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Environmental and climate policy integration: Targeted strategies for overcoming barriers to nature-based solutions and climate change adaptation

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ABSTRACT

Nature-based adaptation planning is a challenging endeavor, not least because it requires transdisciplinary approaches to unite different actors' efforts and capacities. However, empirical knowledge on associated governance processes is scarce and fragmented. Against this background, this paper examines the integration of nature-based approaches for climate change adaptation into municipalities' daily planning practices and associated governance. A city-to-city learning lab was established to systematically analyze selected urban development projects step-by-step, from the initial idea, to comprehensive and detailed planning, procurement, implementation, maintenance and follow-up. The results show the numerous constraints municipal staff face and how they use targeted strategies to overcome them and tap into existing drivers. We identify five, complementary strategies: i) targeted stakeholder collaboration; ii) strategic citizen involvement; iii) outsourcing; iv) the alteration of internal working structures; and v) concealed science–policy integration. Importantly, these strategies reveal an increasing need for relational approaches that, in turn, require individuals to develop the cognitive/emotional capacity to establish trust, communicate inclusively and promote social learning, while at the same time dealing with an increasingly complex and uncertain working environment. We conclude that tapping into the potential of nature-based solutions for climate adaptation governance requires more financial and human resources, and capacity development to support personal development, systematic mainstreaming and, ultimately, more sustainable development.

1. Introduction

Urban areas are human–environment systems that depend, fundamentally, on ecosystems. Accordingly, the concepts of ecosystem services (ES) and nature-based solutions (NBS) are new approaches that recognize the dependence of human societies and their development on natural systems (MA, 2005; EC, 2015). It is hoped that they can broaden the focus regarding the fundamental human relationship with nature and create multiple benefits, including climate change adaptation (CCA) (Folke et al., 2011; Naumann et al., 2014). (see Fig. 1)

Consequently, sustainable urban development requires an understanding of the management of NBS for CCA, and their mainstreaming or integration into urban planning and governance (Hansen et al., 2015; Luederitz et al., 2015; Nordin et al., 2017; Wamsler et al., 2017). Such work has to take place at municipal level, where international and national legislation and policies are translated into practice (Beery et al., 2016).

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However, nature-based planning and associated climate governance is a challenging endeavor for municipalities worldwide (Beery et al., 2016; Brink et al., 2016; Carter et al., 2015; Wamsler et al., 2017), not least because they require transdisciplinary approaches that unite different actors' efforts and capacities (Nesshöver et al., 2017). In addition, both ES and NBS concepts focus on the human–environment system and not existing administrative and political structures, or societal institutions and processes (Beery et al., 2016; Kabisch et al., 2016; Primmer and Furman, 2012; Galaz et al., 2008). They are, thus, not an integral part of existing policy and governance structures (Connop et al., 2016; Kabisch et al., 2016; Pauleit et al., 2017). At the same time, knowledge of governance processes that have the potential to support nature-based planning and adaptation through the (increased) involvement of internal and external stakeholders is scarce and fragmented (Brink et al., 2016; Wamsler et al., 2017; Wamsler, 2015).

Against this background, this paper examines the integration of nature-based approaches for CCA into municipalities' daily planning practice and associated governance mechanisms. It begins with a description of the methodology (Section 2), then the results are presented as a set of identified patterns regarding strategies that municipal staff employ to tap into existing drivers/potentials and overcome multiple constraints (Section 3). Finally, we discuss the relevance of the results in relation to the current literature and practices, and conclude with some policy recommendations and further research needs (Section 4).

2. Methodology

This paper is based on an applied participatory analysis (Burns, 2007; Glassman and Erdem, 2014; Greenwood and Levin, 2006) of Swedish municipalities in order to explore, compare and learn from the integration of nature-based approaches into their daily planning practice and associated governance mechanisms. Data are drawn from a transdisciplinary learning lab that was run in 2018, in the southern region of Scania.

Sweden is an interesting subject for case studies in this field. It is a declared pioneer in climate change and environmental governance (DC, 2014; Hertin and Berkhout, 2001; Jordan and Lenschow, 2000) and tops the Global Green Economy Index (DC, 2014). Furthermore, CCA and the consideration of ES are stated government goals (SOU, 2007; SOU, 2013; Ministry of the Environment, 2013), and the Scania region has made particular progress (Länsstyrelsen i Skåne län 2014).

Consistent with the applied participatory approach, municipalities were selected based on four criteria: (i) their risk exposure (Länsstyrelserna, 2012; SMHI, 2011), (ii) the role and proactive engagement of their staff in promoting NBS and CCA, and (iii) their interest in participating in the learning lab. A further criterion was the inclusion of municipalities of different sizes to support inclusive knowledge co-creation. This brought together representatives from five municipalities (Malmö, Lomma, Eslöv, Höganäs and Kristianstad) and scholars from different backgrounds. Six scholars from three academic institutions and eight municipal representatives participated and jointly engaged in all phases of data collection and analysis.

The lab built upon local actors' desire for increased knowledge exchange and their particular needs, which were identified during a joint workshop in 2017.[1] Each municipality selected relevant cases of NBS for CCA, which were subject to a step-by-step analysis that encompassed the initial project idea, comprehensive and detailed planning, procurement, implementation, maintenance and follow-up (monitoring and evaluation). Specific questions were: When, how and why is nature and climate adaptation considered? Who is involved, when and why? What are the structures, mechanisms and tools that support integration and associated internal and external cooperation? What are the differences and what can we learn from them to advance nature-based planning and adaptation? Four of the cases focused on the creation of new residential areas, while three targeted interventions within existing areas, notably green private–public nodes, a school complex and a green embankment (Appendix A).[2]

Data were collected in 2018–19 during a series of workshops and field visits, group discussions, participatory observations, interviews, videos, case-specific literature reviews and ongoing dialogue between the lab participants. A total of seven case-specific workshops, five field visits, five video recordings,[3] and 12 interviews were conducted and transcribed. Additional workshops on related topics (urban greening and stakeholder engagement) enabled further dialogue throughout the process. Data were analyzed with a combination of literal reading, Grounded Theory (Glaser and Strauss, 1967) and Systems Theory (Bateson, 1979) and systematized, based on a jointly-developed analysis framework (Appendix B) that built upon latest research and theories on environmental and climate policy integration/mainstreaming (Runhaar et al., 2018; cf. Wamsler and Pauleit, 2016; Wamsler and Brink, 2018). Here, *mainstreaming* relates to the systematic integration of environmental and climate adaptation considerations and related stakeholder involvement at local, institutional and inter-institutional levels (cf. Persson et al., 2018). It includes changes in policy, regulations, planning tools, working structures, mandates, finances and human resources (Runhaar et al., 2018; Wamsler 2014; Wamsler and Pauleit, 2016) that span personal, practical and political spheres of transformation (cf. O'Brien and Sygna, 2013). The identification and analysis of relevant data was organized into five phases: (1) the development of a coding scheme consistent with the analytical framework, (2) identification of potentially-relevant extracts, (3) application of the coding scheme, and (4) identification of patterns. Finally, (5) preliminary results were discussed with all lab members before they were revised and finalized.[4]

3. Results

The results reveal that five strategies are pursued by municipal staff and individual champions to tap into existing potentials and

[1] The city-to-city learning lab was an outcome of a joint workshop organized by Mistra Urban Futures Skåne and the Skåne Association of Local Authorities, at Malmö Högskola University on April 27th, 2017, including both municipal staff and academics working in the field.

[2] Unlike the existing literature on citizen involvement related to NBS and/or CCA, this study did not start with a focus on (selecting) relevant cases of (successful) citizen involvement. Instead, it focused on projects relevant to NBS in urban CCA, and how they have been influenced by citizen involvement. This different starting point allowed for new perspectives and a more critical analysis of current mechanisms and structures.

[3] All municipalities made a short video to present their cases and elaborate on the following questions: i) How have you integrated NBS to support urban sustainability and climate adaptation?, ii) What are the main drivers that support this integration?, iii) What are the main barriers for further integration?, and iv) What is the value of working with different stakeholders in the city-to-city learning lab?.

[4] Due to the study's methodology (i.e. its applied participatory analysis and associated knowledge co-production), municipal stakeholders could actively take part in all research phases, from the definition of the research aims to data collection and analysis, and are thus also included as co-authors of this study. Such inclusion is increasingly recognised as being crucial for supporting transdisciplinary processes and the quality of related outcomes (Brink et al. 2018). At the same time, the academic participants ensured the adequacy of the scientific approach and analyses, and citations (marked with quotation marks) are anonymized in order to provide insights without compromising privacy.

overcome multiple constraints (Table 1). These are: (1) targeted stakeholder collaboration, (2) strategic citizen involvement, (3) alteration of internal cooperation structures, (4) outsourcing, and (5) concealed science–policy integration. All cities pursue all of these strategies to a certain degree, while in each case one dominates due to local conditions and context. The following subsections present each strategy and related patterns; they provide concrete examples of activities and how they relate to existing local potentials, constraints, and contexts, and how they link to other strategies/approaches.

3.1. Targeted stakeholder collaboration

This strategy is characterized by the targeted involvement of the private sector, academia and/or other local authorities to support single activities and increase policy support for NBS/CCA. It is based on the assumption that "solid knowledge enables solid decisions" in a context where "institutional knowledge is very limited". External stakeholders are thus mainly involved in the development of expert assessments or providing advice (regarding climate impacts and/or ES), which can also take the form of joint projects and city-to-city exchanges for knowledge creation and mutual learning (cf. Table 1).[5]

Municipal staff use this strategy to address the following barriers and drivers:

- Institutional/organizational: While siloed sectoral work hampers NBS/CCA, the relatively high level of independence of municipal staff allows them to involve private companies or academia to support NBS/CCA through providing expert advice and assessments.
- Policy/legal: With increasing policy support for densification to meet housing demands, there is no adequate regulatory framework for ensuring that NBS/CCA considerations are taken into account in all planning phases. At the same time, the policy landscape is opening up in the support of new planning approaches.
- Financial and human resources: While internal financial constraints are significant (e.g. funding streams), external funding for NBS and CCA-related projects is increasing (including cooperation with other authorities, the private sector and academia).
- Knowledge/capacity: While there is a lack of local knowledge on ES, climate impacts and associated linkages, there is an increasing awareness of the need to address these issues.

Practical initiatives designed to overcome these constraints and tap into existing potentials included, for instance, the establishment of external cooperation in Eslöv to support 'smart densification'. Here, the municipal official responsible for identifying spaces for densification involved a private company and an academic partner to ensure that cultural and regulatory ES would be given due consideration, although this was not an explicit requirement. The private company assessed flood risk. The academic partner assessed ES in the city. The official noted, "These were the pieces of the puzzle that I needed". While the assessments' results were no surprise to the official, it was key to "have it on paper". In particular, they made it possible to execute the political mandate, while also increasing awareness and support for the consideration of NBS/CCA when: i) identifying the best areas to densify; ii) deciding how to densify (e.g. by simultaneously increasing greenery, if needed); and iii) protecting important areas from densification.

In all other cities, champions tapped into their relatively high level of independence to commission any expert assessments that they thought would be useful. One official stated, "They [external experts] are always part of the whole process, we couldn't do without their expertise". However, the lack of a formal framework for NBS/CCA means that such assessments are very different in nature and focus. Different types of environmental, ES and climate assessments were conducted by different types of experts, who used different methods. For example, some assessments focused on provisioning, regulating, supporting, and/or cultural ES and were based on expert evaluations or citizen surveys. Others focused on particular aspects, e.g. biodiversity. Climate impact assessments varied in terms of hazard foci and risk evaluation approaches.

A second type of targeted stakeholder collaboration was engagement in regional, national and EU-financed projects. Examples include the learning lab this study is based on, the nationally-funded Life project in Lomma, and the EU-financed projects NATURVATION, the Smart Sustainable Districts Flagship Project, Biodiversity and Green Surge in Malmö. Malmö is notable for the high percentage of externally-funded, project-based measures, which has led to several flagship projects (Wamsler et al. 2016). But smaller cities such as Lomma, with individual champions, are increasingly able to access external funds. Informal city-to-city learning is common when external finance is unavailable, for instance in Höganäs. Here, internal resources were used to organize study visits to learn from nearby cities about green water management approaches.

The results show that all municipalities apply targeted stakeholder collaboration to some extent. In Eslöv it has been the dominant strategy, and has been used to expand the knowledge base and provide policy support for better consideration of NBS/CCA in specific, short-term projects and systematic mainstreaming in the longer term (e.g. through its inclusion in comprehensive planning). Initial efforts included providing compensation through additional finance and the inclusion of NBS/CCA criteria in land allocation agreement competitions. This was combined with isolated efforts for strategic citizen involvement (cf. Section 3.2).

Kristianstad/Åhus was the only city that took a more cautious approach, instead choosing to increase internal capacities (cf. Section 3.3). Where external stakeholders were unavoidable (e.g. due to agreements made between the real estate department and private developers), targeted communication was identified as key. As one official noted, "I did not try to make use of my power to push things through, I did it very carefully. It was a lot of very small, diplomatic steps to improve things."

3.2. Strategic citizen involvement

This strategy is characterized by a diversity of strategic citizen involvement activities aimed to increase public awareness and avoid contestation/protest (cf. Table 1). The need for such a strategy can be illustrated by the following quotes: "We were focusing on greening, …but no-one was really interested in this." "When the municipality suggested that they would protect the trees, several citizens were against this. We were told that there are too many bird droppings in the area and there is so much noise from the birds, and that's why we can't have trees in the city …". "This is the only input relating to nature that we received during the planning process from citizens".

Overall, municipal staff use this strategy to address the following barriers and drivers:

[5] This strategy could be divided into two separate approaches: i) the involvement of the private sector and academia in the form of consultancy, and ii) collaboration with academia and other cities for joint learning. However, since strategies often involve a mix of both consultancy and joint learning, and for simplicity, it was decided to keep the two together.

Table 1
Overview of the main strategies pursued by city authorities and how they relate to the existing local context, barriers, and drivers.

How officials overcome barriers and tap into drivers/potentials for increased impact/potential	Key contextual aspects that relate to the strategy	Aim of the strategy in relation to overcoming existing, key barriers	Aim of the strategy in relation to tapping into existing, key drivers/potentials	Strategy type in relation to climate policy mainstreaming approach/theory*
A. Targeted involvement of the private sector, academia and other cities (for assessments and joint learning/projects related to NBS/CCA) to support single activities and increase policy support.	Focus strategy on areas where the NBS/CCA knowledge base is insufficiently well-developed to allow for systematic mainstreaming.	To address the lack of basic knowledge and capacity needed to address CCA and NBS in municipal planning (single efforts; short term).	To make use of officials' relatively high level of freedom to commission assessments/ reports and the increasing amount of external support/ financing for NBS/CCA.	Inter-institutional mainstreaming, with a focus on the private sector, academia and other cities, intended to support add-on mainstreaming (short term), increase directed mainstreaming (short term) and lay the ground for more systematic mainstreaming (long-term focus: programmatic, regulatory).
B. Strategic citizen involvement to increase public awareness and improve consideration of NBS/CCA in particular activities.	Focus strategy on areas where citizen involvement is expected to hamper NBS/CCA solutions.	To address the lack of citizen awareness and interest in NBS/ CCA and the fact that citizen involvement has, in certain areas, tended to be counterproductive.	To tap into the potential of younger members of staff who are knowledgeable and interested in citizen engagement, NBS and CCA.	Inter-institutional mainstreaming, with a focus on the general public, mainly to foster add-on mainstreaming (short-term focus: single projects/efforts) and, in turn, open up opportunities for more systematic mainstreaming (long term, through a changed public discourse).
C. Alteration of internal cooperation, working structures and capacities to ensure consistent longitudinal integration, and encourage an internal paradigm shift (from workplace silos to intersectoral work).	Focus on bigger cities, where power struggles and workplace silos play a greater role in NBS/ CCA considerations.	To address the fact that NBS/CCA: i) are currently difficult to address as municipal departments work in silos; ii) are considered too late in the planning process; and iii) are not monitored from the beginning (idea) to the end (follow-up and learning).	To tap into existing high capacities in different departments/sectors, general political support and regulatory frameworks.	Intra-organizational mainstreaming to foster managerial mainstreaming (short term) and, in turn, more systematic mainstreaming (long-term focus: programmatic mainstreaming.)
D. Outsourcing of NBS/CCA implementation, e.g., in the form of providing information and advisory services to help others (mainly citizens) in their implementation.	Focus on areas where contextual lock-ins have dominated actions taken by the municipality and led to stakeholder fatigue. Another focus is bigger cities, where individuals have less influence in systematic mainstreaming.	To address municipalities' lack of influence over private land.	To tap into the relatively high level of interest of the general public, the private sector, and an increasing number of externally-financed projects.	Add-on mainstreaming through inter-institutional mainstreaming that targets private land (owned by individuals and the private sector).
E. Concealed science–policy integration to progressively mainstream NBS/CCA into (in) formal planning regulations, and mechanisms/tools to increase pressure on both municipal staff and policymakers.	Focus on smaller cities where one person can more easily oversee and influence related processes.	To address the lack of top-down guidance, a regulatory framework and tools for NBS/CCA planning.	To exploit the prevailing climate of political support and the capacity of staff.	Regulatory mainstreaming to foster programmatic mainstreaming.

Cross-cutting issues/demands/needs (that result from the above)

- Lack of an institutional and regulatory framework for NBS/CCA mainstreaming.
- Staff are free to commission their own projects/assessment which results in person-dependent implementation. Champions make use of this freedom.
- Implemented strategies are increasingly focused on cooperation, stakeholder involvement and associated transdisciplinary approaches (with different foci, i.e. internal/ external, private sector, academia, other cities, citizens).
- Consequently, there is an increasing need for capacity development to enable staff to engage in relational approaches, requiring cognitive/emotional capacities.
- The latter is needed to establish trust, clear communication and social learning, in a context where staff have to deal with an increasing workload and complex challenges.

* Cf. Wamsler (2015) and Appendix B.

- Institutional/organizational: Citizen involvement has, under current conditions, been rather counterproductive due to a lack of human and financial resources, mechanisms and structures.
- Policy/legal: Increasingly, citizen involvement is a requirement to ensure legitimate and just governmental action. In addition, engagement, or at least consent, is necessary for measures that impact private land.
- Financial and human resources: While there is a general lack of resources for comprehensive citizen involvement, NBS and CCA, interest is growing among staff who are trained in these topics.
- Knowledge/capacity: Although there is a general lack of citizen awareness and interest in NBS/CCA, some influential groups have strong opinions and vested interests.

Practical initiatives to overcome these constraints and tap into existing potentials take different forms. For instance, planning walks, planning games, digital dialogues and targeted media outlets were used in Höganäs, citizens were surveyed in Eslöv (cf. Section 3.1), informal workshops were held with neighbors in Kristianstad, there is continuous dialogue with civil society groups

in Lomma, and citizen involvement forms part of the so-called Business Improvement District (BID) process[6] (e.g. in Malmö).

Most of these activities take place in the initial assessment or planning phases. Participants' views on this issue are illustrated by the following quotes: "We prefer to focus on initial efforts in order to avoid appeals which results in a lengthy planning process. Therefore, we have a lot of resources allocated for citizen involvement. (…) We use a variety of tools for citizen dialogue, with good results". Related activities are characterized by experimentation and testing, as noted by some participants, "We have the advantage of having more and more (…) new graduates (…). Every new colleague of mine has invented a new method for citizen dialogue. That's why we're engaging with Virtual Reality and other technological stuff, which our older counterparts may not exactly do (…)." Other activities are implemented in response to the many and various forms of citizen contestation. Examples include small-scale (e.g. individual statements or disputes during hearings) and large-scale actions (e.g. organized appeals against municipal plans), which were addressed using dialogue and games. An official highlighted, "We work very hard to develop each method [for citizen participation], making them tailor-made and locally adjusted to fit each area."

The involvement of citizens in activities that are not project-related has proved to be particularly effective for both raising awareness and increasing support. In such circumstances, NBS and CCA are not offset by other priorities (such as mobility), creating clear support for future projects. A quote from one participant illustrates the point, "Now we've asked the citizens, and they all think that greenery is missing in the eastern parts of the city, and that means we can and have to work to improve the greenery there."

Strategic citizen involvement was used by all municipalities, although only marginally in Kristianstad. In contrast, it was the dominant strategy in Höganäs. This area has a long history of organized citizen groups with strong (conservative) opinions that have proved to be a major obstacle to planning processes. Here, the strategy was applied in combination with other stakeholder involvement activities such as city-to-city learning and targeted assessments (cf. Section 3.1). In addition, staff had engaged in a few isolated efforts intended to improve internal collaboration between environmentalists and planners, which were however rather *ad hoc*, i.e. not with the aim to change internal structures (cf. Section 3.3).

3.3. Alteration of internal cooperation structures

This strategy is characterized by changes to internal cooperation, working structures and capacities that aim to ensure the consistent, longitudinal integration of NBS/CCA based on an internal paradigm shift from working in silos towards more intersectoral work (cf. Table 1). In the words of an official, "Internal cooperation is our driver".

Municipal staff used this strategy to address the following barriers and drivers:

- Institutional/organizational: The consideration of NBS and CCA requires intersectoral cooperation, but related departments tend to work in silos.
- Policy/legal: Environmental and planning departments are often only involved very late in the process. In addition, private developers are only legally responsible (e.g. for greening) for two years, with negative impacts on quality assurance.
- Financial and human resources: While some municipalities have high internal capacities regarding NBS and CCA, complex administrative and financing structures make internal cooperation so challenging that it has become easier and cheaper to contract external stakeholders.
- Knowledge/capacity: Knowledge often does not stay inside the institution due to high staff turnover and reliance on external experts. In addition, there is a lack of longitudinal monitoring of NBS/CCA considerations from the beginning (project idea) to the end (follow-up and learning).

Practical initiatives designed to overcome these constraints and tap into existing potentials have focused on improving informal networking and communication. Efforts to integrate NBS/CCA considerations early on in the planning process (e.g. before real estate departments and developers have drawn up contracts) are very political, time-intensive and require diplomatic communication and interactions. An example comes from Kristianstad, where an initial proposal from a developer included almost no NBS/CCA considerations. The official in charge of the planning saw this first draft, and decided to strategically involve other departments in the process, although this was not in line with the general working routines. This allowed the views of certain departments (in particular, the Biosphere department) to be given greater priority (the latter department usually has to provide their advice in conjunction with the real estate department, leading to a 'watering down' of NBS/CCA considerations). In addition, this strategy made it possible to combine financial and human resources from different departments to jointly assess ES and develop a quality and design program, which could ultimately be included in framework agreements with private developers. While the initial aim was to improve a specific project, the official hoped to achieve long-term change in working structures. Through the close involvement of departmental heads, this hope manifested for instance in the creation of a new position in the planning department. A municipal ecologist from the environmental department is now employed by the planning department one day per week to ensure that consideration is given to NBS/CCA early in the planning process.

This strategy has also been applied, to some extent, in other cities. Examples include the establishment of intersectoral working groups (e.g. Lomma) and intersectoral learning through joint site visits (e.g. Höganäs). In Malmö, internal cooperation to support the BID process has been improved by strengthening links with the more influential road and traffic department.

The strategy dominates in Kristianstad/Åhus. This relates to the fact that it is a relatively big municipality, where power struggles and workplace silos are more of an issue than in smaller cities, while at the same time basic knowledge and capacities for NBS/CCA are existent. Here, the strategy is combined, although to little extent, with others (e.g. targeted stakeholder cooperation and strategic citizen involvement), as internal reform is considered to be key in achieving both immediate and long-lasting change, with direct links to science–policy integration (cf. Section 3.5).

While other cities have also altered some internal cooperation structures, there is less emphasis. In Lomma, the primary focus on science–policy integration has over time, however, led to similar outcomes. An official noted, "Today, the planning division, where I work, includes environmental, detailed and comprehensive planning, so we are all together now. (…) Working internally has changed quite a lot over the last 10 years with [NBS/CCA] projects like this. It used to be quite clean-cut between the different sectors.

[6] The BID process is a collaboration between several parties for urban development in a certain area. In several countries, the BID concept is based on legislation that forces property owners to contribute both money and resources to urban sustainable development. As such legislation does not exist in Sweden, property owners in Sofielund created a non-profit association that included housing associations, companies and the City of Malmö. The aim is to increase the community's well-being, security and cohesion.

And now we don't really work like that anymore. So, trans-sectoral cooperation has grown over the last 10 years, we really involve each other, and internally we have different groups that make everyone feel part of the bigger project."

3.4. Outsourcing

This strategy is characterized by offering information and advisory services to other stakeholders in order to support their implementation of NBS/CCA (cf. Table 1). In other words, the implementation of NBS/CCA is not conducted by municipalities themselves, but 'outsourced' to other stakeholders.[7] It mainly targets citizens; in some cases, it is also aimed at the private sector, such as medium-to large-scale property owners. It addresses the following barriers and drivers:

- Institutional/organizational: While NBS for CCA are not the top priority, related measures are multi-purpose and can thus be promoted based on other arguments. This makes it possible to address a variety of stakeholders.
- Policy/legal: Current planning frameworks mean that municipalities have very little influence over private land. In addition, lock-ins (e.g. power struggles between departments, and municipalities' priorities) make cooperation with external stakeholders challenging, leading to cooperation fatigue.
- Human and financial resources: While the lack of a budget line for NBS/CCA makes public financing challenging, the implementation of related measures can reduce financial impacts from hazards and increase property values. At the same time, there is an increasing number of externally-financed projects that focus on knowledge creation and dissemination.
- Knowledge/capacity: While there is a general lack of knowledge of concrete NBS/CCA measures and high levels of stakeholder fatigue, private stakeholders are increasingly interested in improving their immediate area.

Practical initiatives designed to overcome these constraints and tap into existing potentials were found in the Sofielund district of Malmö. The area is characterized by a high level of stakeholder involvement to support sustainable development through the BID process. However, cooperation around NBS and CCA issues proved challenging. The following quote illustrates the point, "In the BID process, there are a lot of stakeholders who are very interested in creating more green areas, keeping existing green areas, and they're also very interested in finding solutions for CCA, like ponds, etc., but something is stopping the process … they're so tired of sitting in workshops. Nothing concrete is happening." The reasons given for this were related to, among other things, political and legal lock-ins that made it almost impossible to engage in direct cooperation concerning private land. In response, existing project financing (cf. Section 3.1) was used to develop guidelines to help citizens and private property owners undertake blue-green retrofitting, without direct involvement from the municipality. Similarly, the regional (water and waste management) authority VA Syd has launched a project called 'Make Space for Water', which advises property owners on how to reduce stormwater discharge from their plot, "And that means that one of the more municipal top-down processes … meets bottom-up here." Finally, Lomma has prepared brochures to help the general public engage in NBS and CCA. The municipality has followed up with a survey, financed through cooperation with academia (cf. the strategy presented in Section 3.1).

In Kristianstad/Åhus, outsourcing has, to some extent, been applied to activities that involve private developers, mainly through diplomacy (cf. Section 3.1). An official noted, "I want to have happy developers so that I can also get them to work on NBS/CCA on their own land." Municipalities adapt their efforts to support others to engage in NBS/CCA by focusing on aspects that range from biodiversity, to recreation, social inclusion, and climate change mitigation.

Outsourcing is related to targeted stakeholder involvement (Section 3.1) and strategic citizen involvement (Section 3.2.) via a focus on inter-institutional cooperation. However, the aim is different, as it is not the municipality, but cooperation partners who implement NBS/CCA.

Outsourcing, in combination with external stakeholder involvement, has been mainly applied in Sofielund/Malmö. It is most relevant in built-up areas and bigger cities, where contextual lock-ins and a complex implementation landscape dominate the municipality's ability to take action, and have led to stakeholder fatigue. Another issue is the size of the municipality, as the influence of individual officials is often reduced in bigger cities.

3.5. Concealed science–policy integration

This strategy is characterized by systematic science–policy integration that aims to progressively mainstream NBS/CCA into informal/formal planning regulations and mechanisms/tools (cf. Table 1). The aim is to increase momentum and pressure on both staff and policymakers to give due consideration to NBS/CCA in their daily planning practice. Individual champions who apply this strategy manage to create, through seemingly small and thus little-noticed step-by-step changes, a transformation of policy landscapes, which leads to increasing policy support. It is employed to address the following barriers and drivers:

- Institutional/organizational: There is no adequate regulatory framework or tools, at municipal level, to ensure the systematic consideration of NBS/CCA in current planning practice. An overall vision/approach for mainstreaming is lacking.
- Policy/legal: While there is general political support for NBS/CCA at national level, concrete guidance is lacking.
- Human and financial resources: While there is a general lack of human and financial resources for NBS/CCA, an increasing number of municipalities employ staff with an explicit mandate to mainstream NBS and/or CCA.
- Knowledge/capacity: The number of highly-educated staff with strategic expert knowledge on NBS/CCA and associated legal frameworks is increasing.

Practical initiatives designed to overcome these constraints and tap into existing potentials include, for instance, the systematic inclusion of NBS/CCA in Lomma's environmental goals, comprehensive and sectoral (e.g. coastal) plans, and the development of new tools such as targeted check-lists and ecological compensation to ensure NBS/CCA consideration in detailed planning. An ecological compensation tool, which was the result of collaboration between practitioners and academics, is strongly promoted in Lomma and has been disseminated to other cities, for instance through city-to-city learning workshops (cf. Section 3.1). This was the case for Eslöv, where an official stated, "What we did was that we put in the budget that when there is a development, we have to compensate with trees elsewhere. I said that we have to do that because I took notice of what they [in Lomma] said. So when we had the project, I said, put in an extra budget so that if these trees

[7] Hence, the term *outsourcing* does not mean hiring others to carry out a certain task; rather it describes a more indirect process that involves facilitating (and empowering) other actors to take adequate action/measures.

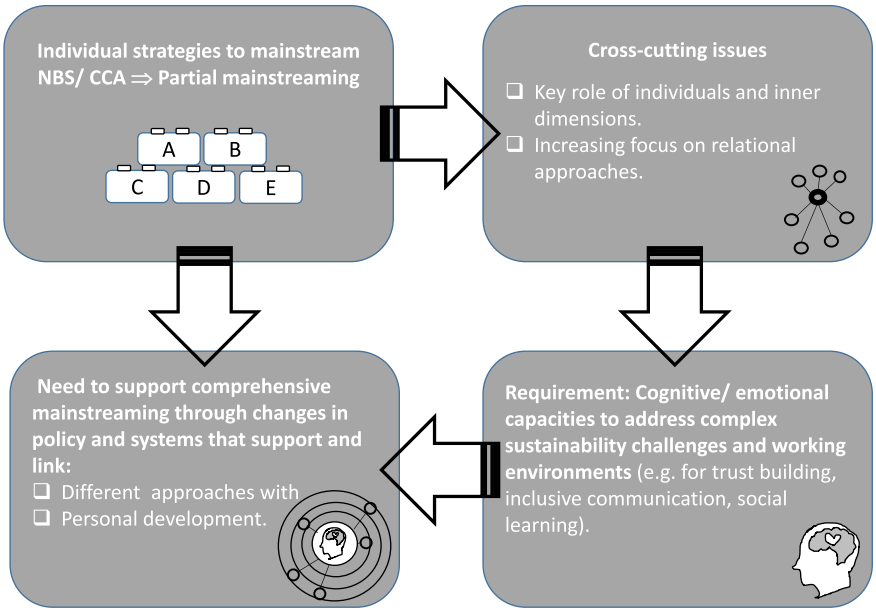

Fig. 1. Strategies for supporting nature-based solutions and climate change adaptation.

disappear, we can plant new ones. That is a kind of climate adaptation measure." "As far as I know, the municipality has never worked with compensation before, and it is difficult to define compensation, because if you take away a tree you can never ever compensate, because it is not there anymore, so putting another tree somewhere else is not compensation. But it is better than doing nothing."

In Lomma, the strategy has progressively increased the municipality's level of formal commitment/mainstreaming, despite the lack of a declared plan or vision. Implementation is ensured through the parallel development of both formal and informal planning mechanisms, and a subsequent push to formalize tools that have been developed informally. The point is illustrated in the following quote, "It was important that we had these political decisions, for instance that an environmental value assessment should be included as part of detailed planning, and that compensation should be applied in all developments. If we hadn't had those decisions, it would be hard for me to push things forward."

Concealed science–policy integration is the dominant strategy in Lomma. It is combined with all other approaches, although they are not all pursued with equal coherence (cf. Sections 3.1–4). The municipality's relatively small size has clearly helped to integrate NBS/CCA into the policy process, as one person can more easily oversee related processes (e.g. strategic, environmental and risk-related planning). Another important contextual factor was the policy landscape and an organizational structure that facilitated the work and influence of individual champions. An official noted, "But the abnormal thing is that they meet every week. So it's five politicians meeting every week.[8] This creates a lot of freedom for me, because if I have a small question I can just pop in (…). And it's very laid back. I think this helps us to be a bit daring (…). It's a big luxury."

Concealed science–policy integration initiatives can be found in all other municipalities, especially in the bigger cities of Kristianstad and Malmö where the level of regulatory mainstreaming is relatively high. However, in most cases, individual efforts and less systematic approaches prevail.

4. Discussion and conclusions

Our results revealed the numerous constraints municipal staff face when working with NBS for CCA, and how they use targeted strategies to overcome them. We identified five complementary approaches, which can be applied in different contexts: i) targeted stakeholder collaboration; ii) strategic citizen involvement; iii) outsourcing; iv) the alteration of internal working structures; and v) concealed science–policy integration. In addition, three cross-cutting issues with wider implications emerge from our results. These relate to: i) the role of individual champions; ii) the increasing focus on relational approaches to better address NBS/CCA; and iii) the resultant need to support the development of cognitive/emotional capacities to foster trust, inclusive communication and social learning, which requires changes to the current regulatory and policy landscape (see Table 1 and Fig. 1). The latter two issues have, so far, received very little attention in research and practice on environmental and climate policy integration worldwide (Nilsson and Persson, 2017). Related efforts, therefore, fail to address their defined goal of targeting the underlying driving forces rather than the symptoms of environmental degradation and climate change, through related policy processes and shared responsibility (cf. Persson et al., 2018; Persson and Runhaar, 2018).[9]

The results show that although the widespread discourse on the

[8] Policy changes, as described at the beginning of the section can, thus, be enabled through political processes, which, in turn, can be influenced by the step-by-step transformation of policy landscapes.

[9] Exceptions include De Roeck et al. (2018), who note that cognitive barriers (related to normative convictions and values) can contribute to weak integration. However, such exceptions generally only refer to policymakers and cognitive/analytical (not emotional or relational) capacities (cf. Nilsson and Persson, 2017).

importance of NBS is an important pathway towards more sustainable climate adaptation and other development outcomes, it has not, so far, translated into adequate support for municipalities. NBS/CCA remain a low priority among municipal planning objectives, while economic development, densification, mobility and housing take precedence.

Consequently, mechanisms and processes for integrating or mainstreaming environmental and climate considerations into sectoral planning remain limited. This outcome is supported by recent reviews of NBS and CCA implementation worldwide (Brink et al., 2016; Runhaar et al., 2018), which demonstrate that knowledge of effective mainstreaming is scarce and fragmented and, consequently, adaptation policy fails to translate into practical outcomes. Our study provides important new knowledge that helps to close this implementation gap, by demonstrating the factors that render different mainstreaming strategies effective. Although the Sustainable Development Goals (SDGs) considerably widen the scope of the mainstreaming/integration challenge (cf. Nilsson and Persson 2017), they also inform policymakers who are tasked with SDG implementation, which requires an integrated approach.

The lack of mainstreaming mechanisms and processes means that the current implementation of NBS/CCA relies heavily on individual champions. The study shows how such individuals have used targeted strategies to overcome constraints, and the part played by their personal commitment, knowledge of NBS/CCA, networking abilities, and capacity to navigate their way in an (uncertain) planning landscape. It is thus crucial to support these champions, who mediate between stakeholders and support transformation processes (cf. Lindsay et al., 2019; Taylor, 2009; Wamsler, 2017). At the same time, efforts must be made to preserve and pass on knowledge within organizations, despite high staff turnover (cf. Carter et al., 2015; Pollitt, 2000).

Interestingly, all of the identified strategies share an increasing focus on relational approaches designed to address barriers and the uncertain planning landscape, and so-called 'wicked' problems that create increasingly challenging working environments (cf. Folke et al., 2005; Hassenforder et al., 2015; Rowe and Frewer, 2004; World Bank, 2015). This, in turn, requires individuals to have the cognitive and emotional capacity to establish trust, communicate inclusively, and promote social learning, while at the same time dealing with increasing complexity and uncertainty. How, for example, assessments are decided upon and the methods that are chosen is not a neutral or value-free process (Vatn, 2009; Robertson, 2012). As the analysis demonstrates, many choices are, for instance, based on personal backgrounds, intuition or policy processes, with the latter typically emphasizing quantification or monetary value in decision-making.

This result is in line with recent studies that call for a greater focus on personal spheres of transformation in order to develop the cognitive/emotional, and relational qualities needed to deal with the increasing complexity and diversity of modern governance (Bristow, 2019; Brink and Wamsler, 2019; Wamsler and Raggers, 2018). Such qualities influence how officials analyze evidence, take decisions, develop policy, negotiate and relate to each other, develop productive relationships with civil society, address conflict and communicate risk (Blennow et al., 2013; Lilley et al., 2014; Bristow, 2019; Sutherland, 2018; Wamsler and Raggers, 2018). Further research is needed to look into ways to better address these issues. This outcome is also in line with a general trend in sustainability science towards more relational approaches to address socio-ecological transformation, which requires changing our ways of knowing (epistemology) and doing (ethics) (Lejano, 2019; Walsh et al., 2019).

The lack of systematic guidance on how NBS/CBA is to be implemented calls in fact for closer attention to be paid to the politics of how environmental knowledge is produced (Turnhout, 2018); one way to do so is to take a more relational approach (e.g. Ansell, 2003; Lejano, 2019) to understanding and analyzing how sustainability strategies emerge. From this perspective, focusing on the web of relationships within the system, rather than on its entities as different objects, improves our understanding of the practices that guide a governance system (Lejano, 2019). One example is the use of Actor-Network Analysis (cf. Latour, 2005) to understand how municipal actors use and interact with artifacts (e.g. maps of ES assessments and scientific reports) that together form part of a value articulation and representation of local nature (Ernstson, 2013). A better understanding of the role of interactions in how NBS/CCA is construed would shine light on the inherently social aspects of how such approaches are formed, and how they later become stabilized within institutions.

The need for more relational approaches and associated capacities can also be linked to the applied learning or living lab methodology, which is increasingly being promoted as a way to address sustainability challenges (Marvin et al., 2019). Participants explicitly stated how valuable they found the lab, "It's an eye-opener to meet people from different backgrounds and get to know how they approach the same subject." "You get to know each other well, which fosters a greater understanding … This way you get more meaningful conversations, and you end up with a great network for the future." "In these knowledge alliances we are able to see that several of our challenges and problems are actually quite similar. Collaboration with other actors … is encouraging, especially when you sometimes feel exhausted by some of the hurdles." "So the creation of processes for interacting with other cities and stakeholders is very valuable and inspiring (…). This has motivated me to push NBS and CA further".

At the same time, the living lab methodology and other transdisciplinary approaches tend to focus on the wider world of ecological and socio-economic structures, governance dynamics and technology, while so-called deep leverage points (Meadows, 1999), such as people's mindsets, values, beliefs, worldviews and related cognitive/emotional capacities are vastly neglected or, at best, only addressed indirectly (Ives et al., 2019; O'Brien and Sygna, 2013; Wamsler, 2018). Accordingly, critiques show that their potential for transformative change is often limited (Smith and Raven, 2012; Sharpe et al., 2016). More research is needed to understand how living labs can be used to act upon deep leverage points to support NBS and CCA, thus going beyond intermediate, first order effects or outcomes (Hansson and Polk, 2018; Wiek et al., 2014).

Finally, we argue that if we are to tap into the potential of NBS to increase CCA governance and implement the SDGs, we must dedicate increased financial and human resources, and capacity development for personal development and systematic mainstreaming to support more sustainable development.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2019.119154.

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