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Pathways to Upscaling Nature-based Solutions for Disaster and Climate Resilient Infrastructure

TARU Leading Edge

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Pathways to Upscaling Nature-based Solutions for Disaster and Climate Resilient Infrastructure

*Advocating for development of codes and standards
at the local level*



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1. Introduction

In modern society economic growth and development serve as the rationale for several actions and endeavours. However, modern society is plagued by disaster and climate risk and therefore development standards have shifted. Unregulated and uncontrolled development practices have led to the destruction of the environment and ecosystem, which has served to exacerbate climate and disaster risk. Within this reality, Nature based Solutions (NbS) have emerged as a means to address societal issues through ecosystem protection and dependence. NbS is seen as a promising step in the right direction for both urban and rural contexts to address several of the sustainability challenges targeted in the United Nations Sustainable Development Goals (UN, 2015). IUCN defines NbS as “actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits”. NbS is well-set to address multiple issues due to its direct benefits and co-benefits. NbS represents a shift in thinking in the late 2000s, from a focus solely on nature to people and nature (Mace, 2014). However despite this paradigm shift, there has been difficulty in widespread adoption of NbS. NbS are difficult to evaluate due to a lack of quantification of the social, environmental and economic co-benefits of NbS. Towards these issues, mainstreaming, planning as well as development of codes and standards serve the purpose of streamlining and implementing growth of NbS actions across the globe.

Codes and standards have formed the basis of modern developmental practices as they are used to define the minimum requirements in which the physical environment must be built and performed (Ben-Joseph, 2012). Beyond this, they serve as legal and moral instruments that can be used by professionals to determine and ensure the benefits to the public (ibid). These codes and standards can function at and across various levels of government: local governments determine and enact coastal regulations; building codes at the national level, and state and national environmental legislation affects local development practices (ibid). Thus, codes and standards can help integrate NbS into the institutional mechanisms that exist in modern development planning. The paper explores codes and standards in the context of NbS. While they may be limited at this stage, the paper focuses on two sets of standards that are structured in diametrically opposing ways; ABC Waters: Design Guidelines and IUCN Global Standard for Nature-based Solutions. These standards are explored to understand their shortcomings and their uses in the process of evolving codes and standards for NbS.

This paper then discusses the drawbacks of modern codes and standards in general. These drawbacks have emerged due to the universal, prescriptive and static nature of these codes and standards which has led to climate and disaster related issues and has increased vulnerability of populations, especially in the developing world. To combat this, there is a need to develop codes and standards that are relevant to the local context. Towards this, the paper proposes a process that involves mainstreaming and communicative planning.

The paper proposes a mainstreaming framework focusing on institutional and public acceptance which is based on work done in NbS literature. This framework would allow for identification of

stakeholders and power dynamics which will allow for best understanding the local context and society. This is further enhanced by identifying terms for communication of benefits and by establishing a shared knowledge base.

The next key is the process of planning. One of the challenges to upscaling is the lack of formal planning considerations in proposed NbS frameworks. The paper seeks to remedy that by proposing the communicative planning as a way forward for implementation of NbS solutions. This planning methodology primarily proposes the idea of inclusive dialogue as the key to addressing current planning issues. The concept of inclusive dialogue can address several considerations for NbS such as inclusivity, collaboration and co-creation of knowledge.

Finally, there is a need to move beyond current structures of codes and standards. Schools of thought such as form-based codes. Other than this, rating and directive frameworks such as LEED-ND have been created to incorporate green design into the development process. These structures are explored within the study as potential structures for NbS codes and standards.

Therefore presenting a process for the development of local, dynamic and output-oriented NbS codes and standards along with possible structures for these codes and standards is the rationale behind this study.

2. NbS Codes and Standards

NbS codes and standards have been considered as crucial to the on-ground implementation of NbS with clarity and precision (IUCN, 2020). However, there are limited codes and standards in relation to NbS. ThinkNature has recently created a framework for implementation through exploration of NbS projects across the world. Through case studies such as Delft, a coastal management solution in the Netherlands, to London's quest for sustainability, several case studies have been used to point out the benefits of NbS. The document, however, details a project-based implementation approach for NbS rather than creating a standard for NbS. IUCN on the other hand, has created standards for NbS based on best practices reviews.

Sustainable agricultural practices in Senegal, to address poor agricultural productivity as a result of soil salinisation and degradation due to erratic rainfall, and their mode of implementation were considered when developing the criterion 1: Identifying societal challenges. Similarly, the other criteria were evolved based on such practices around the world. Thus NbS codes and standards are beginning to evolve within the current global context.

This section takes a look at two current NbS codes and standards. ABC Waters: Design Guidelines and IUCN Global Standard for Nature-based Solutions. These two standards have been selected for different reasons. The ABC Waters: Design Guidelines have evolved in the context of Singapore. This is in contrast to IUCN Standards that have been formulated through consideration of best practices. Each set of standards is analyzed and critiqued to understand the shortcomings and how they can be used effectively.

2.1 Active, Beautiful, Clean Waters (ABC Waters): Design Guidelines

2.1.1 Introduction

The ABC Waters Initiative was developed in 2006 by the Public Utilities Board, the National Water Agency for Singapore. The aim is to create holistic stormwater drainage by integrating drains, canals and reservoirs with the surrounding environment to achieve the full potential of Singapore's water bodies to improve both the quality of water and life. Furthermore, it is to integrate the environment, water bodies and the community to generate new community spaces that can propagate ways of life that thrive around waters (Public Utilities Board, 2018). Therefore, ABC Waters can be seen as an initiative that integrates grey solutions and NbS to achieve sustainable stormwater management.

The holistic stormwater management is divided across three points of a waterbody: the source, the pathway and the receptor. It is at the source and the pathway that NbS is primarily present. On-site detention and retention of stormwater to prevent storm drains in Singapore from being overwhelmed is a key feature of the design. Within this, maintaining water quality is an important feature. In order to maintain water quality, bioretention swales, wetlands and rain gardens have

been suggested. This would improve the water quality of the stormwater and enhance the aesthetics and biodiversity of the locality. Thus integrating nature into urban life is a fundamental feature of ABC Guidelines (ibid).

ABC Waters design enhances the aesthetics and biodiversity of the landscape while slowing down the flow of stormwater runoff. This creates local green corridors by integrating nature into urban life.

2.1.2 Design Guidelines

This section gives an overview of the guidelines and its features

1. Guidelines for ABC Waters Management Strategy

The guidelines present two fundamental considerations:

- Planning Considerations
- Design Considerations

These considerations are important as the design of the feature is dependent on the constraints and potential of a site to affect stormwater flow.

2. Planning, Design and Performance of ABC Waters Design Features

The various elements in a typical stormwater passage as well as the principles and applications of ABC Waters design features and elements are explained to make clear the purpose and the function of the various elements. Further, the ways through which these features and elements could be assimilated into a plaza, architectural structure, or even introduced at vehicular roads and pedestrian walkways are provided. This provides a broad set of actions and principles that are to be considered in the development of any ABC Water Design Feature. The below table provides a summary of the actions and components that are to be focused on under catchment, treatment, conveyance or storage of stormwater.

Catchment Elements	Treatment Elements	Conveyance and Storage
<ul style="list-style-type: none"> ● Planning Strategy ● Analysis of a Typical Plaza ● An Integrated Plaza with ABC Waters Design Features ● Architectural Structures ● Vehicular Roads and Pedestrian Walkways 	<ul style="list-style-type: none"> ● Vegetated Swales ● Bioretention Swales ● Bioretention Basins (Rain Gardens) ● Sedimentation Basins ● Constructed Wetlands ● Cleansing Biotopes 	<ul style="list-style-type: none"> ● Enhancing Waterways

3. Construction and Maintenance of ABC Water Design Features

The set of actions/measures, and standards that need to be followed during the construction, post-completion, and maintenance stages of the ABC Water design features are provided to ensure the effective development of the measures.

These fundamental features cover the entirety of a project, from the planning to the maintenance and evaluation phase, thus serving as a comprehensive standard for the integration of ABC Waters into various construction processes, private and public.

2.1.3 Challenges for ABC Waters Design Guidelines as a global standard

These guidelines and design principles provided in these documents act as a set of minimum standards that guide the implementation of ABC Waters design features. However, for these guidelines to be followed, there needs to be a set of pre-existing infrastructure, equipment, building codes and regulations, land use classifications, the governance framework, awareness among the public, and the most important of all, a well-trained workforce.

While these are available in the context of a country like Singapore where the landmass is compact and the area of governance is also smaller, it might not be in the context of Low and Middle Income Countries (LMIC) where even the indicators of human development may be poor.

2.1.4 How can the ABC Waters Design Guidelines be used?

Although these guidelines and minimum standards cannot be applicable for all countries of the world, they can be looked at as being an example of a local level design code.

Inspirations can be taken up from the whole of the ABC Waters program to develop supporting/enabling institutions, market-based incentives, and contextualized codes and standards for countries with similar geographic, political, economic, cultural, and governance contexts.

Further, similar codes and standards can be developed to cover the co-benefits of NbS that are suitable for the context of any particular country or based on the priorities of that country. In addition, inspirations can be taken with regards to the design and engineering standards and how checklists are used to measure the effectiveness of the works that are being undertaken to ensure that it follows the specified standards and function effectively as intended.

2.2 IUCN Global Standard for Nature-Based Solutions

2.2.1 Introduction

The IUCN Global Standard consists of 8 criteria and 28 indicators that have been developed based on case studies from around the world. The IUCN Standard was developed to allow for greater clarity and appreciation of the concept of NbS so that it can be applied on ground in a systematic manner. The framework was conceived by IUCN in October 2018, further refined by review till March 2020 and released in February 2020.

The IUCN Standard was created as a facilitative standard that would aid in the development, learning, improvement and sustainability of NbS measures around the world. It would legitimize NbS interventions around the world and allow for communication between sectors through the presence of a common framework.

The following are the set of criterion presented in the document:

Criterion 1: NbS effectively address societal challenges

This criterion focuses on identifying the societal challenge to which the NbS is a response.

Criterion 2: Design of NbS is informed by scale

This criterion guides the design of the solution in accordance to the scale of the issue. Scale in this context primarily refers to geographic scale across land and sea, as well as the economic, ecological and societal aspects of the land/seascape.

Criterion 3: NbS result in a net gain to biodiversity and ecosystem integrity

Criterion 4: NbS are economically viable

Criterion 5: NbS are based on inclusive, transparent and empowering governance processes

Criteria 3, 4 and 5 embody the pillars of sustainable development – environmentally sustainable, socially equitable and economically viable.

Criterion 6: NbS equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits

This criterion addresses the balancing of trade-offs and choices that need to be made to achieve short and long-term gains, and how to ensure that there is a transparent, equitable and inclusive process to determine such trade-offs.

Criterion 7: NbS are managed adaptively, based on evidence

This criterion responds to the need for adaptive management, which facilitates continuous learning about system-wide processes and adapting the NbS according to systemic changes.

Criterion 8: NbS are sustainable and mainstreamed within an appropriate jurisdictional context

This criterion is towards embedding the concept and actions into policy or regulatory frameworks as well as linking to national targets or international commitments.

(Source: IUCN Global Standard for Nature-based Solutions)

2.2.2 How can the IUCN Standard be used?

The IUCN Standard can function in several ways but first it needs to avoid the pitfall of codes and standards in general. As mentioned later in the discussion about codes and standards, universal codes and standards reflect industrialized/developed countries' ideals. This can strongly impede their ability to positively impact development processes in developing countries due to differences in context, culture, economic development and society. Therefore, universal standards need to be avoided. Instead local based codes and standards have to be developed. This can be done through mainstreaming and planning processes that allow ease of acceptance of NbS as well as allow for developing of codes and standards that take into account local context, needs, societal norms and practices as well as capacities.

In this scenario, IUCN Standard can serve as a guideline or benchmark that can be used to assess these local codes and standards, rather than be used to develop the codes and standards themselves. Use of the standard as a self-assessment tool for projects has been highlighted by IUCN but they can be primarily used as a benchmark at the global level and also allow for local codes and standards to be assessed and improved over time. The IUCN Standard can also serve as a comparative framework for different interventions

The standard has, to a degree, informed the mainstreaming framework and the selection of the planning process in this paper due to the empirical evidence that has been gathered for the development of the standard.

2.2.3 Drawbacks of IUCN Standard

To begin with, the criteria are extremely broad and therefore are difficult to contextualize at the local level. This issue is further highlighted in the section on challenges to mainstreaming NbS.

Furthermore, while the IUCN Standard seeks to provide a framework towards upscaling and implementation of NbS, they do not provide any specific tools or measures that can aid in the upscaling and implementation. While the motivation is to provide a facilitative standard that can be incorporated into project management tools and approaches as well as to translate NbS into targeted interventions; the lack of tools and measures for implementation means that planners may reject the standard.

The next issue surrounding the standard is the lack of incorporation of development planning measures. The section on challenges to mainstreaming discusses this in greater detail. Specific to the IUCN Standard, there is a lack of suggestion for the kind of planning practices (participatory approaches are mentioned twice in the entire document) that need to be followed to implement measures according to the IUCN Standard. In planning theory, there are planning measures such as communicative planning that can be key to implement measures that follow the IUCN Standard closely. However, such planning processes and measures are not discussed by the IUCN Standard and this can lead to rejection of the standard by planners and implementers.

Another reason is that the IUCN Standards are idealistic in nature. As will be discussed in subsequent sections, with regard to the current issues surrounding codes and standards, strictly adhering to or following the standard closely may require access to economic, environmental and social resources beyond the capacities of local governments and even national governments of developing nations. This would mean that NbS interventions may be altogether overlooked and rejected because adhering to the standard is not profitable. External parties, such as investment banks, may need to invest for NbS to be implemented and even then it may be rejected because developing countries may be against external parties' agendas.

With this knowledge in mind, the next section of the paper looks at the history, evolution and drawbacks of modern codes and standards in general to understand what the issues with them are and how to prevent those issues from seeping into the process of evolution of NbS codes and standards.

3. Historical evolution of codes and standards

Codes and standards have been a staple of every civilization that has emerged on Earth since ancient times. City-states that formed alongside rivers such as the Indus, Tigris, Nile and Euphrates grew so complex in form, structure and composition that laws became codified and social norms became standardized practice (Ben-Joseph, 2012). The Egyptians created benchmark systems to quickly re-establish property lines after the Nile flooded and China enacted a unified land measurement system under the first Chinese Emperor Qin Shi Huang. Codes influenced governing systems and shared a complex relationship with the communities they controlled; essentially blending government control with existing customs (ibid).

Codes and standards further evolved across history. Greece and Rome enacted rules and regulations related to public order and the streets. They also bestowed duties to their citizens as a result of their high regard for civic life and city culture. When moving further down the history lane, London created The Metropolitan Building Act of 1844 due to fears of urban fires and harm associated with poorly constructed housing (Thompson, 1968).

For the controlling of growth and ensuring greater living conditions, regulating street widths and building setbacks were seen as crucial measures (Ben-Joseph, 2012). This would allow relief from congestion, cleaner air and promote light. Unfortunately, this often led to the manifestation of wide, straight and uniform streets and other such emergent features that disregarded the natural and social conditions (ibid).

Modern zoning standards emerged in Germany and was subsequently adopted across countries like the US, UK and Scandinavian countries (Ben-Joseph, 2012). In the US, concerns emanating from land speculation, uncontrolled growth and poor building construction led to the widespread adoption of zoning (ibid). This resulted in creation of acts that provided models for local zoning planning and tools for recording and conveying property (ibid). From road layouts to drainage facilities, physical aspects that comprise the city were addressed as a means to guarantee minimum standards of construction, livability and allowed for control over development as a whole (ibid). This allowed for zoning to be considered as the template for modern urban and suburban districts.

The path taken for the evolution of codes and standards, from social norm based codes and standards in ancient cities to prescriptive, universal and static codes in the modern era, is important to understand as it divulges the reasoning and necessity for their evolution. These codes and standards evolved as a result of cities and their growth, the need to address issues such as health, public order and congestion, primarily physiological needs. Despite their evolution in cities, such prescriptive, universal and static codes and standards are often used in both rural and urban contexts as well as across developing and developed worlds.

3.1 Drawbacks with current codes and standards

As growth and expansion of the city landscape continues uncontrollably, debates over the nature and type of growth have taken precedence across professional and political circles (Ben-Joseph, 2012). Regardless of the stance taken by the debating parties, significantly large sections of debaters agree upon the fact that current codes and standards are obsolete and deficient (ibid). An example of the issues associated with this outdated approach towards codes and standards can be seen in the housing sector. Current building codes have been critiqued by federal commissions, state committees and private studies as resulting in costly construction, an increase of housing costs and obstructing efficiency (ibid).

In terms of housing, the codes and standards not only affect housing but also impact livelihoods as alternative building materials or incremental construction are disregarded. Nearly half the population residing in developing countries cannot afford to build according to prevailing standards (Yahya et al, 2001). This is because current codes and standards have emerged from colonial legacy or have been directly imported from industrialized countries, rendering them unsuitable for the context of developing countries (Ben-Joseph, 2012). Another important issue is that modern codes and standards, such as zoning, do not take into account a city's growth due to changing market conditions nor do they account for community priorities rendering them ineffective over time (Ben-Joseph, 2012)

Existing codes and standards, especially for building construction, spread as a result of ease of uptake for local governments (Ben-Joseph, 2012). The ease of uptake was due to being able to adopt technical requirements with no expenditure on research and creation of individual local codes (ibid). This also allowed for compliance with insurance standards. In the modern era, codes and standards have moved beyond urban centres and now forage into sub-urban and rural contexts.

Nevertheless, change is emerging through ecological and environmental concerns that continue to gain prominence across the world (ibid). The conspicuous interest in ecology, sustainability and lifestyle is shifting focus to physical planning and design (ibid).

These changes in how we plan and what are the type of codes and standards that need to emerge give as a new avenue to explore when developing codes and standards. Universal, prescriptive and static codes and standards being questioned means that NbS codes and standards require a new path forward. This paper proposes the development of local codes and standards through mainstreaming and changes in the planning process. The above conversation on codes and standards means that the new codes and standards that are being developed need to move away from the prescriptive function that they had. This necessitates a look at the new forms of codes and standards that have been proposed by new schools of thought. This further substantiates the arguments against the current NbS codes and standards that have evolved through understandings of best practices around different contexts across the world. The IUCN Standard has evolved through best practices around the world and ABC Waters evolved within the Singapore context.

4. Process for development of codes and standards

The iteration of the historical evolution of codes and standards, the drawbacks of codes and standards in general and the examination of NbS codes and standards recommended was done in order to argue for the need of a new process towards development of codes and standards that is bottom-up in nature. NbS codes and standards have to be local, dynamic and output-oriented in order to effectively address issues. To this end, the process for development of the codes and standards is crucial. The following sections detail the process which includes mainstreaming, communicative planning and new structures for codes and standards. However, before proceeding to these sections, we must look at the primary challenges and opportunities for mainstreaming NbS.

4.1 Challenges and Opportunities for mainstreaming NbS

4.1.1 Challenges

While there are several challenges for mainstreaming of NbS, such as economic and technical challenges, the following two challenges have been looked upon for the scope of this study:

1. Conflict between formal planning and experimentation

There is a dearth of discussion in NbS frameworks on the role of planners and planning in the implementation of NbS. This may be attributed to bias on the part of researchers, with experimentation being considered as the only viable path towards upscaling NbS (Wickenberg et.al, 2021). This bias can be due to researchers working in isolated groups and thus lacking understanding from shared experience and collaboration.

The lack of a planning perspective can result in failure to comprehend two issues:

- conflicts between formal planning and experimentation that impede the uptake of NbS
- the need for planning research to transform formal planning methodologies to uptake climate change adaptation requirements

2. Current frameworks are too general for operationalizing at a local level

The current principles and frameworks for NbS have been conceptualized with the need for coordination at high levels of planning (cf. Cohen-Shacham et al., 2019). Thus they might be too broad to operationalize at the local level. There is a need for translation and adaptation to implement NbS at micro-levels. There is a need to recognize planning processes and policy development, such as local governance structures, at the local level. However, this has a serious challenge as local contexts of planning and development can show variance depending on social, economic and cultural factors. Thus it serves as a limitation for universal frameworks for implementation. While Wickenberg et.al, 2021

have stated that it is too early to dismiss the notion, the arguments before further compound this issue.

4.1.2 Opportunities

Despite these challenges, NbS has certain pathways towards entry. The most relevant to this study are listed below:

- **Adaptive resilience:** Grey solutions despite their visibility, have poor adaptation capability. With the rise of climate related disasters, these grey solutions may be quick to become obsolete. NbS on the other hand can inherently adapt to growing climate and disaster risk and can therefore serve as a cost-effective solution in the long term.
- **Proliferation of disasters:** Disasters have often served as ‘windows of opportunity’ to implement various mitigation and preparedness measures. With the rise of disasters around the world, the tangible impact, economic and social, of such disasters, and the need to prevent them and the losses that can come with them can serve as a point of entry for NbS.

The following sections on mainstreaming and planning serve as pathways towards addressing the challenges discussed, while making use of the opportunities presented, as well as a process to develop codes and standards for NbS at the local level.

4.2 Mainstreaming of Nature-based Solutions

The process of mainstreaming novel approaches and solutions is often quite arduous. It is a process of internalizing the goals of an approach or solution across economic sectors, development models, policies and programs, and essentially weaving it into the fabric of human behavior (adapted from Cape Town Workshop, 2004 September as cited in Cowling (2005). This definition was initially proposed for the idea of mainstreaming biodiversity, but conceptually can serve for mainstreaming nature-based solution as well. Therefore, this paper has adapted it for mainstreaming NbS).

For the sake of mainstreaming topics such as climate change, disaster management, resilience, and other concepts, various events, workshops etc. have been held periodically at various points in time. Thus mainstreaming has been long entrenched in climate risk and disaster risk reduction implementation.

The path towards mainstreaming begins with acceptance. The primary objective of this paper would be to present a bottom-up pathway toward acceptance of NbS beginning at the local level, based on studies by several authors and experts, which would consequently lead to mainstreaming of NbS across local, national and international avenues. The basis of this concept is to divide acceptance into two branches: Institutional and Public Acceptance. The branches may share mutual priority or hierarchical priority depending on factors discussed below. These branches also influence each other in the mainstreaming process.

The elements that are discussed within the framework have been derived based on the IUCN Global Standard and the Public Acceptance-Nature-based Solutions Framework by Anderson-

Rennaud (2021). These frameworks were considered crucial to the development of the mainstreaming framework as they have been derived through extensive exploration of best practices from around the world and are therefore grounded in empirical evidence. The underlying concepts that were important to the development of the framework as well as to the selection of the planning methodology are further discussed in Section 4.4.

The following is a diagrammatic representation of the mainstreaming framework:

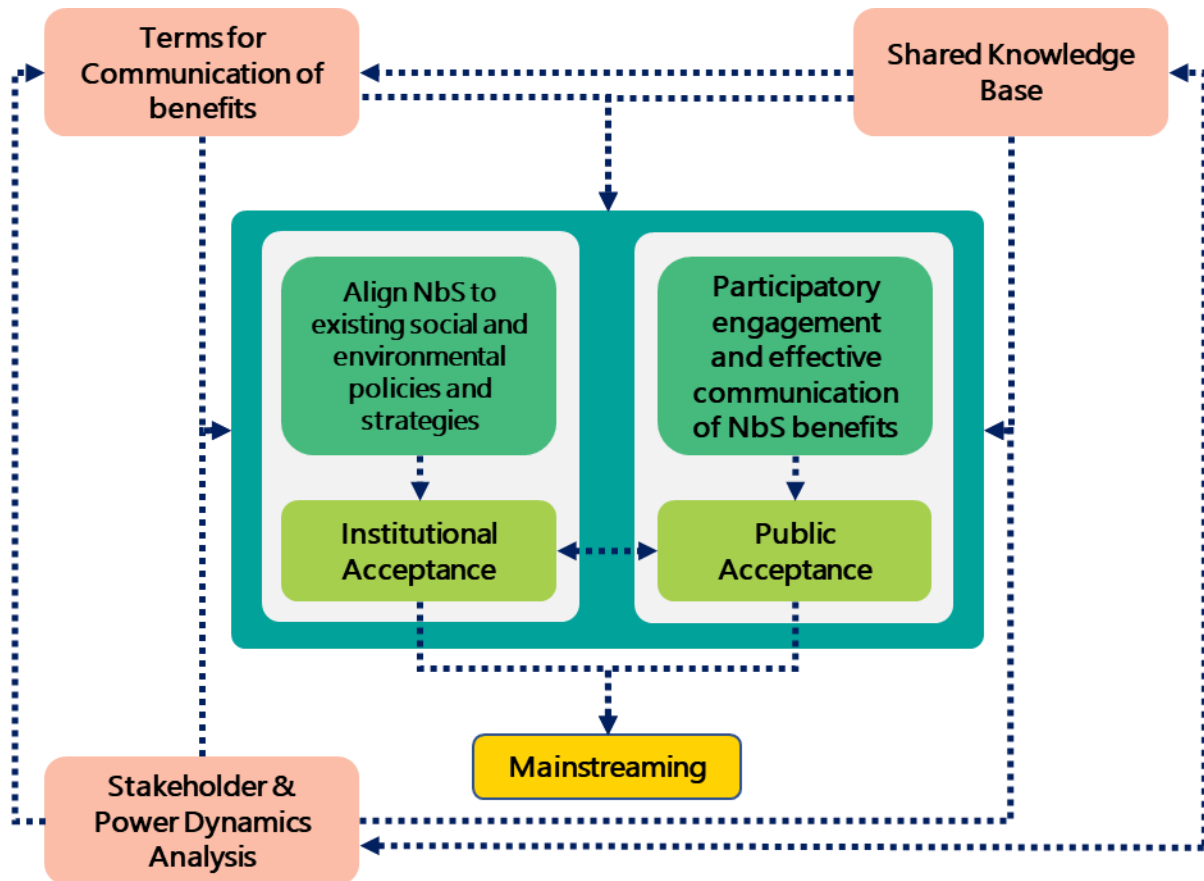


Figure1: Mainstreaming Framework- The figure depicts the process for mainstreaming proposed in the paper. The overarching elements are: terms for communication of benefits, shared knowledge base and stakeholder and power dynamics analysis. In this, terms for communication of benefits and shared knowledge base are the first actions, which is followed by the stakeholder and power dynamics analysis. These overarching elements influence all the elements within the box as depicted by the arrows. The stakeholder and power dynamics analysis and shared knowledge base influence the terms of communication of benefits of NbS over time. The former two overarching elements also influence each other over time. Within the box, the specific element; Align NbS to existing social and environmental policies and strategies influences institutional acceptance while the Participatory engagement and effective communication of NbS benefits influences public acceptance. Finally the branches of institutional and public acceptance influence each other and they mutually contribute towards mainstreaming.

There are certain overarching elements that influence both branches as well as the specific elements for each branch, and may influence each other. These will first be discussed in the following section:

4.2.1 Overarching elements

- Terms for communication of benefits

Due to its ‘newcomer’ tag, support for NbS has been tenuous. Therefore, defining the benefits of NbS with mainstream concepts is important. Concepts that have been identified for this are: exposure, vulnerability, preparedness and recovery. Frameworks such as the Sendai Framework for Disaster Risk Reduction 2015-2030, the now defunct Hyogo Framework for Action from 2005-2015, the Sustainable Development Goals and the IPCC Convention all make references to, all or some of, the terms vulnerability, exposure, preparedness and recovery. The global nature of these declarations and frameworks, as well as the need for disaster risk reduction and climate change as a whole can make acceptance easier. This is not to say that the NbS itself is reduced to these concepts. NbS as a concept goes beyond exposure, vulnerability, preparedness and recovery. However, the benefits of NbS can be communicated with these concepts.

Wamsler et.al (2017), have emphasized that there are four approaches to reducing climate risk: reduce exposure, reduce vulnerability, improve preparedness and hasten recovery. Using the concepts of exposure, vulnerability, preparedness and recovery as the terms for communication of benefits allows for streamlining of language and ease of understanding for government officials and policymakers about the benefits of NbS. Furthermore, uptake might be eased due to the fact that achieving these goals is an important agenda for governments all over the world.

These concepts can also be used in the post-implementation phase to measure the benefits of NbS solutions in general. Furthermore, tools and processes associated with these concepts can be used for implementation of NbS solutions as well. Tools such as hazard analysis and vulnerability assessments can aid in developing plans and identifying high risk areas for implementation of NbS.

Indicators can be developed based on human exposure as the foundation. This can allow for the use of indicators such as well-being indicators, quality of life indicators and pollution and risk indicators that use human exposure as its foundation for analysis. Thus the terms of communication can allow for operationalization of implementation, ease of communication and for monitoring and evaluation purposes.

Furthermore, more NbS terminology can be phased in over time through workshops, declarations and other such activities which can expand the terminology for communication of benefits in the long term. Thus this action is a dynamic action that changes over time with influence from stakeholder and power dynamics analysis (this will determine more culturally and contextually terms for NbS that can be used for communication) and the shared knowledge base (as awareness spreads, more terms can be used instead of just exposure, vulnerability, preparedness and recovery to achieve greater communication regarding the benefits of NbS).

- Shared Knowledge Base

The next element would be the establishment of a shared knowledge base which is essential for awareness generation. A knowledge base is imperative to impart best practices, convey local

context, indigenous practices and innovative models of NbS to the current and future governing groups and the public. This would allow for NbS to seep across society and become embedded within the social fabric, thereby allowing assimilation over time.

This shared knowledge base should be established at the onset of the mainstreaming process, with best practices from around the world as evidence for success and background research on the historical context, with respect to hazards, development and, NbS based works done, of the area of implementation. This can be complimented over time with learnings from stakeholder and power dynamics analysis and learnings from the field. All of these actions can aid in the awareness generation process.

This section was developed based on the Metropolitan Ecological Network that was developed in Lisbon. This is discussed in the section below.

1. Case Study for Shared Knowledge Base: Metropolitan Ecological Network (Lisbon, Portugal)

The Lisbon Metropolitan Area has developed a knowledge base for nature-based solutions that consists of strategic guidelines and climate change adaptation measures as well as practices for ensuring mainstreaming at the institutional level (Wamsler et.al, 2017). These practices, guidelines and measures are organized across three levels of hierarchy based on their importance for the environmental structure (ibid). This network is known as the Metropolitan Ecological Network (MEN) (ibid).

In a 2013-14, a participatory exercise was conducted with officials from across institutional levels (local to national) and academic scholars who concurred that the MEN serves as an important driver for sustainable planning (Mascarenhas et al. 2016).

This case study argues for the need for a shared knowledge base. MEN can serve as a basis while developing shared knowledge bases across. However, Wamsler et.al (2017) have highlighted how MEN cannot capture existing ecosystem services, how they impact human well-being and how they are impacted by planning decisions. These can be addressed through information gathered through stakeholder and power dynamics analysis (next section) and communicative planning (discussed in section 4.3.1) which can serve to enhance shared knowledge bases in the future.

- Stakeholder & Power Dynamics Analysis

Kronenberg et.al (2017), have highlighted the Amoeba tool as a tool to understand the various stakeholders who can promote or hinder the progress of innovative ideas such as NbS. Amoeba tool presents a form of stakeholder analysis that would identify stakeholders, their needs and interests, their level of interest in NbS (from interested to indifferent to disinterested), their ability to influence the success or failure of NbS projects and the roles that they can play in implementation of NbS.

The Amoeba tool categorizes stakeholders in the following manner:

Name	Description
Innovator	Source of a new idea (This group may not always be relevant during the implementation process)
Change Agents	Translate innovations into marketable ideas. (This group is most important for mainstreaming of NbS)
Transformers	Keen to accept new ideas but will not do so at the expense of their personal reputation, position and influence (This group can be swayed through presentation of credibility and evidence of success)
Mainstreamers	Are not for or against change. Accept an idea when it is 'mainstream' (This group will not impede the project. They could be useful in the long term)
Laggards	Separate group of mainstreamers that enjoy the status quo and resist change for a longer duration (This group is not particularly harmful and will adopt the change in the long term)
Reactionaries	Group that actively resists innovation due to involvement of vested interests. (This group is one to wary of)
Controllers	The most powerful group of stakeholders that can influence the rules of the system. (This group is extremely relevant to consider when mainstreaming NbS)

Table 1: Amoeba Tool (Key Stakeholders) (Source: Kronenberg et.al, 2017)

Other stakeholder analysis tools include: Influence/Interest Matrix and Stakeholder Role Matrix have been omitted as they are not comprehensive enough in nature. The Influence/Interest Matrix primarily focuses on the interest and power of stakeholders to influence a project. Stakeholder

Role Matrix captures what knowledge and expertise a stakeholder has to fulfil a role in a certain project, this more towards the implementation phase. The Amoeba tool on the other hand is comprehensive and has a clear structure that allows for mapping all the stakeholders involved and their roles in influencing the project. However if a stakeholder has multiple roles such as an organization acting as both an innovator and change agent (categories within the Amoeba tool), it becomes difficult to categorize them. Another weakness of the Amoeba tool is that grouping together multiple stakeholders within the designated categories can result in loss of an individual understanding of the stakeholder's needs, interests and roles. This can be avoided by assigning the categories individually at the initial stages of the stakeholder analysis and grouping them together subsequently to simplify the understanding. This will allow the information about needs, interests and roles being present while also allowing the implementing party to quickly understand the position of each stakeholder.

The data collection process can be done through desk research on projects in the area, articles about the area and through internet search along with extensive interviews with the stakeholders.

Stakeholder analysis based on the Amoeba tool can allow for concentrated effort to gain the support of and improve collaboration between groups who may be open to up-take of the project while being aware of and avoiding the groups that are against NbS projects.

Power dynamics are important to the success of NbS projects, and understanding the power dynamics is essential for the mainstreaming of NbS (Walmser et.al, 2017). This analysis should be conducted separately as stakeholder analysis may not sufficiently capture the power structures present. This analysis should include an evaluation of shared power, the exercise of power, and power over others (Allen 1998; Verloo 2005). Essentially, vertical (top-down and bottom-up) and horizontal (between local institutions and between local groups) power dynamics analysis. This will allow us to identify the vulnerable groups and also the capacities of local institutions to implement NbS projects. This understanding is crucial as it would help design projects that can best aid vulnerable groups and also allow local institutions to convince higher authorities and their surrounding institutions to up take NbS projects.

Stakeholder & Power dynamics analysis should be seen as the first step towards comprehensive stakeholder engagement activities such as participatory planning. They allow for mapping of the local context, its power structures and important influencers beyond just the public and institutions, which can aid in the completion of the project. The stakeholder analysis should be conducted over the course of the project, its completion and in the long term to allow for learnings to emerge that can be added to the shared knowledge base and allow for changes in the terms used for communication and allow for better courses of action in the future.

4.2.2 Specific elements- Institutional Acceptance

- Align NbS to existing social and environmental policies and strategies

Identification of what is valued by local institutions, planners and politicians is knowledge that may be fundamental to the success of NbS. The versatility of NbS compared to grey solutions can be taken advantage of in this case. While some co-benefits are difficult to quantify, benefits such as aesthetics and increased land valuation, livelihood opportunities and development planning can be communicated more effectively. Aesthetics can be viewed visually and therefore can be appreciated. Improved land valuation can be communicated as green cover/spaces and reduced risk are key aspects that can improve the value of the land. NbS provides livelihood opportunities, through construction and maintenance activities, and can serve as employment opportunities for governing bodies that are trying to increase such opportunities for low income groups. Due to its various benefits, NbS can be incorporated into development planning as its indirect benefits can help improve agriculture, develop drinking water supplies, among others.

Therefore, identifying the areas of significance for governing bodies and pitching NbS solutions that embody these interests can lower the barriers to accepting NbS at the institutional level. The barriers for uptake of, especially at the local level, can be a result of funds being tight due the need to address state mandated projects and directives (Foldvary 1994; Zimmermann 2016). Thus pitching NbS solutions based on areas of significance can allow local institutions to justify the expenditure. This is the rationale behind the development of this section.

The areas of significance can be identified through ongoing and completed projects, policies and practices, to understand what actions are important to the governing bodies, and through communication with local institutions such as municipalities and local governments.

To further this, existing policies and practices that showcase a pathway for adoption of NbS in its implementation need to be identified and reformulated within the NbS umbrella. The following section identifies such avenues for entry.

1. Environment policies

Government policies are characterized by the mechanisms of implementation they have. The most common mechanisms are regulation (command-and-control), market-based (economic) instruments (MBIs), and voluntary approaches. The agendas proposed under various policies are realized through these mechanisms. Similarly, integration of NbS into the existing policy framework will lead to easier and faster adoption. Some of the existing policies that have this potential are:

- Nepal
 - Kathmandu Declaration on Green, Resilient and Inclusive Development (GRID)

The GRID approach pursues poverty reduction and shared prosperity with a long-term sustainability lens. This approach sets a recovery path that maintains a line of sight to long-term development goals; recognizes the interconnections between people, the planet, and the economy; and tackles risks in an integrated way. Since the approach already has Green and Resilience as two of its core components, this approach can be used to push for the adoption of NbS into various plans, policies, schemes, and projects that are undertaken in Nepal.

- Nepal National Adaptation Plan, 2021-2050

The plan aims to contribute to the socio-economic prosperity of the nation by building a climate-resilient society and reducing the risk of climate change impacts on people and ecosystems through the integration of adaptation across sectors and levels of government. Since the core vision behind this plan is the development of climate resilience across these sectors, the potential for integration of NbS across several of these sectors is very high owing to the broad range of benefits and co-benefits that NbS have.

- Pakistan
 - National Environmental Policy, 2005

The National Environmental Policy of Pakistan is a cross sectoral policy covering nine sectors and seven cross-sectoral themes. The main objectives of the Policy are a) conservation, restoration and efficient management of environmental issues, b) integration of environmental considerations in policy making and planning processes, capacity building of government agencies and other stakeholders at all levels for better environmental management, c) meeting international obligations effectively in line with the national aspirations and d) creation of a demand for environment through mass awareness and community mobilization to aim at protecting, conserving and restoring Pakistan's environment in order to improve the quality of life of the citizens through sustainable development.

As observed with the policies of Nepal, it provides policy directives considering the development of various acts and programmes, and regulations that are to be followed across various sectors. The potential for integration of NbS into this policy frame is large considering Natural Disaster Management being a cross-sectoral theme and the impacts of this span across all the nine sectors in focus.

- Sustainable Development Goals

The Sustainable Development Goals (SDGs) were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. There are a total of 17 SDGs which are all integrated. Although the benefits and co-benefits of NbS can be beneficial towards achieving other SDGs they have greater and more direct role to play towards the achievement of the below SDGs:

- SDG 6 - Clean Water and Sanitation
- SDG 11 - Sustainable Cities and Communities
- SDG 13 - Climate Action
- SDG 14 - Life Below Water
- SDG 15 - Life on Land

Since 149 countries have committed to the achievement of SDGs, integration of NbS as a part of these goals give a very high potential for a global reach.

2. Development Plans

Risk-informed development is the process of integrating disaster risk information in long- and medium-term national development plans, and in the public investment planning process. Various existing resources such as the ‘Handbook on Risk Informed Urban Planning for BIMSTEC Member Countries’ by Gujarat Institute of Disaster Management; ‘Risk informed development: from crisis to resilience’ by UNDP; ‘Risk informed development guide’ by Global Network of Civil Society Organizations for Disaster Reduction, and so on provide guidance on the processes involved and the key considerations. Incorporation of NbS as a promising resilience measure will enable effective adoption of the same by the countries and regions that are developing a risk informed development framework.

Some of the ways in which this has materialized is through programmes such as:

- Nationally Determined Contribution Support Programme (NDCSP) in Lebanon that commenced in 2017 and is expected to culminate by 2020. It is an economy-wide and country-wide initiative that focuses on both DRR and CCA.
- Moldova’s National Adaptation Planning Process. It particularly deals with the sectors on Health, Forestry, Transport, Energy, and Gender and implemented both at the national and local levels and focused on CCA- development of medium- and long-term capacities for planning and budgeting for climate change adaptation.
- Mainstreaming Climate Resilience into Development Planning was implemented in Cambodia during 2013-2017. It aimed at strengthening capacity to coordinate all Strategic Program for Climate Resilience (SPCR) investments and to mainstream CCA concerns into national and subnational planning, budgeting, and development.
- Bangladesh’s Inclusive Budgeting and Financing for Climate Resilience (IBFCR) Project from 2014-2021.

3. Resilience Strategies

Many existing resilience building strategies adopt principles as Ecosystem based Disaster Risk Reduction (EcoDRR), Ecosystem based Adaptation (EbA), and other ecosystem restoration measures have similar and overlapping practices and interests with NbS. It would be advantageous to align the communications regarding NbS with such existing practices. Considering that these existing approaches have similar goals as NbS, it would just be a matter of reclassification and addressing the missing components. Below are some actions taken across the world towards ecosystem-based resilience building.

- Aberdares Rehabilitation Project, Kenya

This project was launched in 2006, by the non-profit Green Belt Movement with support from the Agence Française de Développement (AFD). The project has worked to restore the degraded areas of the Aberdares forest ecosystem that provides essential services like water, rainfall, and biodiversity, and in turn would improve the livelihoods of communities adjacent to the area. About

4.1 million trees have been planted on 2,000 hectares of forest and 1,900 hectares of public sites or community areas as a part of this project.

- Mangrove restoration along the Red River Delta, Vietnam

With the rapid development of Vietnam, the mangroves along the Red River Delta were being cut down at an alarming rate to facilitate the development of shrimp farms. As a consequence, the annual cyclones caused more damage along the coast than the earlier years. In 1993, the Thai Binh chapter of Vietnam Red Cross (VNRC) was able to gain the support and funding of international partners which led to a 22-year program, during which more than 9,000 hectares of mangroves were planted across eight provinces.

- Coastal Mangrove restoration

Valuing the protective effect of mangroves for coastal communities is strong. This was demonstrated by a 2005 study by Badola and Hussain analyzed hazard damage to three coastal villages in India's Orissa State, taking prior cyclones as a reference point. The reported damages per household differed significantly in a community not protected by mangroves and in ones that were sheltered by mangrove belt. Surveyed residents appreciated the functions performed by mangrove forest and were willing to contribute to restoration.

4. Livelihood Measures

There have been livelihood measures which involve people and the taken across the world ecosystem and can therefore serve as an excellent avenue towards NbS. Some of these measures are highlighted below:

- AfReSlide (2013-2018)

It is a scientific project funded by the Belgian Federal Scientific Policy (Belspo). The objective of the project was to understand Landslides in Equatorial Africa and identifying culturally, technically and economically feasible resilience strategies. As a part of this it was identified in Uganda and Cameroon that it would be useful to promote the diversification of livelihoods in order to reduce the dependency of people on agricultural land. This in turn has implications for the control of landslides through soil stabilization as a consequence of afforestation measures.

- MGNREGA, India

The Mahatma Gandhi National Rural Employment Guarantee Act is an act that provides rural livelihood opportunities for unskilled workers. The beneficiaries of this program undertake various tasks. One of the commonly undertaken tasks is the maintenance of water bodies. Since the works undertaken are in the same geographical areas as the workers are from, they are more present and possess the local knowledge as well. Integration of NbS into this program will be very efficient as they are already involved in the construction and maintenance of local water bodies. This would provide additional livelihood opportunities for the community and also ensure awareness building.

Thus existing policies and practices across nations can provide further pathways for mainstreaming NbS and should therefore be considered within the scope of this process.

4.2.3 Specific elements- Public Acceptance

- Participatory engagement and effective communication of NbS benefits

The element is based on the Public Acceptance-Nature Based Solutions framework developed by Anderson & Renaud (2021) after an extensive review of successful NbS implementation. It presents four success criteria: provide benefits, increase awareness of benefits, communicate effectively & promote participation and collaboration. These criteria are further influenced by various intermediary factors that are divided between individual and societal factors. These factors include risk perception, trust, effectiveness, competing interests, past experiences, cost and funding and a sense of responsibility for the measures.

In the proposed framework, several of the criteria and intermediary factors are captured. The criteria of increase awareness of benefits, effective communication (terms for communication of benefits and knowledge base serve to address these criteria) and participation and collaboration (stakeholder and power dynamics analysis can aid in addressing these criteria) are captured, to a degree, through the overarching elements. However, it does not comprehensively capture all the proposed measures, for example value-framed communication for the public, within the framework. Therefore, these missing elements can be incorporated based on the need within the context of implementation. The criteria of provide benefits can only be, and should be, communicated effectively post-implementation.

The intermediary factors can be captured, except for cost and funding, through stakeholder and power dynamics analysis. Aspects that are missing within the Amoeba tool, such as risk perception, trust and past experiences can be added to the tool to be captured. Other aspects such as effectiveness and sense of responsibility can only be captured after the project has been implemented and should be captured through participatory engagement to effectively address issues that may arise.

Public Acceptance is crucial to the success of NbS, as acceptance is seen as being crucial to upscaling of NbS more than grey solutions (Anderson-Rennaud, 2021). This is especially true in the design and planning phase and the maintenance and sustainable phase (ibid). A positive sense of responsibility can lead to increase participation in the maintenance and sustainable use phase. A sense of trust and positive past experiences with NbS can all allow for NbS to be up taken effectively (ibid). Since NbS may not have permeated across all geographies, it becomes even more important to conduct an effective stakeholder and power dynamics analysis to understand how to earn that trust and improve collaboration for the project.

4.2.4 Significance of Mainstreaming Framework for NbS

The fundamental strength of this framework is its simplicity. This framework is primarily for mainstreaming. However, it can be compounded by analysis tools, co-benefit indicators and other tools to increase its complexity, allowing it to shift from mainstreaming at the local level to national and global levels. This framework can serve as the base for expansion due to being dynamic in nature, with learnings influencing each element over time. This can allow for improvement of each element over time.

This framework was created with a bottom-up approach towards upscaling in mind. This would begin at the local level and then move towards national and global levels. This would be to avoid top-down, technocratic approaches that ignore local context and can result in failure of the projects in the long term.

To mainstream at the national and global levels, there is a need to add more elements to this framework, such as inclusion of NbS within Disaster Risk Reduction frameworks like the Sendai Framework, national and global workshops as well as making use of ‘windows of opportunities’ such as in the aftermath of a disaster to promote NbS as a measure for disaster risk reduction.

Furthermore, the framework can be used irrespective of context. The stakeholder and power dynamics analysis would allow for the understanding of context and thus give the planners and implementers an idea of which branch of the framework should be prioritized or if they require equal priority.

4.3 Planning

Zoning developed as a result of technocratic planning to quickly address the concerns of the people. This has led to problems in the current generation. Studies on various policy features, in the field of resilience and disaster management, have shown that collaborative approaches are more effective than state mandates (May & Burby, 1996). This stands true for NbS as well (Zingraff-Hamed et.al, 2021). As acknowledged earlier, there is a need to integrate formal planning and experimentation to achieve NbS implementation and governing. To address this, NbS requires a planning process that can adhere to the tenets of the IUCN Standard. With this in mind, the communicative planning theory can give us a way forward.

4.3.1 Communicative Planning

Communicative planning is considered as a means to advance deliberative democracy to allow for planning matters to garner broad, workable agreements (Sager, 2012). Planning decisions are based on inclusive and thorough deliberation. The foundation of the *modus operandi* of communicative planning is to curb influences of coercive power on the discursively negotiated recommendations (ibid). This form of planning can greatly aid the implementation of NbS to be equitable and inclusive. This section is primarily to make the case for communicative planning as a planning methodology for NbS.

Planning is primarily considered to be “uncertainty reduction” by planners and the general public (ibid). As a result, planning is legitimized as functioning in favour of public interest. Several endeavours are undertaken with the idea of public interest in mind. Despite this, public interest is a contentious topic. This is due to public interest being seen as a social technology to homogenize communities in order to curb differences and can therefore be used to legitimize oppressive particularistic ideas (ibid). This is coupled with the reluctance to abandon public interest as a

concept in planning due to its intrinsic ability to (Alexander 2002; Campbell and Marshall 2002; Moroni 2004) legitimize public planning decisions and for politicians' to claim that impartial planning input was considered when justifying their decisions. The question becomes, what decisions can be seen as in favour of public interest?

Sager (2012) gives us an interesting example that can legitimize NbS as well. If “uncertainty reduction” is the crux of planning and is undertaken for public interest, then risk falls within the purview of uncertainty. Planning for risks such as landslides, flooding and other climate and disaster risks is in the interest of everybody as the public is all likely to be impacted by these risks (ibid). This cannot change simply because one individual does not gain the benefits as they shift to another part of the country (ibid). Thus NbS by nature functions for public interest which gives NbS projects viable legitimacy. However, inclusivity is a basic criteria for NbS and there is a need to go beyond inherent legitimacy of NbS to gaining public interest and support through inclusive dialogue.

Inclusive dialogue allows for each individual to judge and articulate their thoughts and arguments for planning actions. Communication is the key to inclusive dialogue, rather than formal aggregation and calculation (Sager, 2012). However, this does not mean all logical problems are solved (Sager 2002, 2005) but it does improve the chances of identifying a consistent collective. This would allow circumventing issues of public interest.

The final roadblock that can impede the decision making process, primarily for NbS and other environmental and disaster risk reduction approaches, is that of “paternalism”.

““Paternalism” can be defined as the interference of a state or an individual with another person against his or her will, and is justified by a claim that the person interfered with will be better off or protected from harm.” (Sager, 2012).

Paternalism is common in disaster preparedness planning (Jennings, 2008). In the discourse on environmentalism Meyer (2008, 221) identifies the attitude: *“We—the informed, engaged, public spirited—wish to protect you the uninformed, apathetic, or egoistic, from the consequences of your environmentally destructive ways.”* Such an attitude can result in negligence of local context and needs.

In light of this issue, communicative planning makes the assumption that through the path of dialogue, the population at large will come to appreciate what course of action is in their own best interest (Sager, 2012). Disagreements may emerge between the planners and the local citizens but communicative planners should take actions that do not disregard the preferences of persons who have consented to the dialogic process and arrived at a decision in favour of uncooperative individuals (ibid).

1. Case Study for Communicative Planning: Medmerry Coastal Protection Project

The project was proposed as a measure to address coastal flooding in the town of Medmerry located in West Sussex, England. The existing coastal flooding mechanism, a 3 km shingle bank, was seen as ineffective due to regular breach. Development impacts and the rise of flood defense infrastructure have resulted in sea level rise and loss of wetland and intertidal habitats to the sea.

The objective of the project was to address these issues through sustainable flood risk management and creation of compensatory intertidal habitats. However, implementation of the project by the UK Environment Agency was met with opposition from the local community. To tackle this opposition, the agency and concerned local people created the Medmerry Stakeholder Advisory Group which consisted of self-elected individuals from the local community who would voice the concerns of the community, interact with the project team and report back to the community. This allowed the project to move forward and reach completion.

The lessons learned from this project include collaboration with multiple stakeholders to arrive at innovative solutions and engagement with local communities to allow for their voices to be included within the project.

The project highlights the need for mainstreaming with a focus on various stakeholders and communicative planning. The project met with opposition from the community primarily due to the community being excluded from the project planning process. It only gained legitimacy and support after the local community was consulted and engaged with for implementation. Therefore, inclusive dialogue represents an avenue to avoid these issues in the future and should be considered seriously as a planning tool for NbS in the future.

4.3.2 Significance of Communicative Planning for NbS

Communicative planning provides a viable planning methodology for implementation of NbS. It adheres to several criteria of the IUCN Standard and takes into account issues of public interest and paternalism while justifying the need for inclusive dialogue. Furthermore, communicative planning can allow for ownership of NbS projects which would allow for the long term sustainability as citizens would be invested in maintaining and monitoring the project.

Communicative planning can occur across departments and institutions as well, allowing for collaboration in planning and implementation of NbS solutions. This is required as planning and implementation is often a cross-sectoral activity and there may be an overlap of actions across departments and institutions.

The need for communicative planning can be further emphasized through the example of the Medmerry Coastal Protection project.

4.4. Significance of the process for development of codes and standards

The mainstreaming framework and the choice of communicative planning as the planning procedure was based on four fundamental aspects; communication, awareness generation, collaboration and inclusivity. While in the mainstreaming framework, the communication process is generally one way, this issue is addressed through the inclusive dialogue process in communicative planning. The fundamental aspects were arrived at through study of the IUCN Standard and the Public Acceptance-Nature Based Solutions Framework by Anderson-Rennaud (2021).

The process captures the most important functions that need to be done to ensure uptake of NbS. While the IUCN Standard is elaborate, it does not take into account differences in expertise and resources around the world which can impede acceptance of NbS across different societies. The process highlighted here can capture the local context and the imperative challenges for the society while also raising awareness to the benefits of NbS and allowing for collaboration across the institutions and the public without extensive expertise and resources.

The mainstreaming framework and communicative planning should be seen as measures that can allow for local level acceptance of NbS and can aid in the development of codes and standards at the local level. Furthermore, the process can be further built on to increase its complexity. This can be done based on processes such as Eco-DRR and ecosystems based climate change adaptation. Other planning procedures and tools can also be added to build this up further in the future.

The next section discusses possible structures for codes and standards of NbS.

4.5 New structures for codes

While the above sections have communicated the process for development of codes and standards for NbS. The following section communicates the structures for these codes and standards. These structures can be used to develop new codes and standards based on the input from mainstreaming and planning processes which would allow for incorporation of NbS into the institutional framework so that NbS measures can be embedded into the institutional process. This would allow for NbS to sustain the long term, beyond project completion and changes in the administration of governments, local and national.

4.5.1 Form-Based codes

Form-based codes represent a paradigm shift in planning. These codes are used to shape the physical form of a city through a focus on the public realm. The ideology behind form-based codes

is to shift from primarily attempting to address the physiological needs of the citizens, such as health, safety and welfare, towards appreciating the perceptual and psychological qualities of place as well. By nature, form-based codes seek to embody the duality and are structured to address this intent (Ben-Joseph, 2012).

Regulations for building form are secondary for form-based codes and therefore the vision for the city is of significant importance to garner support from the public. Therefore, form-based codes envision an intrinsically contrasting view from conventional zoning on regulating land use, with greater importance given to physical form and community design vision (ibid).

Form-based codes, through its intent to address physiological needs, perceptual and psychological qualities of place, can serve as an excellent structure to adopt NbS. NbS is versatile in its benefits and co-benefits and can therefore serve as an excellent foundation for the development of form-based codes. By incorporating community design vision, the societal issues that NbS seeks to address can take the forefront. This can be done through communicative planning discussed earlier. How and where NbS can be implemented will emerge through the community design vision and the proposed physical form of the area.

Thus form-based codes with NbS as a primary design foundation can allow for ecosystem protection and proliferation across contexts. These codes can be developed through local consultation and deliberation and can serve as the foundation for spreading across various nations.

4.5.2 Rating and Directive Frameworks (Design Codes)

Rating frameworks can allow for innovation and code change in the modern era. The framework is used to rate a baseline or minimum standard and outperforming this baseline will allow for change and innovation. An example of such a rating system is the Leadership in Energy and Environmental Design for Neighborhood Development (Ben-Joseph, 2012). The LEED-ND framework has been praised for the simplicity of its checklist to identify and reward good green design choices (ibid). Other countries, such as the UK have agencies such as the Commission for Architecture and the Built Environment (CABE), developing design guidelines, directives and programs since the early 2000s (ibid). Such design codes are seen as valuable tools to promote sustainable processes. However, they are most valuable when applied to large sites or multiple related small sites as it can coordinate multiple teams and development phases across substantial or numerous areas to establish a design vision (ibid).

The rating system is immensely useful for the implementation of NbS measures. In the current context, where external agencies and government agencies are working, in tandem or separately, to implement projects across the world, the rating framework can allow for streamlining of work within the same context and can best serve as a framework for mass upscaling of NbS. However, what needs to be understood is that the rating system has to evolve from the local area through dialogue and deliberation. This can capture the needs of the locality which can be merged with green design to create a rating system that best suits the local context. At national and international level, guidelines for creation and use of the rating system can be formulated. While LEED-ND

may be an excellent rating framework, there is a need to realize that importing frameworks and systems directly into different contexts, especially the context of developing countries, can only result in poor uptake. Another standard that can be studied is the ABC Waters Design Guidelines which might serve to be even better of a framework to study as it incorporates NbS heavily into its features.

Therefore, the LEED-ND framework and the ABC Design Guidelines and its successes and failures can be studied to create rating and design frameworks across the world that can be used to implement NbS measures.

5. Conclusion

Codes and Standards are crucial for systematizing the NbS process. However, codes and standards, in the past, have often been used by local governments to neglect decision-making and instead legitimize less than ideal practices (Ben-Joseph, 2012). Financial institutions and lenders are also hesitant to accept development proposals that deviate from mainstream practices (ibid). This can stunt innovative proposals that can serve development goals, and address societal and environmental issues, in favour of less than ideal mainstream proposals. This means that prior to developing codes and standards, there is a need to deliberate over them.

Codes and standards need to move on from a global and international outlook towards local context based outlook to ensure that they are relevant to the local context and can address issues at the ground level. To ensure this, the mainstreaming and development planning process need to account for the local context. Through communicative planning and targeted mainstreaming efforts, local based codes and standards can be arrived at which would circumvent the issues that have plagued codes and standards over the years. NbS needs to circumvent these issues if they are to successfully be implemented across the world. At the global level, guidelines can be developed that serve as templates for improvement of local codes and standards. The IUCN Standard is one such template as it has been developed through study of best practices. Such global guidelines can serve as assessment and comparative frameworks for local codes and standards.

The paper calls for a shift in thinking on how NbS codes and standards have to be developed and structured to allow for successful upscaling across the world.

6. References

- Alexander, E. R. (2002). *The public interest in planning: From legitimation to substantive plan evaluation*. *Planning theory*, 1(3), 226-249.
- Allen, A. (1998). *Rethinking power*. *Hypatia*, 13(1), 21-40.
- Anderson, C. C., & Renaud, F. G. (2021). *A review of public acceptance of nature-based solutions: The 'why', 'when', and 'how' of success for disaster risk reduction measures*. *Ambio*, 50(8), 1552-1573.
- Andrade, A., Cohen-Shacham, E., Dalton, J., Edwards, S., Hessenberger, D., Maginnis, S., ... & Vasseur, L. (2020). *IUCN Global Standard for Nature-Based Solutions: a user-friendly framework for the verification, design and scaling up of NbS*. IUCN: Gland, Switzerland.
- Ben-Joseph, E. (2012). *Codes and standards*. In *The Oxford Handbook of Urban Planning* (p. 352). Oxford University Press.
- Black, D. (1958). *The theory of committees and elections*.
- Brouwer, H., Hiemstra, W., van Vugt, S., & Walters, H. (2013). *Analysing stakeholder power dynamics in multi-stakeholder processes: insights of practice from Africa and Asia*. *Knowledge Management for Development Journal*, 9(3), 11-31.
- Brugha, R., & Varvasovszky, Z. (2000). *Stakeholder analysis: a review*. *Health policy and planning*, 15(3), 239-246.
- Campanella, T. J., & Godschalk, D. R. (2012). *Resilience*.
- Campbell, H., & Marshall, R. (2002). *Utilitarianism's bad breath? A re-evaluation of the public interest justification for planning*. *Planning Theory*, 1(2), 163-187.
- Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., ... & Walters, G. (2019). *Core principles for successfully implementing and upscaling Nature-based Solutions*. *Environmental Science & Policy*, 98, 20-29.
- Cowling, R. M. (2005). *The process of mainstreaming: Conditions, constraints and prospects*. *Mainstreaming biodiversity in production landscapes*, 18-25.
- Forester, J. (2012). *From Good intentions to A Critical Pragmatism*. In *The Oxford Handbook of Urban Planning* (pp. 285-305). New York: Oxford University Press.

Habermas, J. (2006). *Political communication in media society: Does democracy still enjoy an epistemic dimension? The impact of normative theory on empirical research*. *Communication theory*, 16(4), 411-426.

Hussain, S. A., & Badola, R. (2010). *Valuing mangrove benefits: contribution of mangrove forests to local livelihoods in Bhitarkanika Conservation Area, East Coast of India*. *Wetlands Ecology and Management*, 18(3), 321-331.

Kronenberg, J., Bergier, T., & Maliszewska, K. (2017). *The challenge of innovation diffusion: Nature-based solutions in Poland*. In *Nature-based solutions to climate change adaptation in urban areas* (pp. 291-305). Springer, Cham.

Mace, G. M. (2014). *Whose conservation?*. *Science*, 345(6204), 1558-1560.

Mascarenhas, A., Ramos, T. B., Haase, D., & Santos, R. (2016). Participatory selection of ecosystem services for spatial planning: Insights from the Lisbon Metropolitan Area, Portugal. *Ecosystem Services*, 18, 87-99.

May, P. J., & Burby, R. J. (1996). *Coercive versus cooperative policies: Comparing intergovernmental mandate performance*. *Journal of Policy Analysis and Management*, 15(2), 171-201.

McLean, I., & Hewitt, F. (Eds.). (1994). *Condorcet: foundations of social choice and political theory*. Edward Elgar Publishing.

Meyer, J. M. (2008). *Populism, paternalism and the state of environmentalism in the US*. *Environmental Politics*, 17(2), 219-236.

Moroni, S. (2004). *Towards a reconstruction of the public interest criterion*. *Planning theory*, 3(2), 151-171.

OPPLA (2022). *Case Studies: Medmerry, West Sussex coastal flooding*. <https://oppla.eu/casestudy/18379>

Sager, T. (2002). *Democratic planning and social choice dilemmas: prelude to institutional planning theory*. *Urban and Regional Planning and Development*

Sager, T. (2005). *Planning through inclusive dialogue: No escape from social choice dilemmas*. *Economic Affairs*, 25(4), 32-35.

Sager, T. (2012). *Collective action: Balancing public and particularistic interests*.

Schmeer, K. (1999). Stakeholder analysis guidelines. *Policy toolkit for strengthening health sector reform*, 1, 1-35.

Singapore. Public Utilities Board. (2018). *Active Beautiful Clean Waters: Design Guidelines 4th Edition*. PUB Singapore.

Somarakis, G., Stagakis, S., Chrysoulakis, N., Mesimäki, M., & Lehvavirta, S. (2019). *ThinkNature Nature-based Solutions Handbook*.

Southworth, M., & Ben-Joseph, E. (2013). *Streets and the Shaping of Towns and Cities*. Island Press.

Thompson, F. M. L. (1968). *Chartered surveyors: The growth of a profession*. Routledge & Kegan Paul Books.

U. N. (2015). *Transforming our world: The 2030 agenda for sustainable development*.

Verloo, M. (2005). *Displacement and empowerment: Reflections on the concept and practice of the Council of Europe approach to gender mainstreaming and gender equality*. *Social Politics: International Studies in Gender, State & Society*, 12(3), 344-365.

Wamsler, C., Pauleit, S., Zölch, T., Schetke, S., & Mascarenhas, A. (2017). *Mainstreaming nature-based solutions for climate change adaptation in urban governance and planning*. In *Nature-based solutions to climate change adaptation in urban areas* (pp. 257-273). Springer, Cham.

Wickenberg, B., McCormick, K., & Olsson, J. A. (2021). *Advancing the implementation of nature-based solutions in cities: A review of frameworks*. *Environmental Science & Policy*, 125, 44-53.

Wickersham, J. (2000). *Jane Jacob's critique of zoning: From Euclid to Portland and beyond*. *BC Env'tl. Aff. L. Rev.*, 28, 547.

Yahya, S., Agevi, E., Lowe, L., Mugova, A., Musandu-Nyamayaro, O., & Schilderman, T. (2001). *Double Standards, Single Purpose: Making Housing Standards Relevant to People's Needs*.

Zingraff-Hamed, A., Hüesker, F., Albert, C., Brillinger, M., Huang, J., Lupp, G., ... & Schröter, B. (2021). *Governance models for nature-based solutions: Seventeen cases from Germany*. *Ambio*, 50(8), 1610-1627.