones who can be encountered in usual spaces, in terms of age and social groups (int.24). In Madrid, the community gardens associations have come together to form a very active network of urban gardens associations: "reHd Mad!".

Finally, a relevant *cultural association* identified in Madrid is Despierta [*Wake up*], it organises events and forums to try to share academic knowledge, as well as successful innovative ideas through the commentaries and roundtables (int.23). They are mainly engaged in lobbying and knowledge dissemination. This association aims to share scientific knowledge in a less academic language, one that all citizens can be able to understand. It has the capacity to gather several stakeholders from the other groups (i.e. Government and Private companies), in order to exchange knowledge or project initiatives. Taking this into consideration, it may also be possible that it has developed a lobbying capacity, although no evidence of this has been found. This cultural association is not part of a specific network; however, given its active involvement with the community for lobbying actions towards knowledge exchange between different stakeholders, it has been considered relevant.

Start-up companies have also been identified as an important stakeholder. However, their presence has only been acknowledged as relevant in Valladolid (int.8). They are mainly entrepreneurs or associations who are interested in developing a small business model, and mostly base that model in circular economy. Therefore, their main activities are knowledge development and project implementation.

Another important stakeholder identified throughout Spain are the *private consultants* (int.13, int.15). They mainly execute tasks as intermediaries between private companies, the local governments or the European Union in order to promote knowledge exchange and improvement of innovation projects for grants proposals. Their main activity is knowledge development.

The Urban Ecology Agency of Barcelona [*Agencia de Ecología Urbana de Barcelona*] is another important stakeholder with a very strong presence in Barcelona, it is a *public-private agency*. They undertake projects on behalf of public institutions, foundations, organizations and companies of national and international scope. It applies a systemic approach to redirect the management of cities towards a more sustainable model, providing solutions in mobility, energy, waste, urbanism, water, biodiversity and social cohesion (int.11). Their main activity is knowledge development. About 15% of their budget is coming from the municipality itself, and they also have funding partners the Metropolitan Area of Barcelona and the Provincial Deputation of Barcelona. The Urban Ecology Agency of Barcelona also generates income by undertaking private consultancies. In Barcelona, there is a supramunicipal Metropolitan Area of Barcelona, which includes 43 municipalities. It manages the green areas, wastewaters, beaches, transport, metro, among others. The rationale behind this supramunicipal Agency is that this is at the scale where policies have to be made, in order to have efficient management of the territory (int.3). However, none of the identified stakeholders other than the Urban Ecology Agency of Barcelona, have specified interaction with this supramunicipal agency. Finally, the Urban Ecology Agency of Barcelona has contributed to publishing the Ecologic and ecosystemic urbanism plans, sustainable mobility plan, and the superblocks conceptualization for the Municipality of Barcelona, as well as organized technical courses regarding these topics (e.g. ecosystem-based planning). Although these documents are not explicitly focused on NBS, they include some of the typologies as a complementary technology to help achieve sustainability targets, i.e. superblocks. This agency is a knowledge hub that gathers technical information from their

own research, as well as from the partnerships they have with the academia, the municipality or private developers.

In Spain, many competences from the top levels of *government* (National, Regional, Provincial) are transferred to autonomous communities or municipalities; for example, urban planning and urban greening is a competence of the municipality (int.1, int.2, int.14). Municipalities have the liberty to determine their organizational structure, thus not all municipalities departments have the same competences. Their main activities are regulation, financing, implementation. The higher levels of government are mainly related to regulation. For example, Valladolid has an innovation agency in place, that depends on the financial department, their main goal is to focus on innovation project funding, but some projects might include urban NBS innovations. Innovation agencies can support the process of networking, by working across departments and seeking external partners or funding such as the EU. However, Valladolid is the only municipality from this research with such an agency in place; it requires a political commitment for this to happen (int.8). In the other municipalities included in this research, the Department of Environment or similar is usually the department most directly responsible for the development of GI and NBS. It can also be the responsible department for implementing innovative projects such as sustainable urban drainage systems and water management (int.7). For this reason, the municipality has been placed in a separate circle within the stakeholder map. It oversees the regulation for the implementation of the urban NBS; however, not all initiatives are directed by the municipalities. Therefore, the previously identified stakeholders must have a level of interaction during the implementation of their selected urban NBS. The three municipalities assessed have an open participatory culture, they have a website where the citizens can write their concerns and demands concerning urban regeneration, so they can later be assessed during the participatory assemblies. If one of the proposed initiatives is deemed relevant and affordable by the municipality officials, they are preselected for an open vote in the website, and thus incorporated in the planning if approved.

There is a Network of Local Governments + Biodiversity, it aims to create a stable framework that encourages and promotes, in the whole of the Local Governments of Spain, the adoption of policies, plans and programs related to the conservation and promotion of biodiversity, the protection of the water cycle, the restoration of degraded natural spaces, the improvement of ecological connectivity and the safeguarding of ecosystems. This network works on a knowledge generation base, and they do not provide funding or implement projects. Therefore, their main activities are knowledge development and dissemination.

On a side note, it has been renamed and restructured several times during the last years, creating a degree of miscommunication with the relevant municipalities (int.9, int.10, int.5). In line with these functions, the Law 42/2007 (Natural Heritage and Biodiversity) imposed an obligation on autonomous regions to improve the connectivity of protected natural areas. The 2015 update of this Law (33/2015) obliges the national government to develop a National Strategy for Green Infrastructure, Connectivity and Ecological Restoration [*Estrategia Estatal de Infraestructura Verde y de la Conectividad y Restauración Ecológica – EEIVCRE*] with the participation of the Autonomous Communities. This Law intends to

comply with the Communication of the European Commission on Green Infrastructure and also to incorporate some of the objectives of the EU Strategy on biodiversity up to 2020. The regional authorities are obliged to prepare their own strategies with input by municipalities in response to this within three years of publication of the national strategy (int.1, int.2, int.13). There is no obligation for municipalities to prepare a GI strategy based on this cascading down (int.1, int.2).

The regional governments are supramunicipal entities, they do not exercise government action, nor are they elected by the population, they are elected with the same group/party and at the same time as the municipalities. The deputation is organized with councillors of the municipalities of the province. They have no competences to approve plans or budgets; however, they do have a budget of their own assigned by the national government. The main task of the deputation is support to the municipalities. They provide small municipalities (5000 inhabitants or less) with resources and technical expertise in case of need (int.3, int.9, int.10). That support has been done in different ways, for now, it is giving resources. In large cities like Barcelona, this does not happen to the same extent because they have a lot of capacity and resources (int.14). Regional governments and municipalities have a lot of autonomy from the central government (int.7). As a result, there is a considerable variation across the autonomous regions in the extent to which green infrastructure is implemented (int.1, int.2).

On a more global level, a supranational actor, the European Union (EU) was mentioned, given that it funds several projects regarding NBS innovation in Spain, like Urban GreenUP Project in the city of Valladolid (int.8), NATURVATION with liaisons in the city of Barcelona (int.6, int.15), and finally GrowGreen in Valencia (int.21). This platform is a good area to exchange projects information, because they get to see more projects from Europe, assessing and understanding the cooperation processes, the methodologies so it is also considered a learning platform for urban projects (int.21). The United Nations (UN) was mentioned, but only because the project developers believe it is also in their own interest to comply with the UN guidelines, such as Sustainable Development Goals – SDGs. This mention seems to give the project holders a sense of legitimacy for their projects, but there is no direct relationship with the urban NBS development and the SDGs.