

**NATURAL ASSET MANAGEMENT WITHIN ATLANTIC CANADIAN
COMMUNITIES: EXPLORING PERSPECTIVES AND LOCAL GOVERNANCE
PROCESSES**

by

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Submitted in partial fulfillment of the requirements
for the degree of Master of Environmental Studies

at

Dalhousie University
Halifax, Nova Scotia
November, 2024

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Abstract

A myriad of concepts, frameworks, and terms exist that are associated with ecosystem-based adaptation. Natural Asset Management (NAM) is an approach that began to advance in popularity across Canadian society in the mid 2010s; NAM appears to have recently arrived in the Atlantic Canadian provinces toward the end of the 2010s. This approach, while similar to other ecosystem services approaches, specifically integrates asset management procedures and terminology to assist practitioners with tracking and assessing the inventories, conditions, risks, and service levels of natural assets. As local government and community practitioners communicate about NAM, this concept has begun to diffuse within Atlantic Canadian society, and may have significant impacts for community planning, policy, development, conservation, and ecosystem-based adaptation to climate risks. The perspectives, practices, and communication behaviors of these governance actors are explored within this thesis to understand their experiences surrounding NAM. As Atlantic Canadian governance actors advance in their practices and organization surrounding the NAM approach, it is vital to understand these interactions through the inclusive lens of ecosystem governance.

List of Abbreviations Used

ES	Ecosystem Services
NbS	Nature-based Solutions
NAM/MNAM	Natural Asset Management (sometimes referred to as Municipal Natural Asset Management)
NAI/MNAI	Natural Assets Initiative (formerly known as the Municipal Natural Assets Initiative)
EbA	Ecosystem-based Adaptation
Eco-DRR	Ecosystem-based Disaster Risk Reduction

Glossary

Asset Management: The Canadian Network of Asset Managers (CNAM) define asset management as “the coordinated activities of an organization to realize value from its assets in the achievement of its organizational objectives” (CIRC, 2014, p.1).

Ecosystem-based Adaptation: is defined as “the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change” (Secretariat of the Convention on Biological Diversity, 2009, p.41).

Ecosystem-based Disaster Risk Reduction: can be defined as “sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development” (Renaud et al., 2013, p. 30).

Ecosystem Governance: can be defined as “the integrated and holistic governance of ecosystems that includes formal and informal institutions, collaboration and cooperation across different levels of government, and non-governmental and individual action” (Baird, Hickey and Holzer, 2022, p. xx).

Ecosystem Services: “Benefits that humans recognise as obtained from ecosystems that support, directly or indirectly, their survival and quality of life” (Harrington et al., 2010, p.2781).

Governance: Kooiman (2003) defines governance as the “totality of theoretical conceptions on governing” (p.4) and identifies governing as “the totality of interactions, in which public as well as private actors participate, aimed at solving societal problems or creating societal opportunities; attending to the institutions as contexts for these governing interactions; and establishing a normative foundation for all those activities” (p.4).

‘Municipal’ Natural Assets: defined as “stocks of natural resources or ecosystems that contribute to the provision of one or more services required for the health, well-being and long-term sustainability of a community and its residents” (MNAI, 2019, p. 4).

Nature-based solutions: defined by the International Union for Conservation of Nature (IUCN) as “actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g. climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits” (Cohen-Shacham et al., 2016, p. xii).

Natural Asset Management: “is the process by which natural assets are identified, understood, and ultimately managed to preserve their integrity and the services they provide. This includes

infrastructure (e.g., stormwater management) and non-infrastructure services (e.g., recreation or carbon sequestration)” (NAI & Ducks Unlimited Canada, 2024, p. 3).

Statement

Before beginning I would like to introduce myself to the readers, as my life experiences and perspectives are difficult to separate from this research. An important part of qualitative research is accepting that as researchers our positions in society and our personal backgrounds influence the research we create. It is important to note that my educational background is in environmental planning, and my perspective is frequently derived from that discipline. The first time that I was introduced to the concept of Natural Asset Management (NAM), I was studying as an undergraduate student in community planning. I was given an assignment to write how the concept of NAM and ecosystem services (ES) could improve the sustainability of communities; this was then followed by exploring some of the structural and ethical concerns associated with NAM and ES. Years later I found myself working for local government, where I was tasked with asset management related projects and policy development. I saw firsthand how the *Asset Retirement Obligations Policy PS3280*, now required under public sector accounting standards, was using asset management and finance to assist with tracking environmental risks and helping to decrease these risks of environmental contamination.

It was during that time, that I recalled the concept of NAM. I learned more about NAM while enrolled in a continued professional learning course. Looking back, I was enthralled with the idea of integrating nature into our decisions. Soon I was telling people how excited I was about NAM, sharing reports, and even suggesting policies to reflect this ideology. Reflecting on this time, I realize that as someone who cares deeply about nature, I was attempting to find a way to help nature through my work. I believe that these past experiences in my background have helped to provide me with additional understanding and shared commonalities with the participants. Yet, in understanding this, it also has the potential to bias my point of view.

When I first began my graduate studies, I was still looking at NAM through starry eyes. I had forgotten one of the most important things that I was taught as a planning student: to always remember the precautionary principle. As I moved through the

beginning stages of this research in my first year, I felt an uneasiness that I'm sure many graduate students experience. However, this was coupled with an abrupt realization: was this research going to help advance a new management practice for which we still do not understand the potential long-term social impacts? Was this research helping to support colonialist and capitalist ideology in association with nature? What potential harm could occur? These were not questions that I had considered initially, and for this, I was overcome at times with a sense of fear and guilt. As time moved along, I still felt a great sense of curiosity to learn more about this topic and to understand it from different perspectives, including from the theoretical perspectives which may argue against this approach. By maintaining this perspective, that there are both positive and negative impacts that could potentially occur as a result of NAM, I felt a sense of strength to continue exploring this topic.

In my understanding, it is likely that NAM may be easily viewed from polarized perspectives within Canadian society. Therefore, it is important to me that I represent my findings in ways that do not shy away from contrasting opinions. I also see how the precautionary principle could be considered from different perspectives in relation to NAM. One perspective may be: Do we know enough about the potential social impacts of NAM to move forward with this approach, or should we proceed more cautiously, perhaps halting it until we know more? A second perspective may be: Given the rapid impacts of climate change and unsustainable development decisions, can we afford to wait another decade or two, to obtain enough longitudinal studies in cases where NAM has been used? Those who are focused on ecological sustainability may see the second perspective as the greater risk, while those who are more focused on social sustainability may see the first perspective as the greater risk. In this thesis, I do not set out to ask where a greater risk may exist here. Nor do I assume that there is only room for those two perspectives. What I do set out to do is to learn more about this management practice, as it is currently unfolding in Atlantic Canada. My hope is that this work provides some helpful jumping off points for public discourse surrounding NAM and governance; and I truly hope that this research will increase public

understanding surrounding the perspectives of the NAM practitioners who are attempting to help nature, and their communities, through their work. I believe that in general what we all want is to see improvements to decision-making that help enhance the resilience of our communities.

My past education nourished a desire to protect, enhance, and restore ecological processes through environmental planning. Planning students are taught of the destruction that has been caused historically through poorly informed planning decisions. This can leave us with a sense that we must try to undo some of these past mistakes, and to work diligently to communicate with the public to consider community concerns and the potential consequences of decisions. I experienced what it feels like to work in municipal government, wanting to connect with other local groups and institutions to discuss ecological approaches, while operating in a somewhat fragmented and isolated system. I believed that if we could find a way to connect and collaborate more systematically across departments, communities, and jurisdictional boundaries, that we could enhance our ecosystems and increase our community resilience to climate risks. At one point, I lived and breathed this 'NAM' experience, as I sat at a computer mapping and tracking the condition of engineered assets; I would then walk home staring at the fields, trees, and grass, imagining how such a system could help enhance connectivity across the landscape. I understood what this could mean for communication across departments and groups. In this sense, I have experienced a similar 'NAM mindset' that the participants describe. To help lessen some of my own biases that I originally held, I have carefully phrased the research questions so that they are not worded in a way that carries assumptions (e.g. it is likely that participants have engaged with other tools and theories that have influenced their opinions and decisions regarding ecosystem-based approaches outside of their NAM related work; I also understand that alternatives exist to these approaches). As these experiences have influenced my values and interests as a researcher, I have found that a constructivist/ interpretivist approach is well-aligned with how I approach this research.

Acknowledgements

To begin, I would like to acknowledge that the location where this research was conducted is located (across Atlantic Canada) is in the unceded and ancestral territory of Indigenous Peoples. Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq.

This research would not have been possible if it were not for the assistance and time provided by the local government and community participants. Thank you for allowing me this opportunity to learn as a student and grow my professional knowledge in this exciting new area of research. Thank you to my supervisor, Dr. Melanie Zurba, and committee member Dr. Julia Baird for providing me with support, advice, and confidence building during this research process. Thank you to Dr. Michelle Adams for assisting with the review process and helping to strengthen this work. A special thank you to Dr. Andrew Medeiros and Dr. Eric Rapaport, who provided me with much advice, support, and supervision at the beginning stages and data collection period of this research journey.

I could not have reached this point without the help of a community of academics, and I am incredibly grateful for all the time and kindness that has been extended to me by professors from both Dalhousie University and Brock University. I would also like to thank the staff and faculty of SRES and the Dalhousie School of Planning, who provided me with assistance and advice along the way when needed. Dr. Peter Tyedmers and Dr. Kate Sherren were kind and helpful as they assisted me with navigating this research process! Thank for always providing an ear for listening and advice when needed, given the interdisciplinary nature of this project, it was helpful to have other opinions to strengthen this work. And last but certainly not least, thank you to my loved ones at home, who were always there to provide support through a listening ear during the highs and low of this journey! That includes my darling Petunia, who spent many days cuddled next to my computer on my desk, I could not have done it without you all!

Funding Acknowledgments

This research is supported in part by funding from the Social Sciences and Humanities Research Council (SSHRC). This research is also supported by funding from Dalhousie University through the Killam Scholarship program, and the Nova Scotia Graduate Scholarship program; a special thank you to the funders for providing financial support for this research.

Ce projet de recherche est en partie financé par le Conseil de Recherches en Sciences Humaines.

CHAPTER 1: INTRODUCTION

1.1 Introduction

The concept of integrating nature into the design of human settlements has deep roots throughout history. In more recent decades the concept of ecosystem services has become increasingly popular (Gómez-Baggethun et al., 2010). The Millenium Ecosystem Assessment (2005) notes that humans are reliant upon the benefits provided by ecosystems, often referred to as 'ecosystem services' (ES). Research into governance systems involving ES is an important avenue to assist with the advancement of climate change adaptation in policy and practice. Numerous ES frameworks have been developed by both government and non-government actors on international, national and local scales, often targeting governments to integrate these systems into their daily practices. Between 2001 and 2005 the MA (MA, 2005) was conducted on a global scale in order to gain a deeper understanding of the impacts that human activity and land uses are having on ecosystems and to support conservation and sustainable use decision-making. In more recent work through the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019), collaboration and engagement with local communities, stakeholders, and Indigenous Peoples, has been noted as being vitally important to conservation efforts. Approaches that consider ecosystem services have been linked to numerous benefits for local and Indigenous communities including: enhanced biodiversity and climate resilience (Wüstemann et al., 2017), flood mitigation (Short et al., 2019), and disaster risk reduction in association with extreme climate hazards (Denjean et al., 2017). Climate change is a global issue that involves a wide range of potential risks and impacts to local communities. ES have been identified as a cost-effective approach that can assist with climate adaptation (Wüstemann et al., 2017) and have been linked to disaster risk reduction agendas within international policy and planning (Favre et al., 2017).

Since the advancements to ES in the early 2000s, the development of frameworks surrounding the concept of 'ecosystem services' continues to evolve. Initially following the MA, work on ES was overrepresented by knowledge from economic and natural science disciplines, leading to a narrow range of perspectives in ES (Díaz et al., 2018). In addition to the 'instrumental' values that humans associate with ecosystem services, many scholars and frameworks have since emphasized that embracing pluralism is significant for advancing ES approaches toward a deeper understanding of the value of ecosystems (e.g. Arias-Arévalo et al., 2018; IPBES, 2019; TEEB, 2010; Holzer, Baird & Hickey, 2022). Some frameworks conceptualizing ES include both monetary and non-monetary approaches to valuation; one such framework that provides recommendations for differing valuation approaches is the IPBES (2019). In some cultural contexts, money is less relevant or absent from daily life; while some researchers have attempted to understand people's willingness to pay for ES through non-monetary ways, for example with food items, these types of assessments may be difficult to transfer outside of their local contexts (Christie et al., 2012). Some scholars have chosen to use a combination of these approaches, for example, Wam et al. (2016) used a multi-criteria analysis model that included both monetary and non-monetary aspects to their evaluation of trade offs between competing ecosystem services in the Boreal Forest between different societal groups. It is also important to consider the context wherein economic valuation may be used, as Christie et al. (2012) cautions that in some circumstances involving the monetary valuation of ES, such as biodiversity, the exercise may be overly complex, inappropriate, or unnecessary.

In a broad sense, more recent literature and frameworks surrounding the concept of ES come from a place of understanding that there is a need to include diverse perspectives, methods, and approaches to ES and governance associated with ecosystems in general. Davies et al. (2015) note that diverse perspectives are needed to improve ecosystem service approaches, particularly when attempting to address complex socio-political issues, asserting that diversity in ES assists to "address wicked problems by acknowledging diverse sets of values and accounting for conflicting world

views” (p. 37). Patterson, MacDonald, and Hardy (2017) note that a variety of environmental accounting tools (e.g. ecological pricing, ecological footprinting, carbon footprinting, etc.) have been developed in the past decades to quantify the effects on the environment by humans to assist decision-makers with measurement surrounding goals for sustainability. While monetary valuation is a common method used in ES approaches, quantification of ES does not always necessarily result in translation into monetary terms (e.g. see Moller et al., 2004; Arias-Arévalo et al., 2018; Yang et al. 2018; Wurster & Artmann, 2014; Ebner, Schipke & Tappeiner, 2022; Purushothaman et al., 2013).

It is also important to acknowledge the variety of activities that has been occurring since time immemorial in association with environmental monitoring that are relevant to providing a deeper and broader understanding ecosystems and human relationships to them. Tengö et al. (2014) refer to Indigenous and local knowledge systems as having developed over extended time periods through processes of experimenting and adaptation, and as being highly useful for the sustainable management of ecosystems. A number of studies and frameworks attempt to integrate diverse values and methods to address the need for pluralism in ES approaches, for example, the Multiple Evidence Base approach “highlights the importance of indigenous and local knowledge systems on their own terms” (p.580) and considers the differences between forms of knowledge such as approaches between qualitative and quantitative methods, as well as disciplines (Tengö et al., 2014). Social factors and dynamics have important impacts on the delivery of ES and remain less explored in ES research (Davies et al. 2015). Arias-Arévalo et al. (2018) asserts that “understanding the importance of nature, ecosystems or ES for people involves dealing with multiple, and often conflicting, valuation languages” p.46) Therefore, the dynamics and interactions between governance actors involved in association with ecosystem services are significant areas to consider in research.

Various ES frameworks have been introduced across Canada, including an *Ecosystem Services Toolkit* that was developed in 2017 by an intergovernmental

taskforce (Value of Nature to Canadians Study Taskforce, 2017). Another framework that encourages ES concepts was also released in 2017, originally referred to as Municipal Natural Asset Management (NAM), which was developed and promoted across Canada by the Natural Asset Initiative (NAI). Recently, several local governments across the Atlantic Canadian provinces have been introduced to this management approach. NAM focuses specifically on increasing the recognition of ecosystem services and natural assets within the context of local government decision-making (MNAI, 2017). In addition to NAI, other organizations such as the Federation of Canadian Municipalities (FCM) have also been active in supporting natural asset management approaches in Canada through opportunities for project funding that is provided by the Government of Canada through the avenues such as the Green Municipal Fund program (see FCM, 2019). The Atlantic Infrastructure Management (AIM) Network assists with supporting natural asset management in Atlantic Canada by providing opportunities for learning and networking (see: AIM, 2024; n.d.)

The practice of NAM contains activities such as inventorying natural assets (mapping natural features), condition assessments, risk assessments, determining levels of service, and the economic valuation of ES. The potential for changes in decision-making processes to occur in relation to NAM make it significant to explore the progress and perspectives of local practitioners, especially in relation to climate adaptation and ecosystem governance. Ecosystem governance is a broad term that may be defined differently depending on the context in which it is used. Baird, Hickey and Holzer (2022) define ecosystem governance as “the integrated and holistic governance of ecosystems that includes formal and informal institutions, collaboration and cooperation across different levels of government, and non-governmental and individual action” (p. xx). This research uses this definition of ecosystem governance because it is a largely inclusive definition that also considers informal groups and activities as being significant to decision-making in this area.

1.1.1 Problem Statement

In the summer of 2023, the Atlantic Province of Nova Scotia experienced record breaking natural disaster-related events, including devastating wildfires (Singh & Hopton, 2023) and historic flooding events (Associated Press, 2023). When considering climate change concerns in Atlantic Canada, Philp and Cohen (2020) noted difficulties with the implementation of climate adaptation measures in Nova Scotia. The Province of Nova Scotia mandated that by 2014 that all municipalities develop Municipal Climate Change Action Plans (MCCAPs) (Vogel et al., 2018). Despite these advancements, Philp and Cohen (2020) have identified that institutional barriers currently exist that impede the implementation of the MCCAPs. While there are many known benefits of ES and nature-based solutions, issues have also been identified with their uptake within Atlantic Canada; For example, Rahman et al. (2021) assert that psychological and institutional barriers exist which impede nature-based solutions for coastal adaptation in Nova Scotia. One such barrier, associated with path dependency, means that decision-making and public trust for hard infrastructural solutions is the dominant approach in engineering (Rahman et al., 2021).

Similarly, when considering barriers associated with the integration of ES, issues that appear in international studies discussing ES and nature-based solutions (NbS) include the complexity surrounding challenges with data and ES tools (Ncube & Arthur , 2021) and the need for improved communication and collaboration between groups (e.g. Short et al., 2019). This apparent struggle with ES-related communication across disciplines within governments is an important issue to consider. For example, in a study that addressed the ecosystem services approach across Sweden, Hysing (2021) noted that collaboration and communication surrounding ES “have mainly occurred between professionals” (p.6). Within Canada, Kerr et al. (2021) also echo these types of concerns, noting several factors which impede the ability for governments to support ecosystem services within their decision-making, including: difficulties with communication between disciplines and governmental departments regarding ES, and the difficulties

that staff report with utilizing the recent *Ecosystem Services Toolkit* produced by Canadian government. Through key informant interviews and document analysis, Kerr et al. (2021) found that governments frequently support the idea of ES, yet rarely provide details to the public on the decision-making processes surrounding implementation. Kerr et al. (2021) note that interdisciplinary approaches are not common in governments but are essential to integrating the concept of ecosystem services into practice. Similarly, within graduate research on NAM based out of Ontario, Milligan (2019) identified a key theme surrounding the need for more collaborative work on NAM between groups.

In general, the ES concept has been both applauded and criticized as a tool for decision-making (Tang Kai et al. 2022). In their study on ES in Canadian city planning Tang Kai et al. surveyed municipal government across the county. Tang Kai et al. (2022) found that from a list containing several mainstream ES frameworks, over 50% of the participants stated that none of the above were being used. Tang Kai et al. (2022) assert that the study findings may “imply that mainstream frameworks are not suitable in Canadian municipal applications” (p. 159). It is significant to note that NAM was not mentioned within the study, despite the recent advancement of this approach to ES within Canadian local governments over the past decade.

Given the recent climate-based disasters that have taken place in Atlantic Canada, it is important to explore strategic planning and collaborative action approaches that may help toward addressing local climate risks. Exploring new approaches that consider the integration of nature-based solutions and ES into the decision-making of Atlantic Canadian local governments appears to also be necessary. Local government actors are a significant group involved in NAM within the Canadian context; within the Atlantic Canadian context, governments currently appear to only be adopting the NAM approach at the local level. NAI (2024, August 27) notes that the Government of Canada has taken actions that help support NAM through funding streams and within the *National Adaptation Strategy*. While the strategy encourages

natural and hybrid infrastructure projects, an example of this can clearly be seen within Canada's Natural infrastructure Fund program; the asset details section for small projects funding required applicants to "identify and describe the natural assets or natural asset systems that are part of the project" (Infrastructure Canada, 2022, p. 10), while also including examples of natural and hybrid features that could be considered part of an 'asset system,' (e.g wetlands and bioswales). Therefore, while it is clear that other levels of government have been providing funding assistance to 'natural asset' related projects, local governments and non-government actors appear to be those primarily involved directly in this approach. One possible explanation for this may be that given the level of detail involved in NAM, provincial and federal agencies may find the approach to be unfeasible for application at such large scales.

Although the NAM approach seeks to advance the integration of ES into the decision-making of communities, very few scholarly sources on ES could be found exploring the NAM approach. While it may be assumed that the NAM approach is new, it can be seen within international literature that government use of NAM was occurring nearly thirty years ago in New Zealand (See: Knight, 2003). Within the context of Atlantic Canada, there appears to be very little academic research currently available that explores the NAM approach.¹ More research is needed in this area in order to help increase understanding surrounding the experiences of practitioners, perspectives regarding NAM, and how this approach may be influencing local climate practices and policy in these local contexts. Atlantic Canadian local governments are attempting to address a range of local issues through NAM, including climate adaptation. This research

¹ A Boolean search on the database SCOPUS was conducted using the following terms ("natural asset management"= 5 results), ("natural asset" AND "management"= 341 results). This was then narrowed down by geography ("natural asset" AND "management" AND "Atlantic Canada"= 0 results); ("natural asset" AND "management" AND "Canada"= 4 results). Within the filtered searches abstracts were searched to find relevant any articles. A search on Novanet using the term ("natural asset management" yielded 18 results, from this only 4 were peer-reviewed (one was Canadian, the other 3 are international). A search on Google Scholar ("natural asset management" AND "atlantic canada") yielded 5 results, from this two were scholarly works that were relevant to this topic within Atlantic Canada. **Note:** A systematic literature review was not conducted.

presents the opportunity to explore how the NAM approach is being experienced by actors within local networks, how local actors are communicating about NAM, and how NAM is related to any of their collaborative decision-making processes surrounding climate adaptation.

1.1.2 Purpose and Objectives

This research sought to gain a deeper understanding of how local governments in Atlantic Canada might be using natural asset management (NAM) to make decisions within the context of climate change. The purpose of this research is to generate insight from local governance actors associated with NAM in Atlantic Canadian local government jurisdictions to help advance understanding, climate policy, and collaborative practice in the area of ecosystem governance. To gain a deeper understanding of how the local governments could be using natural asset management to make decisions within the context of climate change, it was necessary to discuss this topic with local governance actors.

To understand current processes and perspectives in association with NAM within the participating Atlantic Canadian local governments, the three following objectives were defined: 1) Describe the network structure and communication channels for natural asset management (NAM) within the participating local governments. 2) Explore commonalities from the experiences and perspectives of the local network actors involved in NAM, and 3) Document how the local networks may be using NAM to advance climate change adaptation through policy and practice.

1.2. Organization of Thesis

This thesis is divided into sections that provide the results of these objectives across two different research papers. Objective 2 is specifically addressed in chapter 4, within the article that explores the themes that arose from the perspectives and experiences

discussed by the participants in interviews. Chapter 4 also provides some insight specific to the participants' perspectives regarding their communication experiences with NAM, making this paper relevant to objective 1 as well. The results for objective 3 are provided in chapter 5, within the article that explores the current governance processes described by participants within interviews and documents. Details relevant to objective 1 are provided within both chapters 4 and 5 with a specific focus on the communication channels within chapter 5. The final chapter 6 includes a results/discussion section to synthesize the key findings. Note that all three objectives were re-phrased into research questions specific to the scope of the two article papers in order to make them clearer for readers, as follows:

Article 1 (Ch. 4)

1. How do local government and community governance actors in Atlantic Canada perceive the NAM approach?
2. What are the participants' perspectives surrounding their communication experiences in relation to NAM?

Article 2 (Ch.5)

1. How might the local network actors be using NAM to advance climate change adaptation through policy and practice?
2. What are the problems and opportunities that the participants seek to address through NAM?
3. What channels are the participants using to communicate about NAM?

CHAPTER 2: BACKGROUND & LITERATURE

2.1 Background

2.1.1 The relevance of asset management in relation to ecosystem governance

The Canadian Network of Asset Managers (CNAM) define asset management as “the coordinated activities of an organization to realize value from its assets in the achievement of its organizational objectives” (CIRC, 2014, p.1). Asset management is a practice that may be used by governments in their attempts to increase accountability surrounding fiscal decision-making and development decisions. The process ultimately leads to the development, or adjustment, of plans, policies, and decision-making through data collection on the assets. CIRC (2014) note that one of the key fundamentals of asset management is alignment. The practice of asset management is meant to align “the organizational objectives with technical and financial decisions, plans, and activities” (p.1). Therefore, asset management activity is significant to governance, as the act of engaging in this practice signifies a desire to affect a change within decision-making processes. This is apparent within statements from the CIRC (2014) document, wherein the authors call into question the relevancy of data provided by municipal representatives based solely on their opinions.

While originally the practice of asset management has been focused upon engineered assets, developments toward applying this management concept to nature have been forming within Canadian society over the past decade, and internationally since as early as the 1990s (at minimum). MNAI (2019) define ‘municipal’ natural assets as the “stocks of natural resources or ecosystems that contribute to the provision of one or more services required for the health, well-being and long-term sustainability of a community and its residents” (p. 4). In 2019, the NAI released a report that specifically provides action steps for governments to advance NAM through professional planning processes; the report encourages planners to influence the alignment of NAM within

government policy, bylaws, and day-to-day decisions. These goals therefore make the recent movement towards NAM particularly significant to ecosystem governance and environmental planning processes in areas where this practice is being adopted.

2.1.2 Searching for the Origins of Natural Asset Management

Concepts that are relevant to NAM go back over centuries. The discussions surrounding natural capital, ecosystem services, and asset management, occurring across a variety of groups and disciplines around the globe appear to have laid the foundations for the NAM approach. The practice of asset management evolved over the period of 1700-1960, originally emerging from the British finance sector (Walker, 2022, ctd. in review of Morecroft). In an exploration of the history of the term 'natural capital' Missemer (2018) notes that prior to the 20th century, various work from writers of different disciplines, social standings, and languages can be found using the term 'natural capital,' however, with no discernable link to the modern viewpoints associated with 'assets.' While reviewing German-language literature from the mid-1800s, Missemer (2018) notes that the work of Albert Schäffle discussing 'NaturKapital' and collective goods edges closer to the modern definitions of natural capital, however, "nothing is stated about a potential link between resource management and asset management" (p.91). As far back as 1906, Missemer (2018) notes that within the work of Irving Fisher, there is a suggestion that the terms 'resources' and 'assets' are of close meaning. Between the 1970s to the 1990s especially, significant debates and influential thought processes were developed that are apparent within the concepts often promoted as part of NAM; these scholarly influences are particularly in regard to ecosystem services and economic valuation.

During this period, Missemer (2018) asserts that in the 1980s, the concepts relevant to natural capital underwent a "rebirth" (p.95). Missemer notes the work of Pearce in the late 1980s wherein the term 'natural capital' is referred to by using the term "ecosystem assets" (p. 599). Pearce (1988) goes on to refer to natural

environments as “a stock of natural assets” (p.599) that provide a multitude of benefits, such as, systems that support life, supplies vital to economic processes, waste assimilation, and spiritual and aesthetic benefits to human well-being.

It is unclear exactly when and where the progression was made from simply referring to ecosystems and natural resources as ‘assets’ in literature, to governments applying asset management methods to assist with their management practices involving nature and landscape decisions. An attempt here to determine who coined the modern term of ‘Natural Asset Management,’ yielded little to this point. Within both academic and grey literature on this topic, writers often launch into discussing the topic of NAM, without providing a detailed historical account. A specific definition for this practice also appears to be frequently absent from many of the reports and literature, suggesting that the term ‘natural asset management’ itself has not been well defined within either academic or grey literature. MNAI (2019) provide the following description of ‘municipal’ NAM as follows, “Municipal natural asset management regards natural features through an asset management lens, focusing on their function in providing municipally-relevant ecosystem services. It recognizes that deliberate protection and management of these municipal natural assets...can provide sustainable municipal services over the long-term, with no capital cost and at a fraction of the maintenance or operating costs of an engineered replacement” (p. 4). After searching through NAI reports, as well as five graduate theses¹ from Canadian universities on this topic, it appears that a history of NAM is not readily available beyond the example from the Town of Gibsons, British Columbia that emerged in the 2010s. In addition to this, the few international scholarly sources found that specifically discuss real world examples of asset management in relation to nature at length, such as in Asset Management of the Subsurface (see description below), also do not provide a detailed background on where this concept originates.

The Town of Gibsons (2019) state that they are “North America’s first community to experiment with strategies to integrate natural assets into asset management and financial planning” (n.p). Globally, it is unclear where this practice may

have first taken place, however, natural asset management was recorded to be occurring in New Zealand as early as the mid-1990s. In a case study, Knight (2003) outlines important factors from the Christchurch City Council (CCC) *Natural Asset Management Plan for Waterways and Wetlands (1996)*. The plan and accompanying strategy adopted by the CCC (1999/2000) specifically used the term 'natural asset management,' and described many details that are similar to the NAI approach. Asset conditions, cost assessments, and a focus on storm water management through an ecosystem services approach and natural restoration are prevalent throughout the strategy adopted by the CCC (1999/2000). There is also evidence of a natural asset inventory, as Knight (2003) notes that the CCC's plan included "broad categories of assets for the city as a whole, such as rivers, environmental asset waterways..." (p.183). The strategy by the CCC (1999/2000) also contains GIS maps of the natural assets, and discussed the importance of defining service levels. Based on the planning documents, it is unclear where the CCC may have derived this approach, or if they were the first government to apply an asset management approach to natural assets. It should also be noted the CCC (1999/2000) highlight that during the preparation of the strategy, consultation processes with elected representatives of Tangata Whenua were included. In addition to the Christchurch example, Maring and Blauw (2018) discuss a method referred to as Asset Management of the Subsurface (AMS), which began being developed in 2015 by a Community of Practice that includes various Dutch municipalities. Maring and Blauw (2018) note that AMS specifically seeks to use traditional asset management methods to also consider "the natural functions that the subsurface, including groundwater, has to offer (ecosystem services)" (p. 390), with a goal to support decision-making and sustainable management. While the language related to NAM has been shown to have deep roots in literature, it can be seen that this ideology appears to be developing into practice in different locations around the globe.

2.1.3 Governments and Natural Asset Management

Through the international examples provided above, it is apparent that the practice of natural asset management within local government has been occurring in countries outside of Canada for the past three decades at minimum. Statistics on the total number of governments performing this practice across the globe could not be found. The NAI website provided a map of governments across Canada who are involved in the NAM process through their initiative, displayed 39 locations in 2023 (NAI, 2023). While this number represents the communities displayed on an older version of NAI Communities Map, NAI (2022) states that they have worked with approximately 100 communities on projects related to NAM; recent updates to the NAI website show a map of 123 projects across Canada (NAI, 2024). In 2022, Eyquem et al. reported that eighteen governments in Atlantic Canada were involved in NAM (NB=11, NS=3, PEI= 2, NFLD and Labrador= 2). It is important to note that figures provided by currently available reports are not exhaustive and may not include other governments who are also embarking on NAM independently or through other avenues, outside of the NAI process. Since the 2022 report was released, the amount of governments engaged in NAM has grown to at minimum of twenty-five in Atlantic Canada (this number may be higher due to regional services networks also being involved; see appendix 1 for a full list of sources). This figure was obtained through compiling existing sources, as well as through word of mouth during interviews for this research. Follow-up calls were made when needed to confirm this number as of current date (please refer to table 2 in appendix 1). While many of the governments engaged in NAM across Atlantic Canada have not yet completed an economic valuation stage (or have not chosen to advance further in some cases), most have completed natural asset inventories detailing the natural features within their local jurisdictional boundaries.

2.2: LITERATURE REVIEW

2.2.1 Common Terminology associated with Ecosystem Services (ES)

Several terms exist within scholarly literature and political discourse to discuss the concept of ecosystems and the benefits that they provide to humans. Given the nature of how language evolves, this overview is not an exhaustive list of terms. Ecosystem services (ES) have been broadly defined by international experts collaborating on the *Millennium Ecosystem Assessment* and by the United Nations as “the benefits that people obtain from ecosystems” (MA, 2005, p. V). Concepts associated with ecosystems and their beneficial services to humans began to surface in literature in the late 1970s through the work of Westman, and were further defined in 1981 by Ehrlich and Ehrlich (ctd in. Nahlik et al. 2012). The ambiguous nature of this term has been noted in scholarly literature. For example, Nahlik et al. (2012) compiled a list of ten definitions for the term ‘ecosystem services.’ Nahlik et al. (2012) assert that vague ES definitions and their underlying ideologies amounts to a “philosophical discrepancy” (p.27) that confuses the defining of what an ecosystem service is depending on the context in which it is interpreted. The inconsistent use of a myriad of terms and definitions associated with ecosystem services is discussed by Nahlik et al. (2012) as being a factor that has hindered implementation efforts.

Canadian-based research on ES policy implementation echoes this concern. A study released by Kerr et al. (2021) consulted with ES policy experts through key informant interviews. Kerr et al. (2021) highlights the frequent use of jargon associated with ecosystem services (ES) as being a barrier to its implementation for Canadian governments and policy. It is not surprising that confusion exists within government surrounding these terms, as it is clear that this confusion also exists within academic literature. For example, Blue-Green Infrastructure (BGI) is another relevant term that is frequently used in Europe (Suleiman, 2021). The term Blue-Green Infrastructure (BGI) has been defined as “an interconnected network of natural and designed landscape components, including water bodies and green and open spaces, which provide multiple

functions such as: (i) water storage for irrigation and industry use, (ii) flood control, (iii) wetland areas for wildlife habitat or water purification, and many others.” (Ghofrani et al., 2017, p.15). However, while Ncube and Arthur (2021) cite this BGI definition provided by Ghofrani et al., they then refer to BGI as being “also known as nature-based solutions” (p.1). This statement by Ncube and Arthur (2021) asserts that BGI and NbS are terms that can be used interchangeably. Kerr et al. (2021) found that “Green Infrastructure, under its various terms “designing with nature”, “natural infrastructure”, “nature-based solutions”, “natural capital design”, and “green building” was a concept that all the key informants mentioned as potentially superseding ES” (p. 1872). Short et al. (2019) assert that Nature Based Solutions (NbS) is a term that recently emerged in academic literature and is not clearly defined. NbS have been defined by the International Union for Conservation of Nature (IUCN) as “actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g. climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits” (Cohen-Shacham et al., 2016, p. xii). Cohen-Shacham et al. (2016) refer to NbS as an “umbrella concept” (p. xi) that includes a variety of ecosystem-based approaches, including, “ecological restoration, ecological engineering, forest landscape restoration, ecosystem-based adaptation, ecosystem-based mitigation, ecosystem-based disaster risk reduction, green infrastructure, ecosystem-based management, and the various area-based conservation approaches such as protected area management” (p. xi). Therefore, it can be seen that dozens of ES-related terms exist, all of which have not been listed here, that seem to all have definitions with slight variations and strong similarities. One thing that all of these ES-related terms appear to have in common is that they are widely associated with multiple benefits, including flood control, biodiversity, and climate change adaptation, which are frequently noted in the work of international academics and global organizations (e.g. MA, 2005; Wüstemann et al., 2017; Short et al., 2019; Denjean et al., 2017).

It is also important to note how terms related to capital and finance are also frequently used in association with ES. A growing interest towards Natural Capital Accounting within governments was noted by a Canadian ES policy expert (Kerr et al., 2021). The term 'natural capital' has been defined as the raw resources that society is dependent upon to provide for all other community capitals (i.e. political capital, social capital, financial capital) (Stern, 2018). These raw resources include "air, land, water, soil, wildlife, vegetation, landscape, and weather that surround us" (Stern, 2018, p.181). The concept of attaching finance-related terms to ES is not new. Missemmer (2018) asserts that important contributions to ecological economics occurred in the writings of Alvin S. Johnson in the early 1900s, within the act of "considering natural capital as the set of natural items that furnish productive services to human beings" (p. 92). Gómez-Baggethun et al. (2010) notes that modern concepts surrounding the economic valuation of ES began to surface in the late 1970s with the work of Westman, leading into the work of Ehrlich and Ehrlich in the early 1980s, and eventually led to the "mainstreaming of ecosystem services in the literature" (p.1) through the work of Costanza et al. in the late 1990s. Gómez-Baggethun et al. (2010) argue that this mainstreaming resulted in a divergence from the original purposes of ES.

The continuous evolution of language appears to be occurring in association with NAM terminology as well. Given the trends in ES- related terminology, it is not surprising to see the rise and fall of the recent term 'municipal natural asset management' (MNAM) that began to surface in recent years within the lexicons of local Canadian governments. After years of promoting the term MNAM in their reports, NAI announced in 2023 blog post that they were dropping the term 'municipal' from their organization's name, citing that this decision was made in order to reflect the inclusivity of other groups in addition to the municipalities; NAI also noted that conversations with their First Nations partners revealed that using the term 'municipal' was considered "unduly colonial" (n.p), and that their organization is committed to the evolution of NAM towards upholding the United Nations Declaration on the Rights of Indigenous Peoples (NAI, 2023, April 5). It is unclear from the announcement specifically what steps

the initiative plans to take in order to uphold UNDRIP, however, it is important to document that NAI has asserted this significant goal for their organization. Based on the decision to drop the term ‘municipal’ from the MNAI acronym, this also extends to using the term ‘natural asset management’ rather than ‘municipal natural asset management.’ It is currently unclear how much further NAM terminology may evolve as the diffusion of this concept progresses across different spheres in Canadian society.

2.2.2 Ecosystem Services Frameworks

Historical & Current Approaches to ES Frameworks

Although not an exhaustive list, this section will discuss some of the ES frameworks that exist. The concept of ecosystem services is not a new idea (Thompson et al. 2021). Thompson et al. (2021) note that “ES-analogous ideas have been included in Canadian planning, landscape architecture, and [Sustainable Forest Management], most of which pre-date the popular conception of ES” (p.315). Some of these historical approaches such as, environmental planning, sustainable forest management, resource management, and landscape architecture were comparatively analyzed along with the MA ES framework by Dalhousie scholars more recently (see: Thompson et al., 2021). Approaches that emerged in the late 1960s, such as Ian McHarg’s landscape analysis method that promoted designing with nature, and the work of Micheal Hough in Urban Ecology from the 1980s were also considered in the analysis by Thompson et al. (2021). Thompson et al. (2021) assert that while the MA ES framework and various historical approaches share the similarity of considering nature’s services to humans, the MA ES framework provides a new perspective on this topic. The consideration of trade off analyses, local scale impacts to the well-being of humans, and human drivers of ecosystem changes are important aspects included in the MA ES framework (Thompson et al., 2021).

The Millennium Ecosystem Assessment Framework

Given the international scale of the work that was conducted through the MA, it is understandably influential and cited often across both academic and grey literature. The approach promoted by the MA considers the cyclical and symbiotic processes between humans and their impacts to ecosystems. This is evident in the statement that “the MA posits that people are integral parts of ecosystems and that a dynamic interaction exists between them and other parts of ecosystems, with the changing human condition driving, both directly and indirectly, changes in ecosystems and thereby causing changes in human well-being” (MA, 2005, p.V). Additionally, the MA promotes the economic valuation of ecosystem services. This is evident through the examples provided by the MA, which attempt to highlight the ecological and socio-economic losses that can occur due to poor management practices. For example, the MA (2005) highlights the overfishing that resulted in the downfall of the Newfoundland cod industry in the 1990s, and the associated costs being at a minimum of two billion dollars to support and re-train thousands of staff who were faced with unemployment. The MA (2005) lists the consideration of these types of economic and non-economic values, outside of the market values of natural resources, as one of their technological response options to assist with decision-making.

Non-monetary Approaches to ES

Criticism surrounding the economic valuation of ES have been highlighted by scholars, as Lele et al. (2013) notes issues such as the misapplication of economic methods by certain disciplines, the ethically questionable practice of applying monetary values to something that holds intrinsic value, and inequality issues that are inherent in trade-off decisions that would impact societal groups differently. ES literature centered on monetary valuation has been criticized for focusing too heavily on the instrumental values of nature, i.e., usages and ways that humans gain from nature (Arias-Arévalo et al., 2018). In their review regarding the concept of natural capital and ecology, Fenech et al. (2003) concluded that economic theory would likely need to be expanded upon to

include non-monetary values, stating that “it is not clear that the value of ecosystems and species ought to be expressed purely in terms of monetary or economic value” (p. 16). Arias-Arévalo et al. (2018) describe valuation measures that are non-monetary as methods that “elicit information about the emotional, symbolic, cognitive or ethical importance of ES” (p. 45). For example, some people may value an ecosystem as sacred and research provides opportunities for a more in-depth understanding of these relationships and their inclusion in valuation methods (Arias-Arévalo et al., 2018). Many methods for monitoring ecosystems used traditionally by Indigenous cultures are associated with observations occurring during hunting and harvesting activities (Moller et al., 2004). In their synthesis exploring Traditional Ecological Knowledge and scientific methods in association with quantitative measures, Moller et al. (2004) argue for a combined approach to ecological monitoring while asserting that while traditional methods are often qualitative, these types of observations are valuable for many reasons (e.g. providing longitudinal data, cost-effectiveness, providing the opportunity for cross-checking, and increase the opportunity for inclusive research).

Researchers attempting to reconcile some of the criticisms against ecosystem service valuation methods have created conceptual frameworks that use quantification through non-monetary methods to inform decision-making (e.g. Yang et al., 2018; Wurster & Artmann, 2014). For example, in a hypothetical scenario explored by Yang et al. (2018) decision makers could use valuation attached to the diversity of certain forest areas and vegetation types to assist them. Similarly, in their attempt to develop a new approach to ES assessments, Wurster & Artmann (2014) assert that a non-monetary framework is required at the site level for urban planning to “reflect land use to consider the demands placed on ecosystem services” (p. 454). In another example, Mackinson (2001) emphasized the potential for using models based on ‘fuzzy logic systems’ to assist with overcoming knowledge gaps in fisheries science by including knowledge from interviews with scientists, managers, and herring fishers (locals and First Nations people), highlighting the use of qualitative and quantitative data in assessments and management of fish stocks. Akin to this view, Patterson et al. (2017)

argue that using a combination of environmental accounting methods, “rather than relying on just one tool, one perspective or one criterion” (p. 19) is likely to produce improved understanding of environmental issues. In a more recent ES study that used non-monetary methods, Ebner et al. (2022) used quantitative data surrounding preferences from a survey (questionnaire), social media content that included geo-referenced data, and qualitative data from participatory workshops to assess the participants’ relationships to mountain lakes through the conceptual lens of cultural ES.

Economic Valuation-based ES Frameworks

In 2010, Gómez-Baggethun et al. noted a trend toward the economic valuation of ES that had been occurring for three decades. The economic valuation of nature remains a controversial topic, both in theory and practice. Pritchard, Folke and Gunderson (2000) cautioned about the use of economic valuation, particularly through the application of cost-benefit analysis, arguing that decision makers may mistakenly assume the results of this approach are objective. In 2013, Purushothaman et al. remarked upon the fast pace in which economic valuation frameworks and practices were being implemented into policy; these scholars took a critical approach to the practice and argued for alternative approaches to economic valuation.

Many of the research articles and frameworks discussed in this review do include components of economic valuation. Since the release of the MA, Maund et al. (2020) note several new ES frameworks that have emerged. As an example within the natural capital field, Fairbrass et al. (2020) assert that there is an “absence of a coherent framework of indicators concerning natural capital (and its benefits) that can aid decision-making” (p. 1). Fairbrass et al. (2020) proposed a new framework that is entitled the Natural Capital Indicator Framework (NCIF) to assist with the issue. Numerous existing international frameworks associated with ES economic valuation are noted by Fairbrass et al. (2020), including, Natural Capital Accounting, the United Nations Sustainable Development Goals (SDGs), and the United Nations (UN) System of Environmental-Economic Accounting Central Framework (SEEA CF). In their UK-based

study, Maund et al. (2020) used the Common International Classification of Ecosystem Services (CICES), while noting its relevancy to natural capital accounting. Maund et al. (2020) state that the CICES framework is similar to the MA, as it is meant to be used for reference and is designed to be adaptable to other frameworks and contexts. The purpose of CICES is to allow ES practitioners to move between various international frameworks and gain a better understanding of the analysis and measurement of ES (European Environment Agency, 2022). Monetary valuations of ES have been associated with decision-making (trade-offs) and generally understanding effects to well-being (Díaz et al., 2018). However, Wurster and Artmann (2014) stress the significance of non-monetary assessments in ES research to assist decision-makers with understanding impacts to ES. As noted earlier, some frameworks emphasize the potential for different approaches to valuation; for example, the UK National Ecosystem Assessment is a framework that includes economic valuation while also recognizing and including room for non-monetary valuation (Mace et al., 2011). It should also be noted that while controversy still remains surrounding the concept of the economic valuation of ecosystem services, this appears to be an approach that is supported by governments on several scales both nationally and internationally through several of ES frameworks, noted earlier (e.g. the MA, SEEA, Canada's ES Toolkit, CICES, UK NEA, etc.).

Debate over Public Sector Accounting Standards in relation to Natural Resources

It is worth noting that even as governments may continue to move ahead with ES frameworks that promote the economic valuation of nature, this topic appears to be a factor that may create significant division across groups depending on their values and ideologies. During the course of this research, interview questions specifically regarding economic valuation were not included in the guide, yet the topic did arise within interviews despite this decision. It is also relevant to consider the current politics surrounding the Public Sector Accounting Standards, both at a national and international level. In 2022, the International Public Sector Accounting Board (IPSASB) released a consultation paper on the topic of the recognition and measurement of

natural resources in the public sector (IPSASB, 2022). Following this, a variety of responses from government departments and other actors across Canada and the dozens of other countries were provided to IPSASB. The response papers contain mixed responses, ranging from enthusiasm to concerns over capacity, feasibility, and social inclusion. It appears that the theoretical dispute regarding economic valuation that has been occurring for decades within academic and conservation circles is now being debated within the realm of public sector finance at an international level.

The IPBES Framework

Another popular international framework frequently noted by academics in ES literature is the International Governmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The IPBES was developed in the early 2010s, when the United Nations resolved to make it an independent body that represents various governments (United Nations, n.d). The IPBES framework includes elements associated with social-ecological systems that occur at different temporal and spatial scales including nature, assets, and governance systems (United Nations, n.d). One of the key issues raised by scholars is whether or not these types of international frameworks can be suitable to the unique context of local areas (Maund et al., 2020). The IPBES (2019) adopts an approach to ES that emphasizes the importance of recognizing a “plurality of values” (p. xxi); One of the key messages (D4) provided in the IPBES report specifically supports governance approaches that are inclusive and integrate knowledge from across societal groups. The IPBES builds upon previous work in the ES field through the Nature’s Contribution to People Framework by emphasizing culture, inclusiveness of knowledge forms, and diverse values (Díaz et al., 2018).

2.2.3 Ecosystem-based approaches to climate adaptation and disaster risk reduction

Introduction to Ecosystem-based approaches

Ecosystem-based approaches to disaster risk reduction appear to be increasingly discussed within academic literature, as could be seen by the publication history within database searches on this topic in Scopus. There are a variety of terms used under the umbrella of ecosystem-based concepts. Faivre et al. (2018) note that “Nature-Based Solutions, Ecosystem-based Adaptation, Green Infrastructure and Natural Water Retention Measures are examples of ecosystem-based initiatives that have been promoted by the European Commission” (p.4). Ecosystem-based approaches have been shown through research to be cost-effective solutions that create economic, social, and environmental benefits to local areas and regions (Faivre et al., 2018). These types of approaches, including green-grey hybrid approaches that incorporate engineered options, can provide a range of solutions that assist with carbon storage, biodiversity, and socio-economic benefits (Welchel et al., 2018). Welchel et al. (2018) highlight that natural infrastructure and well-maintained ecosystems can assist with sheltering humans and local economies from climate risks and hazardous events. One term that is becoming more prominent in recent years is ‘ecosystem-based disaster risk reduction’ (Eco-DRR). A definition of Eco-DRR was provided nearly a decade ago by the United Nations Press; Renaud et al. (2013) define Eco-DRR to be the “sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development” (p. 30).

Research on Eco-DRR and EbA

Eco-DRR and Ecosystem-based adaptation (EbA) assist humans and ecosystems with climate change adaptation and hazardous events through practices that consider natural restoration, sustainable management methods, conservation, and ecosystem services (McVittie et al. 2018). While both Eco-DRR and EbA are associated with providing multiple benefits (e.g. food security, biodiversity, and generally improved resilience to climate change impacts), the primary difference between these approaches is that Eco-DRR also considers non-climate related hazards as well (e.g. avalanches,

earthquakes) (McVittie et al., 2018). EbA is promoted as an approach for addressing climate-related concerns; For example, McVittie et al. (2018) note several measures as being helpful for addressing flood issues, such as, river restoration, wetland restoration, retention ponds, forest riparian buffers, and rain gardens. When it can be shown that flood risks can be reduced through these types of measures, this can be a significant factor for raising public support (McVittie et al. 2018). McVittie et al. (2018) notes that while there is evidence of the cost-effectiveness and multiple benefits of EbA, there are remaining research gaps in this area due to lesser being known on the economic effects and possible negative effects associated with these approaches. In their analysis of dozens of case studies across the EU, McVittie et al. (2018) found that some of the most common factors which contribute to the success of EbA implementation include: 'stakeholder engagement and attitudes,' 'cooperation across stakeholders,' and 'existing knowledge and/or on-going research and monitoring' (p. 50). Therefore, it is likely that the lack of knowledge in this area may contribute to stalling the implementation of these nature-focused management approaches. As more work occurs in this area of research, the increased attention toward these types of ecosystem-based approaches is also apparent on the global stage of governance (see Welchel et al. 2018).

International Policy, advancements, and limitations to EbA & Eco-DRR implementation

Welchel et al. (2018) highlight a series of international agreements beginning in the early 2010s, including the *Sustainable Development Goals*, decisions made at the 12th conference of parties for the *Convention on Biological Diversity*, and the *Paris Agreement*, as being key catalysts to the advancement of Eco-DRR on the global scale. Evidence of these advancements can be seen through recent progress from the European Commission; as part of their approach to climate adaptation and disaster risk reduction, the EU has begun to imbed ecosystem-based concepts within their policies and management practices (Favre et al., 2018). This transformation in management and policy across EU countries is supported by the *Sendai Framework for Disaster Risk Reduction (2015-2030)*, which established a focus toward the ecosystem-based

management of natural resources that are shared across borders (Faivre et al. 2018). This advancement has been described as “a crucial shift from managing disasters to managing risk” (Faivre et al., p. 5). This area of research is relatively new and appears to be in need of significant advancement. In their international review of governance approaches to Eco-DRR and EbA, Triyanti and Chu (2018) found that governance studies looking into these topics primarily focus on political, financial, and institutional inadequacies. Triyanti and Chu (2018) assert that research is needed that considers the “socio-ecological, spatial/scalar, and political dimensions of EbA and Eco-DRR” (p.11). A search for articles related to Eco-DRR found that research related to this term is easily found in international studies, yet it was more difficult to find this terminology in association with Canadian-based research and case studies. Searching on the SCOPUS database resulted in only 20 articles related to EbA within the Canadian context, with the large majority of the case studies being focused on locations in British Columbia, Ontario, and Quebec. As the need to address multiple socio-ecological issues becomes more pressing in the face of climate change, the findings of studies that consider governance in relation to these topics may be essential to paving a way forward through policy and project-based learning.

2.2.4 Governance

The evolution of government to ‘governance’

It has become generally accepted that governments alone do not have the capacity to handle all societal issues. The movement away from hierarchical approaches to decision-making across societies has been noted by scholars (Baird, Hickey & Holzer, 2022; Armitage, de Loë & Plummer, 2012; Kooiman, 2003). Baird et al. (2022) state that “top-down governance has given way, in most cases, to participatory and multi-level approaches” (p. xxvii). Decentralization from the public sector that began occurring in the last century was remarked upon also by Kooiman (1993) noting the privatization and deregulation that was occurring, as well as patterns that began to emerge toward more

balanced actions of sharing responsibilities between state and market sectors. Many issues being governed are usually not only public or private, they are generally shared across society; relationship dynamics between groups consistently change over many scales and levels (Kooiman, 2003). Armitage et al. (2012) assert that with the emergence of new actors involved in significant decision-making surrounding the environment, “governments are no longer the most important source of decision making in the environmental field” (p. 245). Wang & Ran (2023) assert due to the limited capacity of public and private actors to address complex issues, and the increasing fragmentation of “political and administrative authority,” (p.1188), several factors are causing a transformation to occur within the public administration field in recent decades. Similarly, Armitage et al. (2012) refer to the evolving nature of environmental governance, noting that the required knowledge to address the complexity of social-ecological systems is “held by actors outside of governments” (p. 253).

Various terms in relation to ‘governance’

Kooiman (2003) defines governance as the “totality of theoretical conceptions on governing” (p.4) and identifies governing as “the totality of interactions, in which public as well as private actors participate, aimed at solving societal problems or creating societal opportunities; attending to the institutions as contexts for these governing interactions; and establishing a normative foundation for all those activities” (p.4). Therefore, this term is generally seen as people across society working together to achieve solutions to issues. The term ‘meta-governance’ is another important concept to consider. This term was developed in the 1990s, with differing descriptions provided by scholars such as Kooiman and Jessop at that time (Gjaltema, Biesbroek & Termeer, . 2020). The concept behind this term generally refers to the idea that society should also govern those who are attempting to perform ‘governance,’ however, Gjaltema et al. (2020) sought to understand this term more substantially. Gjaltema et al. (2020) asserts that ‘meta-governance’ has been defined in an abstract sense, leaving the term open to ambiguity. In a systematic review, Gjaltema et al. (2020) used their findings to justify

redefining the term 'meta-governance' as "a practice by (mainly) public authorities that entails the coordination of one or more governance modes by using different instruments, methods, and strategies to overcome governance failures" (p. 1771).

Many other terms exist to describe various different types and aspects of governance, which has not been covered here in depth. For example, Bianchi et al. (2021) note that collaborative governance is a concept that is also referred to by various similar terms related to networks and public governance. Wang & Ran (2023) note that the terms 'network governance' and 'collaborative governance' are commonly used interchangeably; at times this can create confusion and make it difficult to distinguish differences between these terms. Wang & Ran (2023) point to literature that shows how these two terms were developed from different theories and ideologies. Struggles with implementing these approaches have also been noted, Bianchi et al. (2021) state that efforts toward collaborative governance can fail even when carefully designed. A deeper understanding of historical contexts and culture is important to consider in the design of initiatives that seek to implement collaborative governance (Bianchi et al., 2021). Scholars also note the importance of considering power dynamics in relation to these approaches. For example, Badry and Hickey (2022) proposed using actor-network theory to advance research on network governance in ways that assist knowledge pluralism and collaboration between diverse actors in ecosystem governance. Morrison et al. (2019) refer to 'polycentric governance,' which involves interaction between several actors who hold authority for the purpose of similar goals. Polycentric governance is an important concept to consider in relation to the environment and ecosystems; in their discussion surrounding 'polycentric environmental governance,' Morrison et al. (2019) assert that power dynamics impact both the design of these governance structures, as well as policy decisions and the assessments for the outcomes of such policies.

'Governance' in relation to ecosystems & inclusion

While the efforts of governance actors can be applied to a wide range of societal issues, the concepts of 'environmental governance' and 'ecosystem governance' are more

applicable to this research. Contemplating how governance may advance decision-making surrounding the natural environment can take many directions depending on the scope that is used. The distinction between daily management decisions and the overall direction provided by governance is also important to make when discussing and researching these topics, as noted by Baird et al. (2022). Bennet and Satterfield (2018) note the common issue within literature on environmental governance of assuming or equating management practices as being synonymous with achieving desired outcomes for ecosystems. Ecosystem governance is a broad term that may be defined differently depending on the context in which it is used. Baird et al. (2022) define ecosystem governance as “the integrated and holistic governance of ecosystems that includes formal and informal institutions, collaboration and cooperation across different levels of government, and non-governmental and individual action” (p. xx). As humans are also part of ecosystems, it is vital to consider the social impacts that governance efforts can potentially exacerbate when performed non-inclusively.

Bodin (2017) used the term ‘collaborative environmental governance’ to emphasize approaches that are inclusive and collaborative within environmental management. However, this approach has also been criticized in some contexts, Bodin (2017) notes that when policy issues are deeply contested by different groups, collaborative efforts may not always lead to successful impacts. In contrast, Brondizio and Le Tourneau (2016) refer to ‘inclusive governance,’ while asserting that efforts to advance conservation and address climate change are weakened without social inclusion in environmental governance; Indigenous and local populations are vital to the success of such efforts. Addressing the values and priorities of populations outside of urban centers are also necessary to improve large-scale efforts for environmental governance (Brondizio and Le Tourneau, 2016). When discussing the concept of promoting diverse values and views through pluralism in ecosystem governance, Baird et al. (2022) assert their choice to “include non-humans, extending agency to animals and landscapes” (p. xix). From all of these definitions, terms, and assertions, we can find that one aspect remains consistent: the act of people working together across

landscapes, scales, and levels, in order to improve quality of life and the direction of collective decision-making. This research therefore considers equity and inclusion as part of its lens, as these are important aspects that were often noted in this review as vital to the success of governance in relation to ecosystems.

CHAPTER 3: RESEARCH DESIGN & METHODOLOGY

3.1 Introduction: Theoretical framework

The following sections outline the main theoretical underpinnings and methodological approaches that were used to help design this research. These approaches and ways of understanding were helpful in providing structure to the preparation, data collection, analysis, and interpretation of the data. The following theories and approaches were used to help understand more about the complex social processes that are unfolding as the participants navigate a conceptual management practice that is new to them.

3.1.1. Constructionist/Interpretivist approach

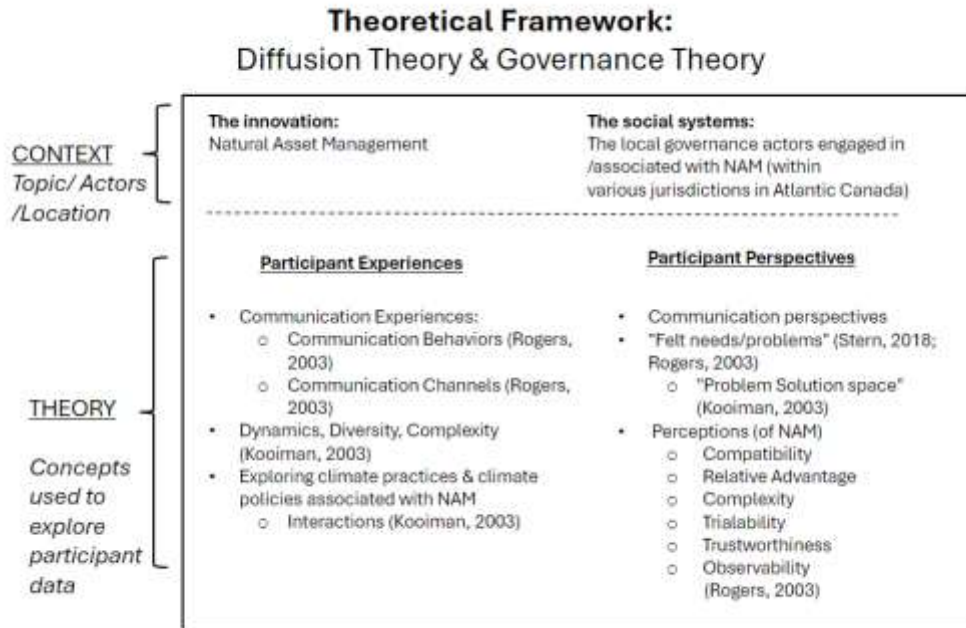
Interpretivism within qualitative research has been described by Guest et al. (2012) as an approach that is “most interested in interpreting deeper meaning in discourse and understanding multiple realities (as opposed to one “objective” reality) that are represented in a collection of personal narratives or observed behaviors and activities” (p. 14). This research aligns itself with this perspective, that multiple realities can exist in the interpretation of data and in relation to the perspectives found on a research topic; the approach taken here is to attempt to explore the different perspectives found in the research in relation to NAM. In doing so, the concept of constructionism cannot be ignored. Burr (2003) notes the alternative view provided by social constructionism is that people construct knowledge between one another, asserting that “it is through the daily interactions between people in the course of social life that our versions of knowledge become fabricated” (p. 3). Constructionist views challenge the perspective that conventional knowledge is based on unbiased and objective observations (Burr, 2003). Through a constructionist lens, this research recognizes that interactions and views have had impacts on the data collection process, therefore making them relevant to the knowledge and results generated. It is important to note that this new knowledge and ‘reality’ is constructed both collectively by the

participants involved and the researchers themselves (Stake, 1995.) Guest et al. (2012) echoes this understanding in their assertion that while text is often analyzed within the context of 'experiences' and in relation to the participants feelings, perceptions, behavior, and knowledge, this is "often generated by our interaction with research participants" (p. 9). Stake (1995) notes that the act of interpretation leads the researcher toward finding new connections and meanings. An important aspect of the interpretivist approach is to impact an audience through conveying a story, as Guest et al. (2012) asserts this intent is the "centerpiece of the method" (p.14). Therefore, I recognize as a researcher that my interpretations and data collection will impact the outcome of the research and that this cannot be assumed to be an entirely 'value-free' process. Additionally, Stake (1995) asserts that the researcher has the choice for how to position their role in research. My role as an interpreter is intentional, as I seek to provide information that shows different realities and viewpoints while also leaving space for readers to draw their own conclusions as well.

3.1.2. Diffusion of Innovations Theory

The Diffusion of Innovations Theory, developed by Rogers (2003) was used to assist with developing the design of this research. This well-established theory provides a basis for understanding how organizations may react when a new innovative approach is introduced into their culture and practices. Rogers (2003) refers to diffusion as a type of social change, defined as a process wherein a new idea is communicated and "alteration occurs in the structure and function of a system" (p.6). In this situation, we can consider NAM to be the 'innovation' and the municipalities and their community contacts (other local governance actors) to be part of a 'social system.' Based on Diffusion theory, a variety of factors are relevant to exploring how social systems interact with a new innovation. By framing the experience of the participants through these elements, it is useful for understanding their experiences in a structured way. Below, figure 1 has been created to show how NAM is being considered here in relation to the theoretical framework.

Figure 1: Theoretical Framework Details



Diffusion theory identifies four main elements that are integral to the process of diffusion; 1) an innovation 2) communication through channels 3) occurring over time 4) among members of a social system (Rogers, 2003). An innovation is defined as “an idea, practice, or object that is perceived as new by the individual or other unit of adoption” (Rogers, 2003, p. 12). By framing NAM as an innovation, this research aimed to understand how the adopters and other local governance actors perceive this approach. Rogers (2003) notes the following perceptions as significant to consider in relation to innovations: *Relative advantage, compatibility, complexity, trialability, observability*. Stern (2018) refers to *trustworthiness* within this list as well, noting that “when potential adopters view the messenger as trustworthy and perceive the following characteristics about the potential innovation, they are more likely to adopt it” (p. 189). What Stern refers to here, is the above five perceptions listed. For example, in the case

of *complexity*, Stern (2018) refers to this factor as “the new practice is not overly difficult to understand or implement” (p. 189). In addition to these perceptions, Rogers (2003) notes that communication is integral to the diffusion of an innovation. As noted previously, (see chapter 1), communication is an important factor that impacts the practical application of ecosystem service frameworks. While NAM is a separate framework that differs from other ecosystem services frameworks, NAM draws upon and includes ES concepts in its approach. Therefore, how the participants perceive NAM and communicate about this practice is likely to have an impact on whether this approach is successful within these local contexts. As such, ‘perspectives,’ and ‘communication’ were significant deductive (parent) codes identified prior to the analysis.

Stern (2018) notes that Diffusion Theory can be relevant to changing the behavior of communities and situations that “involve new business practices or instituting natural resource management rules or governance regimes in which people are expected to adopt new forms of collective or individual decision making” (p. 190). Indeed, this theory has been used in the past for a variety of purposes in association with the promotion of new concepts, practices, or products to individuals, communities, and populations (e.g. health research). Diffusion Theory was selected as a framework for this research because it will be helpful for exploring the communication behaviors, experiences, and perceptions of the participants in relation to NAM. The intent here is to reflect upon how the participants perceive this approach and how they are communicating about this approach; the assumption made here is that this act of reflecting may help advance understanding on the topic of NAM as it relates to ecosystem governance within the context of Atlantic Canada.

3.1.3. The Pro-innovation Bias

Rogers (2003) warns researchers to avoid what is known as the ‘pro-innovation bias,’ described as an implication in research that “an innovation should be diffused and adopted by all members of a social system, that it should be diffused more rapidly, and

that the innovation should be neither re-invented nor rejected” (p. 106). Among several considerations to help counterbalance the pro-innovation bias, Rogers (2003) notes that researchers should not ignore situations where an innovation is rejected; considering the various types of consequences of innovations is also encouraged within this theory. Therefore, this theoretical lens is also used here to help to avoid common pitfalls.

While it is important to understand the participants' initial perspectives surrounding NAM, it is also significant to consider the long-term decisions surrounding the adoption of NAM as well (see figure 1). Rogers (2003) notes that researchers should not immediately assume that an innovation is desirable. Rogers (2003) asserts that “the same innovation may be desirable for one adopter in one situation but undesirable for another potential adopter whose situation differs” (p. 12). This is an important aspect to consider and therefore the analysis identified themes that arose where the innovation of NAM may create tensions over time or show signs of incompatibility as well as compatibility. With all of this in mind, Diffusion Theory was useful during the development of the interview questions to provide a deeper understanding of the participants' experiences that is also informed by previous research on innovations.

3.1.4. Governance Theory

Kooiman's theory has been used in this research to help interpret the data as it relates to governance. Within this theory, Kooiman (2003) describes first order governance as a process wherein actors are attempting to address problems or create opportunities in their daily lives. Recall that Levin et al. (2009) refer to climate change as a 'super wicked' problem, making it especially difficult for policy development. Other important parts of the governance process at this stage are noted by Kooiman (2003) as identifying potential solutions and 'pockets of tensions.' Kooiman (1993) refers to various concepts that are relevant to exploring governance, such as diversity, complexity and dynamics. In considering this, an important aspect of this research was to better understand not only the perspectives of the participants, but also their activities in relation to NAM; this

included exploring their communication on this topic, as well as documenting any climate policy and practice that is occurring in this area.

3.2 Methods

3.2.1 Interview Approach

Interviews are frequently used by researchers seeking to explore topics from a constructivist/interpretivist lens (Shackleton et al., 2021) making this method particularly useful for this research. Additionally, Stake (1995) asserts that interviews are “the main road to multiple realities” (p. 64). Therefore, interviews were conducted to help provide a range of perspectives and experiences of NAM. A semi-structured approach was taken during the interview process because it allowed for targeted questions that were relevant to the topic being explored, but also provided flexibility for participants to talk about their experiences in a less restricted way. Ecosystem services is a very broad subject, therefore, having questions specifically targeted to NAM (as it is a more niche approach that adapts ES concepts from other frameworks into an asset management lens) and the theoretical framework helped to keep the interview discussions stay on track with the main topic and research objectives. The semi-structured approach allows the interviewer to use guiding questions to generate qualitative data in areas the interviewer would like to explore (Shackleton et al., 2021). Open-ended questions were useful for allowing the participants to share insights that dive deeper into this topic.

Shackleton et al. (2021) note that open-ended questions give participants the opportunity to provide answers that produce qualitative data. Although theory and literature were instrumental in the interview guide's development, questions were posed in ways that allowed participants to speak broadly about their experiences with NAM. Although efforts were made to phrase the interview questions in an open-ended and non-biased manner, at times I did see how my interactions with participants may be affecting their perspectives. This was most apparent when participants would ask me

questions, for which I would attempt to answer carefully, but nonetheless does have an impact; this realization is relevant to the constructivist approach noted earlier. While the potential existed to conduct interviews in person, participants opted for the choice to attend interviews virtually. In total, 23 key informant interviews were conducted virtually through Microsoft Teams (11 government participants, 12 community participants). For privacy, the research was conducted in locations that were identified as comfortable for the participants, and not within a public setting.

Key Informant Interviews (KII Method)

Natural asset management is a practice that is relevantly new to Canada, and especially within Atlantic Canada. Only a small proportion of local governments across Canada appear to be currently engaged in NAM; Eyquem et al. (2022) provided a list of 91 local governments involved in NAM, although this was not considered to be exhaustive. As such, it is unclear how familiar the general population currently is with this subject. Therefore, key informant interviews were an appropriate method for understanding the perspectives of those who are closely involved or involved along the periphery of this management approach. Key informant interviews (KII) are useful for gathering qualitative data from people who carry specific knowledge that is relevant to the study (Shackleton et al., 2021). Scholars warn that KII should be used cautiously, as this data collection method also can create biased results. Lokot (2021) asserts that key informant interviews can position the knowledge of experts and individuals of higher status as being more important than other groups in society. Given the limitations of these recruitment methods, it was important to consider other sources within the results of this research. Lokot (2021) advocates that researchers should carefully consider the privilege of key informants when using the KII method of recruitment for interviews. For this reason, careful attention has been paid to the use of quotes within the results, and where permission has been given, the job titles are indicated to increase transparency surrounding positionality of the participants for readers. While data collection for analytical purposes was limited to the information provided by key

informants and the municipal documents, this research also relied on scholarly literature to highlight topics relevant to governance surrounding other frameworks that include ecosystem services concepts (e.g. communication difficulties), to help provide insight. Please refer to appendix 3 for a full list of the interview questions and a summary of this content.

3.2.2 Recruitment & Data Collection

Prior to the recruitment stage, an assumption was initially made that while several governments in Atlantic Canada may be using various different frameworks that include ecosystem services concepts, only the communities associated with NAI were involved with NAM; initially four NAI communities were contacted to request interviews. Following this incorrect assumption, it was discovered during this research through word-of-mouth and online sources that other communities in Atlantic Canada are involved with NAM who are not included on the NAI website. An updated list of sixteen potential communities was re-submitted as part of the ethics process based on the information available at that time. Participants were sent invitations to participate via email and for those who chose to participate. Government participants were eligible to participate if they were involved or exposed to NAM in some way through their professional role. Community participants were eligible to participate if they had been identified by a government participant; participants were also required to have been involved in NAM or ES work with local government, and/or, to be interested to discuss NAM within the context of their professional experience. The tools and decisions for recruitment and data collection were selected based on advice from the Dalhousie Research Ethics Board website (Dalhousie University, 2022). This research followed the policies and guidance provided by the *Tri-Council Policy for Ethical Research on Humans* and the Dalhousie REB.

Snowball Sampling

During recruitment, it was important to select both local government and community participants. Government participants were asked to provide a written and/or verbal list of contacts during the interviews. Follow-up conversations occurred with participants to validate contact lists generated from interview transcripts when possible. As contact sources were not available for the community members who might be associated with NAM, it was necessary to generate a list through snowball sampling (resulting in a list of 124 contacts overall, including the government contacts). This is a method that is commonly used by researchers to gain access to hidden individuals (Penrod et al., 2003). The concept behind snowball sampling is that individuals from within a unique population will know one another (Penrod et al., 2003). A potential downfall of this method is noted by Bickman and Rog (2009) who caution that when participants have limited knowledge of other members within their group, snowball sampling can be biased considerably. Despite this risk, it was decided that snowball sampling was the best method to reach individuals who have some associations with NAM in these communities. Therefore, this recruitment method is limited to providing the perspectives of the key informants and their network peers.

3.3. Data and Analyses

Transcribed interviews and documents were imported into NVivo software for qualitative thematic analysis. Inductive and deductive analysis approaches were used to help gain insight from the perspectives of the participants and answer the main research objectives. In exploratory research, prior to analysis the researcher reads through the data more than once, searching for themes and trends that stand out (Guest et al. 2012). This is a standard practice that helps to familiarize the researcher with the interview data, and this approach was used here to assist in the analysis.

3.3.1 Thematic Analysis

Guest et al. (2012) describes thematic analysis as a method that goes beyond frequency counting of words or phrases by applying a “focus on identifying and describing both implicit and explicit ideas within the data, that is, themes” (p.10). Guest et al. (2012) suggests keeping a codebook that outlines the specifics for each code, including a short title, description and details for when to use the code and when not to apply it to a phrase. Given the short time frame and large volume of data, I was unable to follow such a rigorous protocol as outlined within applied thematic analysis. Instead, I opted to create numerous child codes as they emerged and then organize them into the codebook as they fit within larger themes. Guest et al. (2012) notes that the process for creating a codebook is iterative. I began with a general list of deductive codes and adjusted the codebook as necessary following various stages of coding and winnowing of themes. Based on the theoretical framework (Rogers, 2003) and research objectives, the following six deductive codes were used to provide initial structure to the coding process: **Communication, Climate Policy, Climate Practice, Defining NAM, Felt Needs/Problems, and Perspectives**. The perspectives code, derived from Rogers (2003) Diffusion Theory also contained six additional deductive codes (*Compatibility, Relative Advantage, Trialability, Trustworthiness, Complexity, and Observability*).

After this initial structure was provided, the process of inductive coding began. Any phrases that appeared relevant to the broad themes were collected within those parent codes, generating child codes to reflect emergent themes. Following this, the lists of child codes were printed onto paper, cut up into individual phrases and rearranged to group smaller themes into larger inductive themes. This is a common approach referred to as ‘winnowing’ by qualitative researchers; Guest et al. (2012) refers to ‘winnowing’ while describing how a researcher can get “the number of codes down to a manageable number of categories” (p. 339). Guest et al. (2012) notes that it is common to layer codes, however, in using this layering approach it is necessary to keep track of the original interpretation of the text, as the risk in not doing so “can obscure the distinction between the original text and its interpretation” (p.70). While

the applied method suggested by Guest et al. suggests multiple reviewers of the codes, the capacity of this research was limited to one data analyst. Therefore, I kept close track of the meanings of the codes within NVivo. I re-read the text and adjusted the code descriptions accordingly as I winnowed the themes, as it is also suggested by Guest et al. to refine the definitions of codes during this process. When child code themes did not fit well under the deductive code framework, new inductive parent codes were created to track emergent themes.

3.3.2 Document Analysis

The documents in this research were used to help provide understanding surrounding how participants may be applying the concept of NAM into policies and practice, particularly in relation to climate change action. During interviews, the government participants were asked questions about their policies and practices regarding NAM and their responses were used to generate a list of nineteen documents (plans=6, bylaws=5, reports=6, and program materials=3). These relevant documents were then collected online from local government websites, and in some cases, copies were provided directly by the government participants. Document types included reports, bylaws, plans, policies, and program materials. Please see appendix 4 to view a total list of the documents. A targeted approach was used to search sections of the documents relevant to NAM; these sections/pages were analyzed to search for themes and meaning. Bowen (2009) notes examples of studies where specific sections within documents have been targeted for inductive analysis (e.g. mission statements). During the pre-scan of documents, NAM terminology was searched for within the documents to help find relevant sections. To determine which NAM terminology to search for, an introduction level guide (NAI's Primer on Natural Asset Management) was used as a resource to select relevant terms that are used by NAM practitioners (see: MNAI, 2019)

Documents were imported into NVivo for analysis after interviews were complete, using the deductive codes (Climate Policy and Climate Practice); inductive themes that emerged within the documents were combined with the climate policy and

climate practice sub-themes derived from interviews to find general themes relevant to those overarching codes. In some incidences, pre-existing codes from the previous analysis on the interview transcripts were used where relevant when existing themes emerged during the inductive analysis of the documents (e.g. the 'community inclusion' code). This method is noted by Bowen (2009) in stating that "Predefined codes may be used, especially if the document analysis is supplementary to other research methods employed in the study. The codes used in interview transcripts, for example, may be applied to the content of documents" (p. 32). Bowen (2009) asserts that researchers frequently neglect to include important details about the documents and the analytical procedures used. To improve the quality of the document analysis, details were kept track of according to the suggestions provided by Bowen (e.g. author, date, purpose of document). The interpretation of results for the document analysis were also considered through the framework of Kooiman's Governance Theory to help better understand how the NAM approach may be occurring in relation to governance concepts within the context of the participants' local communities.

3.4 Study Site

This research is broadly located across eight local government jurisdictions within the Atlantic Canadian provinces of Nova Scotia, New Brunswick, Newfoundland, and Prince Edward Island. While government participants typically represent perspectives from communities clearly located within specific destinations or regions, the experiences represented by the community participants may range from local destinations to across broader regions and landscapes. To maintain a greater chance of anonymity for the research participants' identities, the locations of the eight local governments that the participants are associated with have not been identified specifically. Appendix (1) provides an updated list of the 25 communities currently noted to be involved with NAM across Atlantic Canada (this information was compiled from various sources: see appendix 1 for more details) Relevant community characteristics are included in appendix 1, such as population size, recent population change, and settlement type;

settlement types were determined following a community typology method by Hodge and Gordon (2014).

CHAPTER 4: RESULTS PAPER 1

Title: Natural Asset Management within eight Atlantic Canadian communities: Perspectives from local government and community actors

Abstract

Efforts to advance and mobilize the use of ecosystem services from concept into planning practice and government decision-making is a struggle that has been well documented within Ecosystem Services (ES) research. The history of ES has deep roots and a wide range of terms exist that are relevant to this concept; communication difficulties are a common barrier for ES practitioners. Natural Asset Management (NAM) is an approach that includes ES concepts, and has begun to evolve rapidly, particularly within the context of Canadian local government over the past decade. This research explores experiences and perceptions of NAM held by governance actors across eight Atlantic Canadian local government jurisdictions. The findings show that most participants perceived NAM as providing a relative advantage in their efforts to advance ecological sustainability, however, several tensions were identified that are relevant to the compatibility of this approach to ES. The influence of a 'natural asset' mindset was found to be shared through the collective experiences of several participants; the NAM terminology was understood to both help and hinder communication across certain groups. The meanings associated with NAM, its complexity, and trustworthiness, were found to be important factors that influenced how participants advance in and perceive this ES approach.

Key words

Natural asset management, Ecosystem services frameworks, Ecosystem governance, Nature-based solutions, Innovation Theory

Introduction

Frameworks and approaches that consider ecosystem services (ES) have been associated with the potential for multiple benefits toward assisting governments and decision-makers with addressing sustainability concerns, such as, climate change (Wüstemann et al., 2017), disaster risk reduction (Faivre et al., 2017) and land-use decisions within planning (Thompson, Duinker and Sherren, 2021). Maund et al. (2020) note that numerous ES frameworks have emerged internationally following the release of the Millennial Ecosystem Assessment. In an effort to assist with the ES approach in Canada, the *Ecosystem Services Toolkit* was developed by an intergovernmental taskforce in 2017 (Value of Nature to Canadian Study Taskforce, 2017). Recent Canadian studies document the struggles of governments in efforts to implement ES frameworks (Tang Kai et al., 2022; Kerr et al., 2021). Kerr et al. (2021) identified several obstacles to ES implementation, including communication barriers such as inconsistent language use, technical jargon, and difficulties with knowledge exchange. Nahlik et al. (2012) assert that inconsistencies in definitions, terminology, and a lack of unity across various ES approaches create barriers to advancing the ES concept into real-world applications. Maund et al. (2020) note the differences in societal views surrounding ecosystem services as being vital to consider within ES frameworks. Kerr et al. (2021) notes that developing a better understanding of practitioners' experiences surrounding ES is important to consider. Perspective 'narratives' develop knowledge that is generated by practitioners' who are working toward the implementation of nature-based approaches, which can provide helpful learning opportunities (Rahman et al., 2021). Tang Kai et al. (2022) found that awareness of the use of mainstream ES frameworks was limited in their study involving municipal staff across twenty Canadian cities; in some cases, ES frameworks may be viewed as unsuitable for practical use in Canadian municipalities. The term 'natural asset management' (NAM) appears to be relatively new to Atlantic Canadian lexicons by comparison to other ecosystem-based approaches; along with NAM comes a new vocabulary of terms to learn for those who are unfamiliar with both

ES terminology and asset management. While diverse groups of governance actors are involved and/or associated with NAM, local governments are key actors involved directly with this ES approach. Within Atlantic Canada, the popular approach of NAM has recently begun to emerge within the practice of some local governments. Various climate risks are a growing concern in Atlantic Canada; Vasseur (2017/2018) note risks associated with coastal areas, water supply, and flooding in particular. This research was conducted within eight local government jurisdictions across the Atlantic Canadian Provinces (Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland). This paper addresses two main questions: 1. How do local government and community governance actors associated with NAM in Atlantic Canada perceive this approach? 2. What are the participants' perspectives surrounding their communication experiences in relation to NAM? The aim and rationale for this study is in understanding the perspectives of these local actors to advance learning and awareness, and to assist future research on NAM in these local contexts and beyond.

Background

By 2022, Eyquem et al. reported that a minimum of 18 local governments across Atlantic Canada were undertaking NAM activities. These activities are often in association with the Natural Assets Initiative (NAI); The NAI developed in British Columbia following a multi-stakeholder meeting held in 2015 (Town of Gibsons, 2017). Including local governments that have embarked on NAM either independently or have adopted this practice through other avenues, this number is estimated to have now grown to a minimum of 25 across Atlantic Canada (see appendix 1). The practice of natural asset management (NAM) borrows and blends historical ideologies from various disciplines and worldviews; NAM derives ideas from conceptual frameworks such as natural capital, ecosystem services (ES), and nature-based solutions. NAM supports the advancement of ecosystem services concepts and nature-based climate solutions within the service delivery of governments; this approach also aligns with economic valuation to support

the inclusion of ecosystem services in public sector accounting. The NAM approach is differentiated by utilizing specific asset management terminology and methods that have been traditionally applied to engineered assets. The term 'Nature Asset Management' does not currently appear to be well defined within academic and grey literature. NAM may be defined as a framework that encourages bioregional collaboration and includes asset management methods to advance the recognition of ES and implementation of nature-based solutions within the decision-making and development processes of local communities. Practices similar to NAM can be seen in international examples such as storm water management in New Zealand (see: Knight, 2003), and asset management of the subsurface in the Netherlands (Maring & Blauw, 2018). Given that the NAM concept is relatively new by comparison to other approaches to ES, this research draws upon examples of NAM and ES literature in general. In their recent study on ES within the context of Canadian planning, Thompson et al. (2024) found that most participants were aware of NAM and held positive associations with the practice, particularly in relation to decision-making for urban areas. Stern (2018) refers to relative advantage as the "likely benefit of the new practice outweighs the costs and exceeds the value of current practices" (p. 189). The relative advantage of NAM that may be perceived by the participants is an important factor to understanding how and why governance actors have chosen to adopt NAM as a framework for their ES activities. Rogers (2003) defines a 'social system' as "a set of interrelated units that are engaged in joint problem solving to accomplish a common goal" (p. 37); in this context it is referred to as the interrelation between those who are associated with NAM. The communities involved in NAM operate within their own social systems and have chosen to use this approach to help them address a variety of local concerns. The decision to adopt NAM may lead to impacts within governing, as this approach encourages adjustments to how communities make decisions relevant to their surrounding ecosystems. Within the beginning stages of governance, Kooiman (2003) asserts that identifying 'pockets of tensions' is integral to efforts where actors are attempting to find solutions to collective problems. Similarly, Stern (2018) refers to

compatibility as being a state where “the new practice does not conflict with dominant social norms, personal norms, past experiences, or the needs of the adopter” (p. 189). Rogers (2003) identified compatibility as being one of the perceptions that impacts the adoption of an innovation. Roger’s *Diffusion of Innovations* theory and Kooiman’s theory on *Governance* are therefore helpful for exploring a variety of perspectives held by the participants in relation to NAM.

Methods

This research was conducted through a constructionist lens (Burr, 2003) and an interpretivist approach (Stake, 1995; Guest et al., 2012). The study was guided by a theoretical framework using the Diffusion of Innovations Theory (Rogers, 2003; Stern, 2018); to assist with interpretation, this research refers to theory on governance, as defined by (Kooiman, 2003). Local governments who were identified as being involved in NAM were invited to participate. As a group, NAM practitioners may span across various fields, sectors and organizations. This research only provides a glimpse of the diversity of the professional backgrounds that may be involved with NAM in Atlantic Canada; Currently no detailed information could be found that explores the characteristics of this particular group in detail, therefore snowball sampling was used to identify members of this population. Primary data was collected through 23 key informant interviews with 11 local government officials and 12 non-government organization representatives referred to by using a snowball sampling approach (Penrod, 2003; Bickman & Rog, 2009). Local government participants were purposively selected based on their involvement and proximity to the natural asset management approach that is being employed within these local government jurisdictions. Community participants were identified by government participants as being either directly or indirectly involved with natural asset management in these local areas. The participants interviewed for this research identified a wide range of societal groups which they communicate and collaborate with in NAM-associated activities as part of their ‘social systems’ (see chapter 5); the two groups involved as participants in this

research were local government staff and community organization representatives (primarily ENGOs). The eligibility to participate was broadly based on the participants' interest in discussing NAM and their experiences and/or association with NAM. Government participants were eligible to participate if they held experiences or association with NAM through their professional role; these participants occupied a variety of positions working for local government departments in roles that relate to the environment (e.g. managers/ administrators/ coordinators, development officers, planners, strategists, municipal parks). Community participants were eligible to participate if they had been identified as having been involved with local government in association with 'natural assets' through their organizational roles; these participants currently or previously occupied a variety of positions in association with the environment, infrastructure, conservation, and land stewardship (e.g. managers/ coordinators/ directors, educators, leaders, specialists). To see more details related to participant affiliations in association with the quotes used, please refer to table 4 in appendix 5). Participants were provided with options surrounding the use of quotes; this research follows the policies outlined by the *Tri-Council Policy for Ethical Research on Humans* and was carried out under the processes of Research Ethics Board of Dalhousie University.

Interviews ranged from 30 to 60 minutes in length and were conducted using a semi-structured format (Shackleton et al., 2021). Interviews were conducted virtually online using the Microsoft Teams platform between August to December 2023. Interviews were auto transcribed through Microsoft Teams and then adjusted for accuracy by ear using the audio recordings. Transcripts were imported into NVivo for thematic analysis using deductive and inductive coding methods (Linneberg & Korsgaard, 2019; Guest et al. 2012). Sandelowski (2001) recommends that qualitative researchers avoid the mistake of 'verbal counting,' describing this as when researchers make implications toward numbers through their language while not providing them. Following this recommendation, a scale has been provided to increase increase

transparency and assist readers with interpretation where measurements are implied in relation to the prevalence of the themes.²

Top level (parent) codes were generated to organize the overarching themes that arose from the participants perspectives as they relate to theory and the research questions. The parent codes were used to explore the participants perspectives further on what the term 'natural asset management,' means to them, and what their communication experiences have been surrounding NAM. Deductive codes guided by the Diffusion of Innovations theory were used to collect relevant phrases in relation to the participants' perspectives. Inductive themes that arose from this process were organized under the six overarching themes (*Defining NAM, Relative Advantage, Complexity, Observability, Trustworthiness, and Compatibility*). Some of the sub-themes that arose inductively during the analysis are particularly relevant to governance theory (e.g. *organization across communities, tensions, and unfamiliarity*). Please see appendix 7 for detailed descriptions of all the themes.

Results/Discussion

Defining NAM

In their definitions of NAM, participants provided a diverse range of responses for how they would describe the term 'Natural Asset Management.' The participants' views of what NAM means to them may be shaped by many factors; these include, but are not limited to, educational and professional backgrounds, organizational views, their levels of exposure to NAM, and local contexts. While individuals may define this term in close alignment with their own positionality and unique viewpoints, participants may also define NAM based directly on the work their organization is performing. In other instances, participants provided broader definitions of NAM that were less tailored to their own positional context by

² Verbal Counting Scale: 'Few,' 'rare,' 'uncommon'= 1-4 participants; 'Some,' 'sometimes'= 5-9 participants; 'Several,' 'commonly'= 10-14 participants; 'Many,' 'frequently'= 15-19 participants; 'Most,' 'prevalent'= 20-23 participants. Due to the methods and interpretations used here, these generalizations should be considered as a guide rather than a definitive quantification.

comparison. A wide range of definitions for NAM was apparent in the responses of both participant groups. Occasionally participants provided unique definitions that may be based more on ideological views and hope rather than upon direct observations of NAM being conducted in their communities. For instance, one community participant who was less familiar with the concept of NAM by comparison to others in the study, directly related this concept to the equitable distribution of resources. Another participant initially viewed NAM as interchangeable with the term 'natural resource management' and was unable to provide a further definition. The more unique definitions were also apparent in instances when participants would assign their own boundaries and specific natural asset classes or particular features as being relevant to NAM. For example, while some participants perceived natural asset management as only being applied to and/or applicable to natural features that have not been designed by humans or in 'native' condition, others would also include nature-based features designed by humans such as green spaces, bioswales, and rain gardens as being relevant to NAM activities. This 'general vs. specific' binary was more obvious in certain responses, although this was not always present or clearly discernible. This indicates that actors may perceive the NAM approach in a very broad or vague sense or may hold very narrow and specific views for the meaning of this term and what is included in this practice. Outside of this binary, others may define NAM and its relevant activities somewhere in between these two polarized viewpoints. These findings are relevant to disparities in views surrounding ES noted by Maund et al. (2020).

Due to the wide range of descriptions provided, responses were categorized into three broad themes that show the spectrum of views expressed through the participants' definitions of NAM. It is significant to note the distinction between these categories, as responses can reveal how individuals may relate to ecosystems through their interpretations of the NAM approach. Many participants defined NAM through a more anthropocentric lens (i.e. addressing human needs), while some defined NAM in ways that explicitly highlighted the conservation and stewardship

aspects of NAM (i.e. caring for nature). This polarization was balanced by the definitions from a few participants who specifically defined NAM through a socio-ecological systems lens (i.e. ecosystems focus). The following statement provides an example of a definition that closely aligns with the ecosystem focus theme, by considering NAM through a socio-ecological lens that includes both nature and humans, as well as representing a more specific focus by narrowing in on particular methods, features, and areas:

“My understanding of NAM, within the context of municipal parks and open space, is that it would be using natural means to preserve or manage spaces. So, rather than using engineered structures, it would be looking at using more natural ways to achieve that, such as living coastlines, to preserve and maintain your assets.”

-Trails & Open Space Coordinator
Participant #0919

This range of responses is important to consider, such as how practitioners and governance actors view and define NAM may have implications for how people advocate for the application of this approach. For example, in one instance a government participant defined natural asset management and applied this approach exclusively through the lens of drinking water supply; this perspective was largely driven by the necessity to protect this resource for residents who were reliant upon wells and on-site septic. As in this example and others, note that these results do not provide a complete picture for the participants’ perspectives on how they may choose to define NAM. When participants provided definitions of NAM that were specifically anthropocentric or conservation-focused, this would occasionally be followed later in interviews by making statements that revealed a more expanded and balanced view of NAM as they reflected further. This reflexivity is relevant to a stage in thought referred to as ‘deliberative cognition’; this mode involves the overriding of programmed thought toward critical

thinking and reflection (DiMaggio, 1997 ctd. in Kooiman, 2003). While the governance actors continue to evolve in their knowledge and understanding of NAM, the results from these initial descriptive responses provide lessons for organizations moving forward as they may seek to refine their definitions and conceptual understanding of NAM more collectively.

Relative Advantage

Most participants made statements indicating they perceived NAM as having a relative advantage, with four main subthemes emerging under this code. In the first theme, participants viewed NAM as helpful for creating positive advancements in their work and/or communities. Several participants perceived NAM as being necessary to advancing opportunities to preserve nature in their communities. NAM was also seen by participants as helpful for tracking and preventing the loss of habitat and natural areas, particularly in relation to climate change impacts and rapid development. Participants commonly viewed this approach as vital to advancing planning and development processes from an ecological perspective within their communities.

Second, participants frequently perceived NAM as offering a more desirable approach to decision-making in general, particularly regarding development. A few participants specifically described NAM as being a more proactive approach by comparison to the current and historically reactive decisions made by governments. Participants also perceived NAM as offering a more standardized approach to data that would improve decision-making across geographic and political scales. People from both groups viewed NAM as useful for justifying planning projects and increasing opportunities to fund conservation work. These themes around proactivity and ecologically sustainable decision-making can be seen in the following comment from a government participant:

“We are [in] a province and city that’s growing quite a lot...it’s almost more important now to take stock of where these areas are, as they're often one of

the areas that would probably come up first, these undeveloped lands where it would make sense to build a new subdivision or new commercial area, etc. So, it's kind of balancing that need for growth and development with also trying to protect and enhance the natural areas we do have.”

-Anonymous

Participant #0808

Rogers (2003) argues that the more individuals perceive an innovation to be advantageous, the higher the likelihood will be that its adoption rate occurs rapidly. Given that the participants frequently found the NAM approach to provide a relative advantage within the context of their current and future practices, this may provide some explanation toward the recent trend in Atlantic Canada of local governments engaging with this approach.

Third, the flexible thinking sub-theme emerged from the statements of some participants who felt a desire to see a greater sense of creativity and flexibility in the way that we think about, understand, and make decisions about nature as a society. Participants expressed a sense of need for broad cultural change and increased education surrounding nature in general for both the public and decision-makers. Status quo approaches and rigid thinking were noted by participants as being a barrier to advancing ecologically sustainable management decisions; a willingness to try new approaches, be adaptable, and take risks were also noted by participants as being important to supporting the learning of communities attempting to use NAM and/or nature-based approaches in general. The barrier inherent within ‘status quo’ approaches referred to by the participants, is relevant to literature that refers to path dependency as a barrier to advancing ES and/or nature-based solutions (e.g. Rahman et al., 2021; Kerr et al., 2021), whereas Waylen et al. (2015) asserts that the term ‘sticking points’ may be a more accurate term for referring to this problem. This issue is referenced within a Canadian-based study on ES, where Kerr et al. (2021) notes the

“lack of flexibility to institutionalize ES frameworks” (p. 1870). It is significant to note that participants commonly viewed discussions surrounding NAM as being an avenue to assist them with overcoming this barrier of rigid thinking across society and organizations; this finding was most apparent within a sub-theme that emerged in relation to the mindset surrounding ‘natural assets’ that participants had both witnessed in others and experienced themselves.

The ‘natural asset mindset’ sub-theme emerged from the comments of several participants, represented equally by both groups, who described this approach as a new way of thinking, discussing, and framing their perspectives on their work, the environment, and conservation practices in general. The concept of ‘natural assets’ was viewed by these participants as a thought process that provokes conversations across disciplines, groups and jurisdictional scales; Some participants directly associated NAM as a way of attempting to be more holistic in their collaborative work processes. Participants who described successful communication experiences perceived NAM as a positive topic that assists them with facilitating conversations across professions, government departments and through informal avenues such as sharing success stories online. Community programs and events (e.g. ‘No Mow May,’ fire smarting, and watershed initiatives) were also noted by government participants as particularly important avenues that assist with communication between local government and residents about certain aspects of NAM. One government participant noted that their organization now views and protects natural areas differently than they did before gaining this new ‘natural asset’ perspective. One community participant experienced NAM as a precursor to local governments getting involved with nature-based approaches to climate change with their organization, noting that the ‘natural asset’ understanding appears to advance government staff knowledge and helps to provide a basis for discussions on nature-based solutions. Another community participant noted the history of their organization, describing the origins as beginning from a singular ‘natural asset’ lens in the early 1900s, and eventually evolving up to an ecosystem approach. These examples reveal how the ‘natural asset’ mindset may be an influential

factor that contributes toward organizations communication and collective efforts in acting to protect ecosystems:

“I think that the natural assets [concept] is bringing the industry and the conservation mindsets together to approach it [climate change] from that perspective. And I think that it's bringing together different industries, combining them, or at least deepening the conservation industries understanding of more technical things”

-Executive Director

Participant #1207

From this common experience that several of the participants share surrounding a ‘natural asset’ mindset, we can see that as the idea of NAM diffuses between societal groups in Atlantic Canada, this concept is influencing their discussions and learning in relation to their work and nature in general. The concept of NAM appears to be assisting the participants with overcoming some of the barriers previously noted in ES research regarding communication difficulties referred to by (Nahlik et al., 2012; Kerr et al., 2021). These findings demonstrate that these participants experience the ‘natural asset’ mindset as helpful towards breaking down barriers related to siloes and struggles with interdisciplinary communication within certain contexts.

Complexity

Three subthemes arose that are significant to the complexity of the NAM approach: general communication challenges, NAM terminology, and difficulties with understanding the NAM methods and/or tools. Within the general communication challenges sub-theme, some community participants noted difficulties in developing and maintaining consistent pathways of communication with other organizations (including their local governments) to discuss NAM and nature-based solutions. Participants sometimes noted a general lack of understanding about NAM, natural

processes, and ecosystem services as a barrier to effective public communication about NAM; a lack of understanding across society was also noted by a few participants in relation to economic valuation and municipal processes as being a communication barrier for NAM. In a few instances, participants perceived that a general disinterest in society makes it more challenging to gain attention and facilitate communication about NAM through public discourse and media. Several of the communication challenges noted by participants mirror the results commonly noted in ES literature, such as, siloes (Hysing, 2021), differences in understanding across professional fields and education backgrounds (Ferraro & Failler, 2022; Wüstemann et al., 2017), limited capacity, and staff turnover (Kerr et al. 2021).

Although NAM terminology was more often viewed by participants as being beneficial for communication across societal sectors, the NAM terminology sub-theme also highlights the participants concerns for how inaccessible language can potentially hinder communication between certain groups. While participants may regularly use the term 'natural asset,' they may also use other terms that are more well-known or accessible, depending on the audience or situation. Participant statements would sometimes indicate switches in their use of terminology in their daily practice; this tendency of switching terms mid-sentence was also found in interview statements. This may indicate that these participants perceived the terms 'natural asset' and 'natural asset management' as somewhat interchangeable with other more commonly used terminology associated with nature-based approaches and environmental management. In a few instances, differences in understanding surrounding terminology appears to have dissuaded practitioners from using NAM terminology in their public communications. While one community participant described NAM as a shared term that can assist with streamlining communication, participants also viewed NAM terminology as technical jargon that requires additional effort in explaining to diverse audiences. In one instance, this struggle prompted a municipality to re-consider and simplify their communication strategy:

“So that was the big red flag of, well, if the journalist can't write a story to communicate this, I think we're going to have to backtrack and think about the language we use when we talk about natural assets.”

-Environmental Strategist
Participant #1027

In contrast to the views demonstrating how NAM can assist practitioners with communication through a similar mindset and vocabulary, this theme demonstrates that NAM terminology can also create a barrier in public communication efforts. In addressing social-political issues, Kooiman (2003) asserts that “the media play an important role in offering the widest possible range of interpretive frames for these discussions” (p. 39). While these conversations are occurring within the public sphere to some degree (see: Russell, 2021), a wider societal discussion on this topic appears to be limited within these Atlantic Canadian local contexts. The communication challenges identified here by the participants are important factors that contribute toward this issue. The issue of limited public discourse is also relevant to the potential outcomes of NAM, as Rogers (2003) warns that change agents generally introduce innovations into systems with the assumption that its consequences will be desirable, however, research has shown that it is common for future impacts that are undesirable and unanticipated to also occur. The implications of NAM terminology were viewed as significant; some participants perceived the term ‘natural asset’ to be instrumental in influencing societal perspectives on nature and communicating across groups to support conservation, while a few participants found the colonial and capitalist associations with ‘asset’ related terms to be off-putting. One of these participants, who was strongly supportive of the NAM approach, suggested the potential to adjust language surrounding NAM to be more inclusive of diverse worldviews. The issues surrounding NAM terminology are complex, particularly when participants recognize the concerns and choose to use the

NAM terminology as needed for communication. This decision may be potentially explained by the candidness of one community participant who asserted that despite such deterrents, they viewed this terminology as necessary to communicate the significance of protecting nature while operating under hegemonic systems and in scenarios where decision-makers are less easily swayed by intrinsic values. With all of this in mind, perspectives surrounding the terminology of NAM itself raises moral issues within the realm of governance, even within the views of governance actors who find its use to be helpful for advancing the protection of ecosystems. The terminology is therefore important to consider in future discussions, as proponents of this approach seek to improve communication surrounding NAM while also striving to be more inclusive in their approaches. It is important to note that the methods used in this research limit the perspectives included in the results. During recruitment, attempts were made to reach a wider range of groups. Due to the interest and availability of potential recruits, as well as the capacity of organizations and the primary researcher, a less diverse range of participants were included in this research.

In the final subtheme related to complexity, several participants made comments regarding the generally complex methods of NAM; seven people directly shared about their difficulties with fully understanding the NAM approach. A few participants were perplexed by the process of economic valuation, noting that they were uncertain how to approach it, or doubting whether or not it actually works. Some community participants noted the time consuming and labour intensive aspects of data collection and analysis as being a barrier to NAM. On rare occasions, participants made direct remarks about the NAM tools; A few government participants noted that the dashboards and NAM tools available to them are not currently being used, while others noted that their existing tools and the NAM inventory dashboards were useable and helpful in their work. The primary reasons cited for the lack of use of NAM tools/methods include uncertainty for how to use the tools effectively, and a general sense of comfort derived from the use of GIS layers developed in-house. Despite the

apparent struggle to fully understand this approach, participants in this theme expressed excitement and interest for continued learning.

The struggles with fully understanding NAM methods may partially explain why statements directly relevant to trialability were rarely mentioned. Participants who had the opportunity to be involved in the NAI inventory projects would occasionally note their appreciation for the experience of receiving help with beginning their NAM journey, which was seen as being financially affordable to them. The main topic observed in these participants' statements was the limitations that constrain their ability to conduct implementation trials. These limitations were noted to take different forms, such as, funding access, liability concerns, and the physical terrain of project sites. How participants choose to define NAM and its applications may also impact their perceptions of what constitutes an appropriate scenario wherein they could conduct trial runs of this approach. Rogers (2003) notes that trialability assists with learning through practice. Therefore, the limited experience with trials noted by participants is an important aspect that impacts their understanding of NAM.

Observability

Statements relevant to the observability of NAM were predominantly made by community participants. One government participant noted that they had not seen NAM cause anything to occur in their municipality, while others expressed enthusiasm over the wide range of all the 'natural asset' related projects they had either observed or have been involved with through their work as local government staff. Here, the question comes to mind whether these participants viewed the projects as being a direct result of NAM practice, or if these projects might have been carried out regardless of NAM being adopted by these government organizations; this question became too complex to answer definitively through the analysis. A few of the community participants reported seeing positive results occurring in association with NAM projects within their own community or in other, occasionally distant, locations. Four community participants made direct statements that revealed a general lack of opportunity to

observe the results of NAM within their own communities. Some community participants were unaware of what their local government is doing in relation to NAM, while others perceived that NAM data is not being used effectively or to its full potential in their communities.

The sub-theme of 'unfamiliarity' that arose inductively is significant to the overall observability of NAM in these contexts. Out of the 23 participants, eleven described feeling a general lack of familiarity with NAM, with eight of these being community participants. Statements within this theme included primarily community participants who described not being involved enough with NAM to fully understand this approach:

"I love the idea and I love what I've seen so far, but then, I think it comes back to my current lack of understanding where I just don't know the specific details of what natural asset management really looks like."

-Watershed Group Coordinator
Participant #1012

Given how recent the newly adopted process of NAM is to these local areas, a few community participants noted that they had not yet fully formed their opinions regarding what concerns they might have for this approach. The government participants who expressed unfamiliarity with NAM referred to it as a new concept for which they are still forming their understanding of in relation to their operations. Kooiman (2003) asserts that governance actors form images of what they are governing, which can include a range of information, such as "wishes, goals, hypotheses, theories, convictions..." (p.29). It appears that the majority of the participants are still in the early process of forming their images of NAM. This is particularly important when considering that community participants were more likely to express their unfamiliarity with this approach. While the findings reveal a range of experiences in relation to the participants opportunities to observe NAM; this theme demonstrates that observing NAM was a less

common experience for community participants. Stern (2018) defines observability as a state where “there is opportunity to easily observe the results of the practice, either through demonstration or observing neighbours” (p.190). Observing an innovation is noted to be an important factor impacting its adoption rate and communication about it (Rogers, 2003). It is therefore important to consider how the currently limited observations may impact community perceptions and governance processes surrounding NAM in Atlantic Canada.

Trustworthiness

Similar to the unfamiliarity theme, several participants (primarily from the community group) expressed a general uncertainty surrounding the trustworthiness of current NAM processes. Many of these concerns circled around some doubt in the accuracy of the raw information derived from provincial datasets used in NAM analyses. Due to the time-consuming nature of data collection and analysis across vast landscapes, these participants were weary of the inherent risks surrounding misled decisions that could be based on information that is out of date and containing gaps. Similar to the community participants who expressed the need for ‘eyes on the ground level,’ a few government participants noted ground truthing as being an important step needed to supplement the desktop assessments of data for NAM. Due to potential risks, participants also expressed a desire to see caution exercised in the use of economic valuations. These statements regarding trust in data processes are intrinsically linked to the concerns previously noted in the *complexity theme*, and can be understood through the following participant’s reflection on this issue:

“We always want to be humble in the face of models and assessments that we have chosen to do based on the available information; there’s a certain amount of uncertainty.”

-Anonymous

Participant #1210

Uncertainty in the data may also deter public communication efforts, as this lack of confidence was noted by one government participant as being a hindrance to beginning discussions with the public on this topic; in such instances practitioners may opt to wait until they feel more certainty in the NAM approach. Participants also wanted to ensure that NAM practitioners would approach decisions and interpretations of the data holistically; concerns were noted surrounding the risks of assumptions and the expressed need to consider the scope and direction of decision-making through NAM as a practice. As noted earlier, Rogers (2003) refers to occurrences where desirable and undesirable consequences have arisen from innovations; the findings within this theme show that the participants are reflecting on the potential for negative impacts, which contributes toward actions that cautiously approach and slowly include NAM within their practices.

Compatibility

Responses relevant to compatibility were organized in three emergent themes: *tensions, organization across communities, and complimentary aspects*. Participants revealed several tensions that may limit their ability to adopt NAM into their daily practices as a long-term decision. One of the main tensions identified was the potential for clashing views and common issues that may arise from upsetting the status quo. Competing views over land management practices across property lines and jurisdictions were also noted as areas of tension. With perspectives similar to those shared in the NAM terminology theme, five participants were particularly cautious of the underlying values of the NAM, viewing it as an approach that aligns itself with colonial and capitalist ways of thinking, especially in relation to views on land ownership and the economic valuation of nature. Although some participants held these concerns, they also counteracted these statements by strongly supporting the NAM approach within their interview responses. By contrast, seven participants specifically highlighted

economic valuation as a critical step in NAM to advance the protection of nature during land-use decision-making processes. Other participants did not mention economic valuation, perhaps due to being less aware of it, or choosing to avoid discussing this complicated topic altogether. The diverse and sometimes contradictory perspectives shared in these statements are reflective of the scholarly debates on ES that have been occurring for decades. For example, Pritchard, Folke and Gunderson (2000) caution that decision makers may incorrectly assume that the results of economic valuation are objective within cost-benefit analyses. Within the trustworthiness theme in particular, it can be seen that governance actors can hold cautious perspectives toward NAM.

Other tensions over diverging viewpoints were brought up by some participants who were unsure if overall 'buy-in' for NAM will occur within their communities and organizations. Dissonance between staff departments and council regarding NAM were noted by a few participants as an area where tensions can potentially arise. A small sub-theme that arose within this category was 'misconceptions surrounding nature,' characterized by statements regarding humans dislike for natural 'unruly' spaces in favor of 'tidy' green spaces. Some participants noted this as a barrier for implementing NAM fully into practice, as conflict can arise between departments, organizations, and the public where a general lack of understanding is held for the value of these types of natural areas. These participants experiences recount how different levels of awareness about nature across organizations can create issues with miscommunication involving maintenance procedures, making it difficult to see through the full long-term benefits of their nature-based projects in some cases. Tensions surrounding the maintenance of public spaces were also a concern in relation to issues with invasive species, public safety, and the lack of organizational capacity at the ground-level to appropriately care for areas with increased vegetation. Participants in this theme expressed how a lack of unification in understanding about nature within government culture, and society in a broader sense, is a significant constraint to adjusting procedures. These participants strongly emphasized the need for having clearer lines of communication established in local jurisdictions to resolve some of these areas of tension. Kooiman (2003) notes that

while various interests will result in situations where tensions arise, “the clashes are part of the problem and solution space” (p. 143) of governance. The tensions identified here by the participants experiences and perspectives therefore represent an important step toward collective problem-solving in relation to NAM. It should be noted that the results presented here are limited to the perspectives shared; the majority of the participants were positioned in environmental and conservation-based roles, however, some participants come from planning, management, development, and engineering backgrounds.

The sub-theme of *‘organization across communities’* emerged from the statements of several participants; organization across jurisdictional levels and geographic scales was an important factor that participants viewed as integral to the compatibility of the NAM approach in their communities and organizations. Several participants noted the importance of alignment across municipal departments, between different levels of government, and community actors as being crucial to the future success of NAM. The importance of having ‘eyes on the ground level’ was emphasized by three community participants, as those who spend time in nature regularly hold unique perspectives and are essential to environmental monitoring processes; these participants highlighted the importance of involving various community groups early on in conservation, restoration, and decision-making surrounding ecosystems. Participants from both groups stressed that support from different levels of government is also needed to assist with their efforts in this area. For NAM to be truly effective, statements from this theme emphasized the need for policy and operational roles to be reformed to facilitate better cooperation across government and society.

Relevant to organization across communities were the desires expressed by several participants to see the direction of NAM explored more meaningfully within their communities; these statements were marked by a general sense that NAM is lacking direction. Elements of this theme were found to carry through all of the sub-themes associated with compatibility, making it particularly relevant. These participants perceived NAM as requiring a more clearly directed focus toward its intent and

organization within the communities who are adopting this approach. Community participants noted a desire to see more educational resources being shared across communities to assist with NAM activities. Current resources may be scattered across different locations, leaving practitioners who wish to advance this approach feeling unsure where to look for certain information when needed. These participants also expressed a desire for increased engagement and community inclusion in NAM, while stressing the need for direction and support in general from higher levels (e.g. provincial governments). This finding is consistent with Canadian-based research on ES frameworks, as Kerr et al. (2021) noted the voluntary nature and lack of mandates surrounding ES as a barrier for local government staff to implement these types of initiatives. These participants recognize through their lived experiences that the direction of NAM may fluctuate based on local context, immediate priorities, and the worldviews of practitioners. This theme is particularly significant to the potential future of governance involving NAM, promoting social equity, and collective learning in this practice. An additional small sub-theme arose when four of the participants noted their desire to see practitioners operating from a Western perspective grow a deeper understanding through the inclusion of viewpoints from Indigenous communities. The importance of relationship building and a desire for increased understanding and collaboration in ecological work was expressed within these participants' statements. The Indigenous community inclusion theme is also relevant to the flexible thinking theme noted earlier, as it reveals those participants willingness to expand their views on nature through a different lens. Although this topic was less commonly mentioned, the inclusion of Indigenous communities in conversations surrounding NAM is significant for practitioners to address. The recognition of diversity is an important quality within governance and governing (Kooiman, 1993). Rogers (2003) notes that understanding Indigenous knowledge and other existing knowledge systems has shown to be important to the success of introducing new innovations; ignoring this can lead to potential adopters perceiving an innovation as incompatible. Similarly, Maund et al. (2020) asserts that differences in values and perspectives between 'experts' and the

public need to be included in ES frameworks and decision-making processes to increase societal support and the effectiveness of these approaches.

In statements where several participants found NAM to be particularly compatible to their regular practices, the *'complimentary aspects of NAM'* sub-theme arose. These participants described NAM as complimentary to their work and the ecosystem related activities that they have been involved in both now and prior to the NAM approach being introduced. These government participants viewed NAM as a useful approach to integrate into their decisions surrounding land use and planning; these participants noted that they are at the stage of discussing NAM theoretically within the context of their work roles and upcoming projects, while others found that the inventory data and the 'mindset' associated with NAM was already beginning to assist municipal decision-making on a somewhat regular basis.

A few community participants specifically noted that the work they perform in their organizational roles aligns well with the NAM approach, particularly within the realm of community-government collaboration and planning. The participants statements demonstrate how community groups and non-government organizations are highly instrumental in a range of activities relevant to NAM, such as, data collection and monitoring, habitat mapping and protection, restoration activities, and assisting with the development of environmental policies and plans. These community participants note that their experience makes them particularly well-suited to being involved with NAM at local and regional scales. The potential for future uses of NAM was also a popular topic; participants anticipated a wide range of opportunities where NAM could be used in the future to advance their work, such as, tracking vegetation loss across landscapes, public communication, policy development, supporting species through habitat resiliency, climate change adaptation, natural infrastructure projects, and obtaining funds for nature-based projects. Scholars point to the significance of ES concepts fitting within the existing structures of institutions (Hysing, 2021; Gómez-Baggethun et al., 2010). Compatibility is an important factor to consider in relation to ES frameworks, as Rogers (2003) notes that innovations which are perceived as

incompatible will be slowed in their rate of adoption. Within this theme, several participants have identified a variety of ways for which they perceive NAM to be compatible within their current and future practices to advance the preservation of ecosystems in their local areas and beyond.

Conclusion

The results of this research demonstrate a variety of perspectives from governance actors in Atlantic Canada surrounding the recently emerging practice of natural asset management. Positive associations toward NAM are particularly evident within the relative advantage and compatibility themes. Compatibility and relative advantage are especially significant to impacting the rate of adoption for an innovation (Rogers, 2003); this may account for why the participants have adopted NAM and continue to maintain a positive outlook for this approach, despite the struggles they are currently describing with NAM in relation to complexity, trialability, and observability. Recall, struggles in communication are an important factor that impacts the implementation of ES frameworks (Kerr et al., 2021, Hysing, 2021). The 'natural asset mindset' theme demonstrates the communication successes shared by participants; NAM has been assisting these practitioners to push through some common communication barriers, such as siloes and interdisciplinary communication.

It is important to note that the participants were consistently supportive of this approach when asked directly if they considered NAM to be necessary (see chapter 5); this is significant when considering the contrary experiences described by these participants. The issues identified by participants, particularly within the themes surrounding unfamiliarity, complexity, tensions, and trustworthiness, are important to consider for their potential impacts to the overall longevity of the NAM approach within these local contexts. The findings presented suggest that there is a need for increased understanding, inclusion, and communication between Atlantic Canadian governance actors in relation to NAM. Within the context of the communities involved, I argue here that what matters most are not only the values and norms of the adopters and

members of the current 'social systems' involved with NAM, but also those not involved who may be impacted by the adjustment of decision-making processes. Within the diversity of values related to ecosystem governance, Baird et al. (2022) choose to "include non-humans, extending agency to animals and landscapes" (p. xix). In governance related to NAM, I would also include non-human species within the description of 'communities' here as well. It is recommended that future studies on NAM in Atlantic Canada seek to gain perspectives from other diverse groups, organizations, and individuals regarding this approach. It is also important to consider that Atlantic Canadian governance actors are in the early stages of the NAM process, having only begun developing images in their minds for the potential of NAM. Kooiman (1993) asserts that to represent the diversity of meanings in relation to social-political questions and the formation of governing images, it is necessary for the different levels of actors to use an "interactive communication and decision-making process" (p. 46). The range of NAM definitions generated from interviews also reveals that this concept is not well-defined; NAM can be represented through a diversity of perspectives. Organizations may consider communicating with diverse groups about NAM, whilst developing their own definitions of NAM to clearly reflect their purpose, vision, and intent for this practice.

Acknowledgements of Funding

This research is supported in part by funding from the Social Sciences and Humanities Research Council (SSHRC). This research is also supported by funding from Dalhousie University through the Killam Foundation and the Nova Scotia Graduate Scholarship.

Declaration of Interest

The authors declare no competing interests that could impact the results of this research.

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CHAPTER 5: RESULTS PAPER 2

Title: Natural Asset Management in Atlantic Canada: Exploring governance, communication and nature-based climate adaption in policy and practice

Abstract

Natural Asset Management (NAM) is an approach to ecosystem services that has been developing in international contexts; the advancement of NAM across Canada over the past decade has led to the recent growth of this approach being used within the Atlantic Provinces. This study explores the early experiences of governance actors associated to NAM through the lens of their work related to ecosystems and climate adaptation situated in Atlantic Canada. Local government and community participants were sought for their experiences in relation to NAM. The findings indicate that an interrelationship exists between NAM and the ecosystem-based approaches to address climate change that participants regularly engage in; NAM is a factor that is both influential toward and supported by the nature-based climate action and policies carried out by governance actors. Despite frequently expressed support for the NAM approach, the communication behaviors of participants reveal that governance actors were more likely to discuss nature-based topics in a broad sense with the public and other affected groups. NAM was found to be less well understood or communicated through the lens of governance and decision-making surrounding ecosystems.

Keywords

Natural Asset Management, Ecosystem Governance, Community-Government collaboration, Nature-based solutions, Climate change

Introduction

Ecosystem services (ES) approaches are linked to a wide variety of community benefits in association with resilience to climate change and biodiversity (Wüstemann et al.,

2017; Short et al., 2019, Denjean et al., 2017). Ecosystem services (ES) have been broadly defined as “the benefits that people obtain from ecosystems” (MA, 2005, p. V). The MA (2005) notes that ES can include a wide range of services, such as regulating (e.g. climate control), cultural (e.g. spiritual), provisioning (e.g. water) and supporting (e.g. the cycling of nutrients). Due to inconsistencies with a variety of definitions and terms associated with ES, Nahlik et al. (2012) asserts that this concept has been hindered from practical applications, and that a more collective approach is necessary to advance the ES concept. Communication difficulties are identified as barrier to the implementation of ES (Short et al., 2019; Kerr et al., 2021; Nahlik et al. 2012); Hysing (2021) notes the complexity of ES as a limitation that challenges the ability for broader public communication surrounding this concept. Various approaches to ES exist, as Maund et al. (2020) note the increase of ES frameworks that emerged following the release of the Millenium Ecosystem Assessment. Ghofrani et al. (2017) refer to Blue-Green Infrastructure (BGI) as “an interconnected network of natural and designed landscape components, including water bodies and green and open spaces which provide multiple functions” (p.15). Natural Asset Management (NAM) is an approach to environmental management that considers natural systems as assets that “contribute to the provision of one or more services that are required for the health, wellbeing, and long-term sustainability of a community and its residents” (O’Neill, 2018, p. 33). While similar to other approaches such BGI and natural capital accounting, NAM applies specific terminology and approaches traditionally used for the asset management of engineered assets. In recognition of this shifting approach to environmental management in certain Canadian communities, it is vital to consider how these advancements may be influencing the local contexts of ecosystem governance and nature-based climate adaptation where the NAM approach has been adopted. Dynamics, complexity, and diversity are noted by Kooiman (1993) as important governance concepts in relation to interactions that occur between private and public sectors. This research explores the activities and communications of NAM actors to gain a deeper understanding of their experiences with this innovation in relation to these

governance concepts. While the experiences explored here are shared from within the Atlantic Canadian context, some aspects of these findings may also be relevant to other political and geographic contexts where NAM is being undertaken. The following three research questions are explored within this article: 1. What problems and opportunities do the governance actors seek to address through NAM? 2. How are the governance actors communicating about NAM? 3. How might the governance actors be using NAM to advance climate change adaptation through policy and practice?

Background

Within the Canadian context, promotion of the NAM approach began to arise more prominently in the 2010s when the Natural Assets Initiative (formerly known as the municipal natural assets initiative) began to develop. Following advancements with NAM in areas such as storm water management services in the Town of Gibsons, British Columbia, a multi-stakeholder meeting in 2015 led to the decision to launch the Natural Assets Initiative (Town of Gibsons, 2017). Within Atlantic Canada, a minimum of 18 local governments were reported by Eyquem et al. in 2022 to be engaged in NAM activities. Based on a compilation of sources, 25 Atlantic Canadian local jurisdictions at minimum are now estimated to be involved in the NAM approach; this includes those who have adopted this approach through NAI or have taken different avenues (Eyquem et al., 2022; City of Dieppe & KPMG, 2021; NAI, 2023; 2024; Town of Mahone Bay, 2022; Eastern Charlotte Waterways & Town of Saint Andrews, 2019). As governance actors attempt to address climate issues that pose serious risks for the health, well-being, and safety of populations, it is vital for communities to adopt inclusive approaches for determining solutions to such problems. Theories on governance and the diffusion of innovations can assist with navigating societal discourse surrounding various frameworks and approaches to ES and socio-political issues. First-order governance is defined by Kooiman (2003) as a stage where governing actors attempt to address problems and generate opportunities in their daily practices; within the 'problem and solution space' governing actors experience tensions while considering potential options

to address socio-political problems. Similar attention is paid to these influential factors within Diffusion Theory studies, Stern (2018) refers to such aspects as the 'felt needs' and problems experienced by actors within social networks. Exploring these issues are therefore relevant to understanding how participants may relate to and use the NAM approach to address community needs and concerns. When considering the dynamics surrounding these types of societal needs (i.e addressing social-political issues) through the lens of governance, communication is a critical factor to consider; Kooiman (1993) identifies interactive communication and decision-making at various levels as an important part of the governing process. Holzer, Baird, and Hickey (2022) note that communicating effectively is a key factor to increasing the diversity in perspectives within ecological decision-making. Communication is also featured in Diffusion of Innovations theory as an important factor to social change; Rogers (2003) describes communication channels as being one of the main elements integral to the process of innovations diffusing across social systems. Depending on the context of how people learn about new ideas (i.e the communication sources or channels) this can have an impact on peoples' interpretations of messages and whether they receive them (Stern, 2018). To explore themes surrounding the governance actors' experiences with the NAM approach as they strive to provide solutions to socio-political issues (e.g. climate-related issues), a governance lens is used in this research to help provide insights. Kooiman (1993) refers to 'dynamics' as a "composition of forces" (p.37) that can influence patterns in systems (e.g. social, natural, and technological forces). Kooiman (1993) asserts that to understand the dynamics of socio-political systems it is necessary to gain insight into the interactions that occur, which are distinguished by three forms as: interferences, interplays, and interventions. In defining these three types of interactions, Kooiman (1993) refers these as basic patterns, organized (formal) patterns, and organized (directed) patterns, respectively. The ways in which governance actors are engaging in activities and communication surrounding NAM therefore provides insight through a deeper understanding of such interactions.

Methods

This research draws upon governance theory (Kooiman, 2003) and diffusion of innovations (DOI) theory (Rogers, 2003) to help understand and interpret the participants' perceptions and experiences with NAM. The philosophical approach has been guided by a constructionist/interpretivist lens (Burr, 2003; Stake, 1995; Guest et al., 2012). The materials for this research are 23 key informant interviews and 19 public documents (plans, bylaws, reports, and program materials). The collected documents were published within the date range of 2019-2023. Most of the documents were created by local governments, with the exception of four documents that were created by NGOs or consulting firms, often in consultation with community members and local governments. During the recruitment stage, a snowball sampling approach was used to identify potential interviewees (Penrod, 2003; Bickman & Rog, 2009); Atlantic Canadian local governments found to be involved in natural asset management were contacted and invited to participate in interviews. Government participants were asked to provide lists of contacts in writing and/or verbally to identify other actors whom they associate with regarding natural assets. Ten representatives from local government (including one representative from a regional service commission), and twelve participants from community organizations were interviewed. The local government participants are associated with (at minimum) eight local jurisdictions located in four Atlantic Canadian provinces, with the communities ranging from rural to large cities. Broad eligibility criteria were developed, based primarily on participants' experience and/or association with NAM. Government participants held experiences or associations with NAM in their roles; these participants were typically involved through environmental aspects of their work. Community participants were identified for their involvement with 'natural assets' in association with local government; these participants typically were involved with community organizations in roles and/or projects relevant to the environment and conservation.

This research follows the policies outlined by the *Tri-Council Policy for Ethical Research on Humans* and was carried out under the processes of Research Ethics Board

of Dalhousie University; participants were provided with options surrounding the use of quotes. Interviews were conducted via Microsoft Teams between August to December 2023. A semi-structured format (Shackleton et al., 2021) was used for interviews ranging from 30 to 60 minutes. Auto-transcribed transcripts were adjusted for accuracy while listening to audio recordings. Methods suggested and referred to by Bowen (2009) were used in the document analysis; Bowen (2009) suggests collecting certain types of information (e.g. signatures, dates, and authors) within documents; these details were collected as part of the document analysis. Interview statements where government participants associated NAM as being relevant to programs and/or recent progress in policy and plan development were used to select documents for analysis.

A customized 'verbal counting' scale³ was created to improve transparency for the readers during the interpretation of the results. Sandelowski (2001) recommends that qualitative researchers avoid 'verbal counting,' which is described as using language to make implications of numbers without providing those figures. Deductive parent codes were developed based on the research questions and organized under three overarching themes; Exploring the 'Problem and Solution Space' of NAM, Climate-related practices associated with NAM, and Climate-related policy development associated with NAM. Statements surrounding climate-related policies and practices were searched for within interview transcripts and the documents as noted by participants for being significant to NAM. The 'communication channels' deductive code was derived from DOI theory by Rogers (2003). To better understand how participants may perceive NAM as a solution to assist with socio-political issues, their responses were analyzed from the following interview question, *"Is NAM needed? If yes, how/why is NAM needed? If not, why is it not needed?"* Statements were then coded to generate sub-themes that arose inductively from the text and transcripts were thematically analyzed in NVivo, using deductive and inductive coding methods (Guest et al., 2012).

³ Verbal Counting Scale: 'Few,' 'rare,' 'uncommon'= 1-4 participants; 'Some,' 'sometimes'= 5-9 participants; 'Several,' 'commonly'= 10-14 participants; 'Many,' 'frequently'= 15-19 participants; 'Most,' 'prevalent'= 20-23 participants. Due to the methods and interpretations used here, these generalizations should be considered as a guide rather than a definitive quantification.

Results/Discussion

Exploring the 'Problem and Solution Space' of NAM

Participants frequently perceived NAM as a necessary approach within their local areas and beyond to improve environmental management. Including instances where the responses were ambiguous⁴, these participants expressed support for NAM, especially by comparison to conventional approaches. Participants provided various reasons for viewing NAM as necessary to address common community concerns and needs; the results were arranged into seven sub-themes. Issues were noted particularly in relation to rapid development, the preservation of ecosystems, financial and socio-cultural issues, climate change, and the need to improve decision-making and management processes surrounding nature and water resources.

Rapid Growth Concerns & Improved decision-making

Several participants noted their concerns over the rapid pace of development occurring in their communities. It should be noted that most of the Atlantic Canadian communities that became involved with NAM in recent years have experienced population growth between 2016-2021 (see appendix 1). While participants often expressed the need for development, this theme emphasized the preference participants hold for decision-making to improve sustainability in development. NAM is perceived as an approach that may help to balance local and regional development decisions by including more data relevant to ecosystem decline. Participants viewed NAM as useful for improving baseline data; this was frequently noted in association with the tracking of the loss of habitat and vegetation over time. Some participants also viewed NAM as a method that could increase the perceived value of natural spaces in

⁴ Ambiguous statements were when participants would describe the benefits of NAM without directly stating whether or not they perceived it as necessary, making the responses less clear. One participant did clearly state that NAM was not necessarily needed, however, this was followed by referring to NAM as an improved method for approaching development decisions.

decision-making, with the intended impact of decreasing the need for reactive approaches to issues created by conventional development; for example, sustainable decisions that increase the resiliency of both natural and engineered infrastructure in the long-term was perceived as an advantage of NAM. Participants perceived NAM as an approach that may provide a relative advantage to them within their decision-making processes, noting the holistic perspective that NAM allows in comparison to conventional approaches. The natural asset inventory data and multi-disciplinary approach provided through NAM was viewed by participants as highly useful for improving development decisions, environmental governance, and planning processes, as one participant notes:

“I think it’s important to have the information and to have those natural assets not only managed, but catalogued, so decision-makers and residents alike can work together to make informed decisions”

-Anonymous

Participant #1204

This theme is closely tied to the *Preservation of Ecosystems* theme, characterized by the commonly held concerns over ecosystem decline. A desire to strengthen the health of ecosystems by protecting natural spaces and wildlife habitat was viewed as a significant need; participants perceived NAM as being an avenue to help address these concerns. NAM is viewed by these participants as being integral to facilitating and advancing various actions such as tree preservation and strengthening ecological corridors across local landscapes. These concerns also extended to both non-human and human species, with participants noting topics such as urban heat island effect, improved air and water quality, overall climate resilience, human health, and active transportation corridors. The direct socio-economic and cultural impacts of NAM to humans were less often discussed; the social benefits of NAM were typically noted as providing advantages such as public access to nature and place attachment. Faivre et al.

(2018) highlight ecosystem-based approaches as solutions that are cost-effective while providing local areas with social, economic, and environmental benefits. Similarly, McVittie et al. (2018) refer to the multiple benefits of ecosystem-based adaptation, while also noting that lesser is known regarding the economic impacts and potentially negative effects related to these approaches. The themes surrounding decision-making, rapid development, and ecosystem preservation mirror this gap in understanding; the participants perceive NAM as a solution that helps to address their concerns in these areas, however, less appears to be known by the participants surrounding the possibly undesirable socio-economic consequences of this approach.

Financial concerns

One direct advantage specific to humans was expressed by participants who perceived NAM as an approach to assist communities with acknowledging the financial benefits of ES. Through the application of NAM terminology in conversations regarding landscapes, this may influence how people view nature in general following their introduction to this concept. This was apparent in comments where participants would discuss the ‘natural assets,’ and the need to manage them appropriately for longevity; this included a desire to protect natural assets not only for their intangible value, but also for the financial savings that a community may reap through decisions to protect and enhance nature, as one participant noted:

“Needed? I'm not sure. I think we already have ways of dealing with stormwater management so it's not necessarily a need. I think it [NAM] is an alternative approach that is a valuable tool to explore as opposed to conventional development. I think it's a way of cost savings to taxpayers and municipalities as well as it just being a more environmentally sustainable approach to development.”

-Planner

Participant #1024

Concerns over poor development decisions and their long-term consequences having direct financial impacts were noted, such as, damages to built infrastructure relevant to loss of vegetative buffers, and the maintenance costs associated with impermeable surfaces and hard infrastructure. Participants noted that removing the benefits that natural infrastructure provides has financial implications for a community's built infrastructure in the long-term. These financial concerns ranged from the individual (e.g. property damage and increased electricity bills) to wider community impacts (e.g. environmental disasters being exacerbated through planning and development decisions). Participants viewed the environmentally sustainable development lens encouraged through NAM as a solution to assist with balancing these financial impacts for communities. Tourism and attracting new residents were some additional areas where participants perceived NAM as being a mechanism for advancing their community's financial strategies. Additionally, NAM was viewed as being relevant to funding streams for its potential to assist communities with securing finances to advance environmental management. These financial benefits noted by the participants are consistent with other studies where scholars refer to the cost-effectiveness of ecosystem-based approaches (e.g. McVittie et al., 2018; Faivre et al. 2018). While financial benefits may occur for some societal groups in association with NAM, the trade-offs inherent in the decisions are key to consider. Pritchard, Folke and Gunderson (2000) argue that through economic valuations, particularly when applying cost-benefit analysis, decision-makers may assume that this approach is objective. Therefore, the financial benefits highlighted within this theme become vital to consider in relation to how future NAM-related projects and funding may impact communities in Atlantic Canada and who benefits from these decisions.

Climate Change Concerns & Improved Environmental Management

Participants often perceived NAM as an approach that helps to address climate impacts through ecosystem-based adaptation and mitigation. When describing why they

considered NAM to be necessary for their communities, some participants specifically noted the climate-related vulnerabilities of both human and non-human species, as well as habitat and infrastructure. Sea level rise, erosion, degradation of natural spaces, heat waves, wildfires, and flooding were particularly areas of concern that participants sought to help lessen impacts from through NAM. Managing climate risks and hazards through natural infrastructure and well-maintained ecosystems can help to shelter human communities and local economies (Welchel et al., 2018). The NAM approach was viewed as useful in relation to climate action planning within communities; these participants viewed NAM as an important avenue to help facilitate ecosystem-based disaster risk reduction in their local areas and across geographical and political scales:

“It's important to know what is there so that we can take stock of the effects on those inventories and be able to respond, whether that's replanting or rebuilding things. In many communities natural assets are a really big component of the services that are offered to residents and so to help maintain quality of life, and especially in the face of climate disaster, being able to meaningfully manage those are important...”

-Lilian Barraclough
Participant #0921

NAM was also perceived by several participants as being needed to improve the management of natural features and water resources in general. The cultural block/shift subtheme that arose is also relevant to the participants desires to see approaches that help to overcome systemic ‘blocks’ that impede improvements in environmental management. When discussing current approaches to environmental governance, participants in this theme commonly referred to a need to break through cultural and institutional barriers to advance efforts for ecosystem management in their daily

routines. These perspectives referred to the need for a shift in thinking that would facilitate alternative approaches to conventional methods and development decisions. Participants also emphasized a need for greater awareness and education across government, society, and professions in relation to ecosystems. These participants perceived NAM as a necessary approach to help increase understanding and provoke changes in attitudes and decisions that impact nature. This theme is relevant to the overall complexity of governance processes that is referred to by Kooiman (1993) who asserts that complexity can be explored as an operational issue that is relevant to the various interactions between “parts and wholes” (p. 39) of systems. The desire and perceived need to address socio-ecological issues more holistically through NAM is emphasized by the participants in this theme.

Climate-related Practice associated with NAM

Interview statements reveal that the participants associate NAM with a wide range of pre-existing and new activities that their organizations are regularly engaged in relevant to nature-based climate adaptation and mitigation. The occurrence of nature-based climate adaptation activities was one of the dominant themes that emerged from the interviews and documents. Statements from both interviews and documents in the climate-related practice code were arranged into six inductive themes: Blue-Green Infrastructure Adaptation, Community Inclusion, Risk-based Activities, Managing for Resiliency, Value, and Efforts to Organize.

Blue-Green Infrastructure Adaptation

Participants commonly associated NAM with their activities related to blue-green infrastructure enhancement. Government methods to protect green infrastructure included actions such as encouraging residents to participate in ‘No Mow May’ efforts, detailed tree planting programs, and developing new incentives for private wood lot owners. Statements in this theme noted general concerns surrounding tree loss, climate impacts such as drought, flooding, biodiversity loss, and the need to support pollinators

and carbon sequestration efforts. Activities to strengthen and enhance blue-green infrastructure were commonly discussed by community participants as being the main avenue through which they participate in NAM; these efforts often included projects in relation to watersheds, riparian zones, erosion control, and planting. Comments from government participants in this theme tended to focus more on topics such as canopy growth, natural corridors, enhancing opportunities for pollination, green spaces, and climate risks. Encouraging storm water management through blue-green infrastructure was commonly mentioned in interviews and documents. Noted efforts included work relevant to wetlands, dykelands, and living shorelines, as well as projects that use nature-based solutions (e.g. retention ponds, bioswales, rain gardens). The protection and expansion of wetlands was also a common practice noted within documents and interviews. One such method referred to by participants was the acquisition of land through new purchases and donations to facilitate actions for flood prevention and habitat preservation. Some participants also noted coastal protection activities as relevant to their NAM efforts. Actions to address coastal erosion and implement natural shoreline projects were most often noted in this theme, including a few instances involving engagement and seeking community advisement surrounding coastal areas. The interactional activities described by the participants provide examples of ‘interplays,’ described by Kooiman (1993) as formal patterns of interferences that are organized between actors and networks. While it is evident that these interplays related to ecosystem-based adaptation are occurring, it is less clear how these dynamics are being affected by NAM.

Risk-based Activities & Managing for Resiliency

In addition to focusing on blue-green infrastructure, participants noted numerous ecosystem-based activities in association with NAM that they related to climate risk reduction in general. Activities to address climate risks and manage for the resilience of communities and ecosystems were significant to the participants. Participants were likely to associate NAM with nature-based activities that are occurring

or being promoted locally to address climate risks. While commentary was made regarding goals and long-term planning, participants tended to focus more on present activities when discussing climate risks and resiliency; interviewees discussed this topic mostly through the lens of existing activities they were aware of or engaged in themselves. The risk-based activities were wide ranging, including efforts related to invasive species, forest health, watershed management, erosion control, soil health, food security, wildfires, flooding, and coastal protection. Within documents, the majority of the statements relevant to climate risks were focused upon addressing concerns for flooding, food, and water supply, however, a wide range of climate concerns were noted in general.

A relationship between community climate change concerns and discussions surrounding NAM was directly identified by some participants as a significant factor driving the diffusion of the NAM approach in relation to environmental management in their local areas. This is important to consider, as Whelchel et al. (2018) asserts that although international recognition has been growing to support the advancement of ecosystem-based disaster risk reduction, the majority of countries have not made these types of approaches a standardized part of policies and practices to address climate risks. Risk-based activities mentioned in documents most relevant to NAM processes included actions like natural asset mapping, risk assessments, and the promotion of natural asset projects. A recognized need to enhance climate resilience through NAM emerged within four documents, particularly regarding invasive species, tree health, food systems, species biodiversity, and flood regulation. While the incorporation of climate risks and natural assets directly into formal asset management planning was occasionally noted, this type of progress appears to be less common and in nascent stages. 'Risk issues' are noted by Kooiman (2003), who asserts that risks at both individual and structural levels are important to consider in relation to governance. The themes surrounding risk and resiliency are primarily considered at a community level, with statements more likely to be through the lens of how NAM may lessen risks for communities.

The 'Value' of Natural Assets

The topic of valuing natural assets in general was sometimes noted in documents; value was expressed differently depending on the context of these phrases. Value was described regarding a range of values inherent to and irreplaceable within nature, including those which cannot be quantified, such as general well-being. These phrases typically listed specific 'ecosystem services' which were considered to bring great value to the communities. Documents showed that a few communities have recently begun to engage in or promote the process of quantifying the economic value of natural assets within municipal practices. The document findings were reflective of sentiments expressed within interviews, showing that those who support this practice tend to recognize a wide range of values within nature, including the climate-relevant and economic aspects quantified through NAM and other approaches that include ES. Maund et al. (2020) assert that the integration of diverse societal viewpoints into ES frameworks is necessary to improving their effectiveness, transparency, and support systems. The concept of values in relation to ES can encompass a broad range of views and is often explored in ES research. It is important to consider the diversity of values expressed here, as well as the potential limitations to the current conversations regarding NAM in Atlantic Canada.

Community Inclusion in NAM

Collaboration, engagement, and education were the key themes that emerged in relation to the inclusion of community in NAM activities; Collaboration was the most common activity found to be occurring in climate-based practices associated with community inclusion in NAM. A variety of community-government partnerships were noted by participants to involve interrelated work that helps support NAM; these projects usually include efforts to enhance or restore natural areas. Local governments and community organizations reported partnerships with a diverse range of governance actors, including First Nations, private sector groups, watershed groups, NGOs, and academic institutions; these collaborations typically involved projects relevant to

ecological conservation. While these activities and projects were considered by the participants to support NAM, they may not always be designed through the NAM concept and approach. Although it could not be ascertained how often NAM is discussed as a conceptual approach through these community-government collaborations, it is unlikely to be a frequent occurrence; where these incidences could be found, they were more likely to develop between municipalities and NGOs in joint projects that were environmentally focused. When considering the practices surrounding ecosystems, Baird et al. (2022) note the importance of distinguishing between daily management decisions and the direction that is provided by governance. When decisions are being made to include NAM as part of ecosystems management, it is vital to consider how collective efforts can advance the awareness and direction of such decisions.

Community organizations were noted to be involved in various activities supporting and promoting the NAM approach in collaboration with local governments through projects and study reports. Local governments and community actors reported different ways that they collaborate to specifically advance the process of NAM; these activities included efforts to build upon natural asset inventories through mapping, enhancing condition assessments through supplemental data, and cross-referencing natural asset data through alternative methods and local knowledge. Although such activities were reported, it was more typical for the community participants' involvement in NAM to be from the position of a supporting role, such as restoration activities rather than direct involvement in the desktop-related asset management aspects of NAM. Community participants would also describe themselves as part of the data collection and analytical procedures for natural areas and biological species, rather than being part of 'natural asset management' itself, which they sometimes perceive as a separate process for which they hold limited knowledge on. This could be seen from the comments of six community participants who referred to their experience of supporting NAM, while not being directly involved in the 'asset management' aspects. In such instances, community participants remarked upon their awareness of NAM, while

also referring to their own position along the periphery of this conceptual approach; this experience was often described as not being fully aware of how this management process may work as a whole:

“ I know that they [the City] has a municipal natural asset inventory and those sort of outwardly focused things that I do know that they have. But I wasn't involved in how that was developed or discussions about how they're going about their own environmental management. It's more so kind of looking from the outside in.”

-Project Manager

Participant #0922

This finding suggests that while participants relate to NAM as a broad approach that encompasses many environmental management activities on the ground, the desktop procedures and decision-making processes associated with NAM are less well understood. For example, participants seemed to consistently understand NAM as an avenue for progressing nature-based projects, however, the data analyses and financial accounting for natural assets that may influence project decisions were less understood. This experience was not limited to the community actors, as government actors may also consider themselves to exist along the periphery of NAM in some instances. Experiences of separation between the NAM approach and environmental governance processes are also apparent in the educational and engagement activities described by the participants. When participants reported that community engagement and education was occurring in relation to NAM, it was more likely to be in reference to specific aspects of environmental management that were viewed as being relevant to NAM, rather than about the topic itself. For example, government-led efforts for public communication relevant to NAM were typically described as focusing upon specific types of natural assets and nature-based topics, such as, informing the public about local climate risks, providing advice on ecosystem-based adaptation for property owners, teaching residents how groundwater infiltration occurs in a local context, or

asking a community how they would like to see management improve surrounding an urban forest. Similarly, community groups were identified as vital to educating the public and municipal staff on topics related to the natural environment, however, this education was also more likely to cover specific natural features, ecological processes, and climate related topics, such as watershed health and invasive species management. Instances where local governments engaged in education specific to the NAM approach were more often through actions like staff training. Current and future efforts anticipated to increase education, communication, and engagement specific to NAM were also sometimes noted by participants. The inclusion of local and Indigenous populations is noted to be vital in addressing conservation and climate issues (Brondizio and Le Tourneau, 2016; IPBES, 2019) and the success of innovations (Rogers, 2003). Within ‘collaborative environmental governance’ Bodin (2017) emphasizes the importance of approaches in environmental management that are inclusive, while also noting that when various groups deeply contest policy issues, attempts to collaborate may not lead to successful outcomes. While the participants report that collaborative efforts in NAM have been advancing with certain examples of success, the nature of these collaborations currently exhibit limitations that impact the ability to infuse diverse viewpoints into the NAM practices.

Community participants reported working collaboratively with government and NGO actors to advance nature-based projects and conservation within their communities, and in some instances across regions and provinces. Work collaboratively across groups and jurisdictions specifically regarding the NAM approach was less typically reported by this group, although there are occurrences. While the community participants more typically described their role as providing support to NAM practitioners and local governments, a few described their work as directly using the NAM approach in collaborative projects with local governments; these projects involved comparative data analyses, building upon natural asset inventories, and identifying levels of service for further assessment. A variety of resources were also found to be provided by community organizations to local governments in their efforts to assist with

NAM; these contributions commonly include advisement, direction toward funding streams, training, leading restoration projects and community volunteers, providing public education, mapping and inventory assessments of natural areas, and creating plans to assist with the maintenance and action goals for long-term planning and management of natural features. Wang and Ran (2023) caution that the terms ‘network governance’ and ‘collaborative governance’ are sometimes used interchangeably, despite their different underlying ideologies. In consideration of this distinction, the interactions surrounding NAM within these local contexts may be better described as governing efforts that are emerging from networks to advance ecological design in planning and development practice at local and regional scales.

Also relevant to advancing long-term changes in environmental planning, the *Tracking activities* sub-theme emerged within interviews and documents; this organizational activity is significant to assisting with tracking progress on climate action, as well as environmental monitoring in general. These activities designed to advance the organization of NAM across societal and spatial scales were relevant to climate practice within the local contexts explored. The most common activity involved inventory assessments through mapping natural assets across local and regional landscapes; some participants and documents revealed that additional tracking activities complementary to NAM are being used to assist both government and community actors in their goals for nature-based climate adaptation and mitigation. Tracking health indicators relevant to watersheds, wetlands, and urban forests were most likely to be noted within this theme. Community organizations, volunteer residents, academics, and local groups assist municipalities with tracking a range of factors such as water quality and temperature, channel depth, carbon storage, and tree species. Details relevant to the geographic location of newly planted trees, canopy coverage, species at risk, loss of forest cover to invasive species, and annual abatement expenses are examples of indicators that local governments are attempting to integrate into climate planning practice in relation to natural asset inventories. These activities were noted to be linked to the implementation of existing or newly developed local climate change plans. Kerr at

al. (2021) suggests linking ES to specific initiatives by breaking the concept into components to address needs in Canada, such as climate change adaptation. The findings here show that climate change planning and NAM are closely related within these local contexts.

Efforts to organize across departments and geographic boundaries is another significant sub-theme that emerged in the descriptions of the participants current practices involving NAM. The NAM approach was reported to be developing across government departments, professions, and geographic boundaries. Local government participants reported discussing NAM with a variety of community actors and departments. While many government departments and community actors may be involved in NbS and other climate-relevant projects, it was more typical to find NAM efforts being organized through one or two municipal departments. These departments were more likely to be involved in planning, development, and administration; Government staff leading NAM approaches were typically in roles relevant to the environment or tailored to a broad lens of ‘sustainability.’ Collaborative work directly specific to the NAM approach appears to be most often occurring between government staff and a small number of NGOs that could be described as change agents or strong proponents of NAM. When community organizations are involved, providing their time and energy in ways that indirectly support NAM appears to be more a typical occurrence. Gjaltema et al. (2020) defines ‘meta-governance’ as “a practice by (mainly) public authorities that entails the coordination of one or more governance modes by using different instruments, methods, and strategies to overcome governance failures” (p. 1771). The findings surrounding organizational efforts demonstrate that NAM is a unifying factor; proponents of NAM in Atlantic Canada are using this approach as a form of meta-governance to advance ecological sustainability in their local regions. Theoretical conversations about collectively organizing NAM across jurisdictional boundaries were also reported in a few instances by local government participants. One example of community-government collaboration on a project employing the NAM approach was noted to be occurring across several neighboring jurisdictions in Nova

Scotia. In another instance, a community participant identified the multi-jurisdictional conservation work their organization has been performing for several decades as being an example of NAM, although it had not previously been described using this term. Practitioners and governance actors may or may not consider pre-existing conservation approaches as similar to NAM, however, NAM was generally viewed as being akin to prior practices. Additionally, while some local governments may be working on NAM with organizations that operate across Canada (e.g. the Natural Assets Initiative), others are choosing to embark on their NAM journeys more independently; networks local to the Atlantic provinces are also a prominent resource that local governments have been working with on NAM. These findings show that NAM is a factor that is assisting practitioners' efforts toward the organization of bioregional approaches that address current and future climate-related concerns. The interest in the *future potential of NAM* subtheme reveals that many participants perceive NAM as being relevant to addressing various climate concerns that impact quality of life and safety for both human and non-human species alike. Although the NAM activity occurring across regions appears to be currently limited, it is significant to consider through the lens of future community planning across bioregions in Atlantic Canada.

Communication surrounding NAM

Participants reported using various avenues for communication on topics relevant to NAM; however, direct communication specific to the NAM approach was more limited. A few government participants noted communication efforts with developers for the purpose of encouraging changes that promote goals for preserving natural assets through ecologically sustainable design, although it is unclear how NAM may or may not be included within these discussions. The reported avenues for community engagement surrounding NAM-related topics include methods such as surveys, questionnaires, and requesting feedback through formal public commentary on the values that locals place on certain natural features. Several of the local government participants referred to their official engagement activities as being relevant to public

communication in relation to NAM; participants frequently noted that official planning activities were an important avenue for public discussions relevant to NAM, particularly in relation to larger scale projects. It should be noted that during the process of developing community plans, projects, bylaws, public surveys, and other community feedback activities, these public discussions were described to be focused on specific types of natural features or perspectives on natural areas in general. This communication behavior in relation to NAM was identified frequently across the interviews; it was more typical for local governments to describe communication about natural areas in their current public engagement in general terms, rather than specific to the NAM approach:

“We engaged with the public for I think a month and a half, where we were speaking about incorporating planning bylaw, and we are developing regulations. So, we're trying to get feedback from the public about what they want to see and part of that also required understanding of how they see natural assets and their lakes, beaches, etc., and we're educating them a little bit about using nature-based solutions as well.”

-Anonymous

Participant # 0802

This strategy appears to assist the actors with reconciling pre-existing processes for communication surrounding the environment while gauging where NAM can assist or fit within their current ecosystem governance activities. Rather than discussing NAM as an approach to decision-making processes surrounding environmental management, community participants were also more likely to report communicating with the public in relation to nature-based topics in general. Other avenues for community outreach surrounding topics relevant to nature-based management approaches included methods such as social media postings, educational signage, newsletters, and community planting events. Participants typically described these communications as being part of or relevant to NAM activity. Nahlik et al. (2012) notes the inconsistent

usage for multiple terms and definitions relating to ecosystem services as being a factor that hinders the implementation of ES. While the communications are relevant to NAM, these findings show that indirect communication regarding NAM currently appears to be a norm that can occur depending on different social contexts.

The most common avenues for directly discussing the NAM approach were found to be through networking streams, such as conferences, and interpersonal communication between professionals; regarding community participants this also may include individuals who are retired or acting as volunteers, but who hold specific knowledge relevant to the environment, ecosystems, or technical skills. Public communication directly about the NAM approach was found to be most often facilitated through websites; a few instances were noted of local government representatives communicating with the media directly about the NAM approach. Presentations to the Mayor and Council are another avenue where the public may learn about NAM as an environmental management approach that their local government is involved in, although this was less commonly reported. Therefore, interpersonal communication directly specific to the NAM approach in these local contexts appears to be occurring primarily between professionals; this finding is consistent with results from a study by Hysing (2021) on ES implementation in Sweden. This common behavior for people to communicate and transfer ideas with others whom they share similar characteristics is noted by Rogers (2003). The tendency for experts and professionals to be involved in socio-political problem solving is also noted by Kooiman (2003), asserting that significant separation may exist between people who are experiencing such problems and those attempting to address them. Nine participants reported that direct public communication about the NAM approach has been, or appears to be, delayed in their community; reasons cited for this delay were capacity, the need to gather more information and knowledge, and the fact that practitioners are still in the early stages of understanding and developing this approach. Although practitioners may initially require time to familiarize themselves with the NAM approach, from a governance

perspective Kooiman (2003) stresses the importance of diverse perspectives being included in the process of defining problems as one of the first steps.

Participants frequently recognized that a need exists for greater discussion surrounding the topic of NAM; in the *communication strategies* subtheme, a need for improved literacy surrounding topics of environmental management through increased opportunities for public education was also noted as a necessary strategy to advance NAM. The importance of specific and strategic communication about NAM was perceived by several participants as vital to advancing public discourse in this area; suggestions for this included formal engagement and consultation, official communication strategies developed by professionals with training and skills in public communication, and the creation of sources and chains of communication that are more direct, consolidated, and collaborative. In one instance, a community of practice appears to be developing due to the collective need for Atlantic Canadian practitioners to grow their knowledge and tailor the NAM approach to local contexts; these collaborative efforts to develop community support to advance NAM expertise are nested within existing local networks and allow for the facilitation of NAM projects across jurisdictional boundaries to address multiple concerns, including climate issues. Rathwell and Peterson (2012) note that bridging organizations play a critical role in developing ties between municipalities in relation to ecosystem services. Some rare instances where Atlantic Canadian-based non-government organizations were involved specifically in the development and education surrounding NAM as an approach to ES were reported by participants; these community organizations act as bridges to communicate about NAM with government and non-government actors through wide reaching networks that span across the Atlantic Provinces. Kooiman (2003) notes the increase in needs that call for social-political issues to be addressed through arrangements that share responsibilities across the public realm in a collective sense. As NAM practitioners begin to coordinate themselves, discourse regarding communication strategies is relevant to inclusion, equity, and expanding the diversity of perspectives when developing governance processes surrounding this approach.

Climate-related Policy Development Associated with NAM

In comparison to climate practice activities, much fewer references to climate-related policy were found across the interviews and documents. Three sub-themes arose within the policy-focused statements by participants in relation to NAM: Development Controls & Legal Mechanisms, Climate-based Policy Development, and Updated Approaches to Planning and Land Conservation.

Development Controls & Legal Mechanisms

A variety of actions to control development impacts on natural assets were noted, including measures to increase land conservation through land purchases, easements, buffers, and requirements to plant and protect urban trees through the creation of new bylaws. These statements stress the need for adjusting development requirements and decisions to mitigate erosion, protecting and increasing local tree canopies, and improving flood control standards. Legal mechanisms, such as tree bylaws and newly created or adapted regulations to preserve natural and coastal areas, were more likely to be mentioned by participants as being significant to their NAM efforts. Land conservation agreements and the potential for new zoning types for floodplains were less commonly mentioned, although these steps were highlighted as important legal measures that the participants perceived as integral to supporting their work on NAM. Documents and interview statements reveal that new zoning categories have recently been, or are soon expected to be, created in at least four local jurisdictions; the new zones target issues such as coastal erosion, flood risks, drinking water protection, and the protection of green space. The need to advance legal protections for natural features was also apparent in participant statements regarding future development decisions. Expressed desires to see policy measures that advance flood prevention and enhancements to natural infrastructure were particularly significant to these participants. Within one municipality, both government and

community participants highlighted local interest to see increased incentives and requirements for tree protection and the enhancement of canopy cover within the development process for new housing subdivisions.

A strong interest in protecting trees was also apparent within the *Climate-based Policy Development* theme, where new policy development was found to follow⁵ or coincide with NAM activity. At minimum, three of the local governments have developed in-depth policies and bylaws to protect their urban forest since 2020. For example, these new legal documents included requirements such as a permit process and tree risk assessments; measures to enhance urban street tree inventories also included details for species diversity, canopy protection, and invasive species management. This theme also revealed the occurrence of collaborative climate action, such as policy development to facilitate improved tree management practices between local government departments and private property owners. Events in three communities where citizens and council members have organized to declare climate emergencies were also found to be pre-emptive or coinciding with NAM activity. The findings from this theme reveal that a relationship may exist between a community's concern over local climate impacts and their likelihood to adopt and/or try using the NAM approach. van Vliet (1993) refers to the 'interdependence' that exists between private and public actors due to the increasingly complex nature of society, noting that coordination is necessary to effectively solve problems. While the interactions taking place in these jurisdictions to form climate-based policies occur within complex socio-political contexts, the legal mechanisms and development controls noted by the participants in association with NAM provide key examples for how the actors are advancing the NAM approach through interventions.

⁵ This observation recognizes that NAM may be an influential factor in climate-based policy development but does not claim causality given that multiple factors influence these decisions.

Updated Approaches to Planning & Land Conservation

Updates to how participants view and approach methods to protect and preserve nature are apparent within the planning and land conservation subthemes. Updated policy and planning vision statements within documents from three local governments showed specific aims to include natural features and NbS within planning decisions to address climate concerns, particularly in relation to flood risk mitigation and storm water management. These statements often promote nature-based approaches and refer to the intent of decision-makers to prioritize natural drainage approaches over engineered solutions when possible; the importance of considering a hybrid approach to addressing storm water through both natural and engineered solutions was also noted by participants. Whelchel et al. (2018) notes that ecosystem-based approaches that may use both natural and engineered solutions, also referred to as hybrid 'green-grey' solutions, can provide a wide variety of environmental and social benefits to communities. Ecosystem-based concepts and approaches that pre-date the participants' adoption of NAM are evident; these practices typically align with or are similar to NAM.

Although interviewees referred to NAM as significant to their community planning approaches, less support for this was found in the documents. This may be partly due to occurrences where local governments were anticipating updates to their municipal plans, making some documents unavailable for analysis. Documents from five local governments revealed NAM approaches and terminology being recently applied to planning documents, particularly within municipal plans, background planning reports, and climate change action plans. It was less common for governments to note the creation of, or updates to, existing asset management plans. The updating and creation of new forestry plans were noted as relevant to NAM by participants, particularly in relation to urban forests, replanting efforts, and hazard prevention. Government participants regarded climate action plans as key tools that support their work to advance NAM, particularly through land conservation goals and targets to address a range of climate-based issues, especially regarding flooding, invasive species, temperature regulation, and CO₂ emissions. This finding shows that local governments

are using existing or updated plans and the NAM approach in tandem to support community climate goals. For example, one municipality made detailed amendments to include NAM policies in their municipal plan and routine decision-making to preserve blue-green infrastructure; these actions support their NAM priorities for the protection of the drinking water supply and proactive management to reduce flood risks. Kooiman (1993) refers to interactions that are “organized and directed” (p. 38) as ‘interventions.’ The adjustments to climate-related policies referenced by the participants and within documents provide examples of how NAM is an influential factor relevant to such interventions. Government participants would also report having not yet reached the stage of integrating NAM into formal policies. It should be noted that successful climate policy advances in relation to land conservation and natural asset protection were more likely to be mentioned by government participants; this finding may indicate that local community organizations are less likely to be aware of the current policy adjustments that are occurring within these jurisdictions in association with NAM. Occurrences where community actors, local governments, and provincial departments worked together to advance land conservation were noted by these participants as highlights in relation to NAM. Community participants were also more likely to note the struggles to implement such policies, such as coastal protection efforts, and their desire to see more policies and bylaws put into place that preserve natural features. These differences in understanding between government and non-government actors are important to consider, particularly within the context of the document analysis findings; table (A) shows the differences in NAM terminology usage in relation to document type.

Table 1: Climate-related Policy and Planning Associated with NAM

Document Type ⁶	NAM terms used	Climate-related Interactions
Plans (6) *	3/6	<p>Policy Changes (Interventions)</p> <ul style="list-style-type: none"> • Storm water management • Invasive species Management • Tree Policies
Bylaws (5) **	0/5	<p>Legal Changes (Interventions)</p> <ul style="list-style-type: none"> • Coastal Zoning • Sensitive areas protection • Street trees (Canopy) requirements
Reports (6) ***	5/6	<p>Planning & Assessments (Interferences/Interplays/Interventions)</p> <ul style="list-style-type: none"> • Tree Tracking • Flood Risk Mapping • Wetland condition assessments • Climate change vision /priority setting • Urban forestry management • Vision for NAM and risk reduction in planning
Program materials (3) ****	0/3	<p>Community programs (Interplays)</p> <ul style="list-style-type: none"> • Tree planting programs • Food security action planning

(See supplementary materials [appendix 2] for further details)

A clear communication behavior pattern emerged in policy development surrounding the use of NAM terminology; NAM terms were found to be directly used in plans and reports, while the associated bylaws and program materials do not include this terminology (see table 1). NAM terms were less likely to be found in signed documents, even in instances where government participants directly noted these

⁶ *The plan documents include: (4) Climate adaptation/action plans; (2) municipal plans
 ** Bylaw documents included: (2) Street trees bylaw; (1) development regulations bylaw; (1) zoning bylaw; (1) Municipal plan bylaw
 *** The report documents include: (1) Program report; (2) wetland/ watershed study reports; (2) planning reports; (1) committee report.
 **** Program materials include three pages from municipal websites that communicate about environmental programs noted by government participants as being relevant to the NAM.

policy document updates as being related to NAM. The one exception is found within an officially signed municipal plan that repetitively includes NAM terms. In such instances where NAM terms have not been used in documents, adjustments and/or assertions have been made to increase environmental protection within, and were referred to by interviewees for their relevance to NAM. This pattern may reflect efforts to avoid potential issues over the use of this new terminology; local governments may be more comfortable using pre-existing terms to describe natural features in certain types of legal documents. The potential reasons for this pattern are unknown, as this was not explored within interviews; it is also presumable that some of these adjustments to documents may simply coincide in their timing and relevancy with NAM, rather than being a direct result of adopting this particular approach to ecosystem services. Findings from these climate-related policy themes suggest that the influence of NAM is a contributing factor toward recent or upcoming changes in environmental policy and/or law within at least six out of the eight local jurisdictions included in this research.

Limitations

The recruitment methods used and the nature of NAM being in the early stages of governance in Atlantic Canada are factors that impact the diversity of worldviews, perspectives, and experiences expressed in this research. The local governments involved in this research were identified as being in the early stages of NAM; most considered their organizations to have begun this process within the last five years. While interviewees typically linked their activities surrounding nature-based approaches to NAM, this research does not imply causality; that is to say that while the activities are relevant and help to support NAM, numerous existing factors influence the climate and conservation practices of these local communities which have not been explored fully within this research. How people define and perceive NAM and its applications may fluctuate as they reflect on this topic; this factor is likely to have impacted the perspectives and themes that have been shared in this research. The verbal counting

applied here is an attempt to provide transparency to the interpretations provided and should be considered an estimate; qualitative statements are open to interpretation and these numbers could fluctuate based on perspectives.

Conclusion

Through the themes presented, this research reveals that the NAM approach is an influencing factor in relation to climate action. NAM both supports and is supported by environmental policy and planning within these Atlantic Canadian local contexts. It is not unusual for the work engaged in by the NAM actors to be related to practical applications in nature-based projects, which may or may not pre-date the participants' exposure to NAM. Both the documents and the perspectives shared by the participants reveal that the NAM concept and approach is becoming entwined with the climate-related policy and practice of the participants. This is especially true in situations where the participants have advanced further along in their NAM journey, and for those that have begun to adjust this approach and/or restructure their work and roles to adapt NAM to their organizational needs. Rogers (2003) notes this stage where adopters modify the innovation and may also adjust their own organizational structure to fit. Various factors influence and shape environmental policy, therefore, it should be stated here that NAM is one influential factor to consider among many for the environmental management and governance processes within these local contexts.

The actors involved perceive the NAM approach as being useful to assisting with a wide variety of socio-political issues; policy development and practical activities in relation to nature-based climate change adaptation and mitigation are frequently associated with NAM by the participants. Similarly, communication regarding nature-based topics in general appears to be an important strategy that the actors consider to be part of, or relevant to, their efforts in NAM. Governance actors may use a variety of avenues for communicating directly about the NAM approach, however, the findings of this research indicate that it is less typical for government-community discussion to be occurring directly about the NAM approach as it relates to collective decision-making

processes. Within the act of balancing needs, problems and solutions, Kooiman (1993) asserts that this “requires open channels, flexibility and mutual recognition of divided and complementary responsibilities” (p. 47). The relevant observation to be made here is that while the actors are engaged in a variety of NAM-related activities, the communication directly related to this ES approach currently appears to be considerably limited. The communication requires more specific intention toward identifying NAM as a collective process that influences decision-making; this is a necessary step to encourage discourse on NAM within the wider public realm to improve understanding of NAM in ways that embrace diverse experiences and additional views. Recently, the Canadian Standards Association (CSA Group, 2023) developed the *CSA W218:23*, which provides minimum requirements pertaining to natural asset inventories across Canada; this type of organization surrounding NAM is an important advancement for the public realm as well as for the social systems currently engaged in this ES practice. The need for community education and engagement specifically regarding NAM was noted by Atlantic Canadian governance actors (see chapter 4); Given that these types of actions were not typically reported by the participants to be occurring, it is vital for proponents of the NAM approach to initiate efforts that will advance community education and public engagement specifically in relation to the NAM approach and its potential impacts on climate action, community-based environmental monitoring, and ecosystem governance in Atlantic Canadian communities.

Acknowledgements of Funding

This research is supported in part by funding from the Social Sciences and Humanities Research Council (SSHRC). This research is also supported by funding from Dalhousie University through the Killam Foundation and the Nova Scotia Graduate Scholarship.

Declaration of Interest

The authors declare no competing interests that could impact the results of this research.

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CHAPTER 6: CONCLUSION & RECOMMENDATIONS

6.1 Introduction

This research explores themes surrounding the perspectives and experiences of governance actors engaged in Natural Asset Management (NAM) in Atlantic Canada; the results of this research provide insights from the participants related to their perceptions of this approach, as well as a deeper understanding of the communication channels and the climate policy and practices surrounding NAM. Climate risks and development pressures are significant factors that are influential in the decision for these local communities to adopt or become involved in NAM as an approach to ecosystem services; this activity may have important implications for decision-making surrounding development and ecosystem-based adaptation at both local and regional scales within areas where NAM has been adopted. In 2017, Vasseur et al. noted that the impacts of climate change, such as sea level rise, flood risks, storm surges, and erosion were expected to increase in their intensity across Atlantic Canada. Atlantic Canada is also expected to experience more demands on water supply and impacts to various industries due to drier conditions in summer (Vasseur, 2017). In their recent report, Dietz and Arnold (2021) warn that Atlantic Canada is experiencing threats to infrastructure from increased flooding, which is exacerbated by climate change, and poses risks to both coastal and overland areas. In addition to this, Natural Resources Canada (2024, May 21), note that 2023 was a record-breaking year for wildfires across the country, including the Atlantic provinces, with climate change being noted as a key factor in this issue. In addition to the climate risks posing threats to humans and ecosystems it is also important to consider the potential impacts of growth. The local government participants who participated in this research represent communities that have all experienced population increases since 2016; this growth places additional pressure on decision-makers regarding impacts to both development and the preservation of ecosystems. Given the risks posed to public safety, ecosystem health,

and infrastructure, it is vital to advance approaches that assist with climate resilience and ecologically sustainable development in Atlantic Canada. Ecosystem-based approaches, in addition to engineered methods, can help to lessen the burden of many climate issues by increasing the resilience of ecosystems and human communities. In relation to flood risks in the Atlantic provinces, Dietz and Arnold (2021) assert that “[alternative] approaches, though not yet broadly used, include the use of nature-based approaches to dissipate or slow down water before it affects an asset, as well as managed retreat and relocation” (p. 15). The participants interviewed in this research expressed strong support for the use of nature-based approaches to climate adaptation, often providing examples of their relevant efforts as they seek to protect and preserve ecosystems in their local areas and beyond.

The themes surrounding communication in this research are also relevant to findings from studies on other approaches to ecosystem services (ES) ; Scholars note communication issues as a factor that impedes progress on ES (Short et al., 2019; Nahlik et al. 2012; Kerr et al., 2021). Dietz and Arnold (2021) highlight the need for effective communication, public education, and outreach as being vital to the advancement of climate adaptation in Atlantic Canada. The general need to include diverse perspectives is a significant topic commonly noted in ES literature; This research highlights the desire for increased inclusion and improved communication surrounding NAM within several themes that arose from the interviews. The future of ecosystem governance and development in Atlantic Canada is likely to be influenced by NAM within the local jurisdictions who choose to adopt this approach; this research has shown that the influence of NAM is already creating some impacts within these local contexts. Despite being in early stages, NAM actors in Atlantic Canada have begun to integrate aspects of this approach within policy and practice.

6.2 General Outcomes of the Research

Objective 1 sought to describe the network structure and communication channels for NAM in the participating local governments. This research involved participants from eight jurisdictions across the Atlantic Provinces of NS, NB, PEI, and NFLD. During the course of the research, the data collection methods were adapted when an initial network survey obtained a low response rate, making the data unfeasible. Therefore, this research does not provide network mapping or an in-depth look at the complete structure of the local networks involved in NAM within these local contexts. Rather, the results showed that usage and familiarization with this conceptual framework does span across the boundaries of government departments into community organizations and non-government networks in Atlantic Canada. It was not feasible to gather quantitative data or a complete list of organizations involved in this approach, however, appendix 1 does provide a starting point for future researchers who may wish to conduct network analyses in this area. Based on snowball sampling that resulted in a list of 124 contacts, this revealed that the governance actors involved in NAM across Atlantic Canada may come from a wide variety of disciplines, sectors, and positions, however, participants were most often from disciplinary backgrounds or positions associated with conservation and/or roles with an environmental focus. Although governance actors did occasionally note communication with other levels of government about NAM, this was less common, and the actors involved in NAM were found to be predominately those at the local scale. The organization of NAM networks appear to currently be in the very early stages of formation within these local contexts and could often be described as being ad hoc in relation to specific projects and events, such as conferences.

The communication themes provided many insights into how the participants experienced and perceived communication in relation to NAM. A variety of communication channels were noted to be used in relation to NAM, such as interpersonal channels (e.g. in-person and virtual meetings, emails, conferences, etc.)

and mass media channels (e.g. news, internet, social media). The communication channels used by the participants were diverse when discussing nature in a general sense, however, direct communication activities specific to the NAM approach itself were typically more limited to certain avenues and groups. The communication behaviors (discussed in paper 2) revealed themes that show patterns in the interactions when discussing NAM. For example, direct discussion surrounding the NAM approach is more likely to take place between professionals, and the document analysis found that NAM terminology is more likely to be used in specific document types over others.

The themes on communication perspectives (found in paper 1) provide insight into why these communication behaviors may occur in lieu of direct communication on the NAM approach in certain instances; the identified issues include both structural and socio-cultural barriers that limit how governance actors are likely to communicate about NAM directly. For example, NAM terminology was noted by practitioners to assist them in communicating with other professionals across different fields, making this approach useful for breaking through barriers associated with siloes and interdisciplinary communication. Governance actors involved in or associated with NAM regularly attached the NAM term and approach to their previous, current, and future projects surrounding ecosystems and nature-based approaches. However, the NAM terminology was typically viewed as more complex to use in public communication.

The communication perspectives themes show the governance actors' desire to see an increase in more structured, strategic, and official communication surrounding NAM. This was juxtaposed with the finding that participants appear to be more often discussing nature-based topics relevant to NAM, rather than the NAM approach itself. Although the participants generally perceived communication surrounding nature-based topics to be relevant to NAM, it is less clear how common it is to directly discuss the NAM approach within collaborative projects and cross-organizational discourse surrounding ecosystems. While this discrepancy is apparent within interview responses, it is more easily discernible through the written documentation that the

participants associated with NAM. While using the NAM terminology is helpful for some, this research also notes that it may be off putting to some people as well; it could be argued that the flexibility that some NAM practitioners may hold around the use of terminology is beneficial for inclusion. For example, to address the inclusion of diverse perspectives, Managi et al. (2022) notes that the Nature's Contribution to People concept has been framed to promote the inclusion of diverse views, such as those of local and Indigenous Peoples, while also considering perspectives from the ES concept; this conceptual framework attempts to address diverse ways for understanding the benefits of nature. Approaches such as the Nature's Contribution to People (NCP) concept are important to consider for facilitating discussion surrounding philosophical differences with the aim of achieving common goals to preserve ecosystems. In their discussion of the NCP concept, Managi et al. (2022) asserts that integrating diverse values within decision-making is "critical for reversing the dangerous decline of nature" (p. 703). In general, the innovation of NAM is evolving within these local contexts of Atlantic Canada; as practitioners communicate and conceptualize how this approach may suit the needs of their organizations and communities. I assert that what matters most is to encourage opportunities for direct communication about NAM that also emphasizes an understanding for the various ecosystem-based adaptation approaches that exist within Atlantic Canada. Finding commonalities among the various EbA approaches is necessary to promote collaboration across diverse societal groups in Atlantic Canada and to facilitate the improvement of decision-making processes.

Objective 2 sought to explore experiences and perspectives of the participants. As the innovation of NAM unfolds across the Atlantic Provinces, this research shows that the participants perceive this approach as helpful to advancing their efforts to preserve ecosystems and promote nature-based solutions for addressing climate change. How participants define NAM and the activities they consider relevant to NAM may have important implications for how they choose to develop this approach further. For example, some actors may not view economic valuation as a necessary step to carry out

their NAM activities, while others may view economic valuation as a highly important step to advancing NAM in their local communities.

While it was prevalent for participants to hold positive perceptions toward NAM, concerns surrounding data accuracy, social inclusion, and logistical issues were also noted in relation to the NAM approach. The proclivity for the NAM practitioners to fully advance this approach is limited by caution surrounding how others may perceive and accept changes to the status quo, and the general capacity of the local communities involved. The mindset associated with 'natural assets' appears to be an influential factor in the perspectives of several governance actors, although a variety of pre-existing and coinciding factors would also contribute toward their advances to enhance and/or protect ecosystems. While some may view NAM as an umbrella term that encompasses a wide variety of ecosystem management activities, others may view this approach as a complimentary component nestled within their organization's overall approach to ecosystem management. In general, paper 1 outlines in detail the perceptions that the participants held in relation to NAM through the lens of Diffusion Theory (Rogers, 2003). Participants were highly likely to perceive the NAM approach as providing them with a relative advantage in their daily and future practices; it was also common for participants to find examples for how NAM was compatible with their existing practices. However, a number of tensions and concerns were raised within the perspectives themes as well. These outcomes provide opportunities to better understand the current experiences of governance actors associated with NAM in Atlantic Canada through a reflective lens that may assist in future conversations across diverse groups on this topic.

Finally, objective 3 sought to document how the local governance actors may be using NAM to advance climate change adaptation through policy and practice. The research themes (particularly in paper 2) revealed that participants associate NAM with nature-based practices and policy development that contribute toward climate action and ecological resilience within their local communities and beyond. Participants associated NAM with a wide range of their activities related to ecosystem management,

species and habitat conservation, ecological restoration, disaster risk reduction, NbS, BGI, and ES in general. The documents and interviews findings showed that participants regularly associated this term (NAM) with the various nature-based activities they engage in; NAM appears to have been influential toward policy changes within some local contexts in Atlantic Canada.

6.3 Recommendations for Atlantic Canadian governance actors

One of the key findings of this research was that participants hold a wide range of definitions for what NAM is and what this practice includes. As NAM practitioners seek to advance this approach, it is recommended that organizations develop their own definitions of NAM to clearly identify the meaning and intent of this practice as it relates to their own unique contexts. This act may benefit organizations and other public and private actors by providing increased clarity. Some organizations and communities have found (or may find) that they have very specific uses for NAM that they apply to certain classes of natural assets; this targeted approach appears to assist some practitioners and may be expanded upon later. Redefining an innovation is a stage that allows an organization to suit their needs; routinization may reduce the likelihood of later changes as an innovation becomes embedded in the structure of an organization (Rogers, 2003). Therefore, it is recommended that organizations redefine their concept of NAM during these early stages to increase the opportunity for flexibility within this approach at later stages.

Recall that governments and practitioners attempting to use different approaches to ES have found this to be a complex endeavor (see: Hysing, 2021; Tang Kai et al. 2022; Kerr et al. 2021). As NAM practitioners increase their understanding of this recent approach in Atlantic Canada, seeking to join or develop a community of practice for NAM is recommended to help assist one another. Communities of practice have been shown to effectively enhance skills and foster learning between practitioners in a variety of societal sectors, including in cases of ecological restoration; these

dynamics help to develop co-constructed knowledge and meaning surrounding the actions of groups (Dendoncker et al. 2018). An updated list of communities engaged in NAM across Atlantic Canada has been provided (see appendix 1). While participants generally found that NAM holds a relative advantage to their communities and organizations, some participants also expressed the desire to see caution applied to the NAM approach; it is recommended to encourage open discussion of any issues and concerns with NAM to help limit biases. Rogers (2003) notes the pro-innovation bias, where researchers assume that an innovation should be adopted rapidly, expecting that neither re-invention nor rejection should occur. During the course of the research, a few instances were found where it was apparent that NAM had been discontinued, with the reasons being cited due to staff turnover. In another case, NAM continued but through a different lens developed by the organization. It is suggested that organizations consider ways to adapt NAM to local contexts, while also keeping an open mind about other possible approaches to ecosystem services. Literature that explores diverse values surrounding the concept of 'ecosystem services' and the different methods for valuation (both monetary and non-monetary) are important to consider within organizational approaches to NAM (See: Arias-Arévalo et al., 2018; Ebner et al., 2022; Moller et al., 2004; Lele et al., 2013; Wurster & Artmann, 2014); much of this information surrounding values and pluralistic approaches would be useful and transferrable for communities who are attempting to integrate the NAM approach within their service delivery.

There is tremendous potential for NAM to assist with increasing the resiliency of Atlantic Canadian communities through its methods for enhancing ecosystem monitoring and ecosystem-based climate adaptation/mitigation. Participants generally showed very positive associations with this practice, but this praise should be also considered through the lens of their positions in society. NAM practitioners should seek to communicate as much as possible with diverse groups who may hold alternative views toward NAM. A range of shared perspectives provided by the results of this research help to identify some common tensions surrounding NAM; it is recommended

that practitioners use this information (found in chapters 4 and 5) to build upon in future problem-solving discussions that include groups that have not been heard from yet on this topic. Kooiman (2003) notes that in first-order governance as actors define problems, “at later stages, others may surface who have not yet expressed themselves, and measures can be taken to ensure that these ‘silent’ people also get involved in the defining process” (p. 140). This is an important stage that may therefore assist practitioners to improve the NAM approach within their local contexts (and could potentially lead to creating a local approach to ES that draws upon more diverse perspectives and values).

Some of the most significant findings of this research arose from several themes wherein the participants expressed a strong need for increased direction, education, communication, and engagement surrounding NAM. Exploring funding avenues to assist with developing a public communication strategy that organizations can use for NAM is strongly recommended. Given the capacity issues faced by local governments, it is also recommended that other levels of government and societal actors interested in NAM should seek opportunities to facilitate public discussion, learning, and collaboration surrounding this topic in Atlantic Canada. The Atlantic Infrastructure Management (AIM) Network provides opportunities to assist NAM practitioners in this area (see AIM, 2024; AIM, n.d.). While some local governments have been cross-referencing NAM data with locally collected data and community groups, this was not a frequent occurrence found in this research. It is therefore recommended that NAM practitioners, communities, and higher levels of government seek opportunities for these types of collaborations to occur.

6.4 Recommendations for Future Research

Future studies are recommended to direct a focus toward the perspectives from community groups and interested parties that are not included in this research. The methods used and responses to this research during the recruitment stage limited the diversity of perspectives shared; in particular, some viewpoints missing in this research

include those from the business and finance community, developers, First Nations and Indigenous communities, public works departments, academics, federal and provincial governments, and disaster prevention/response departments (e.g. fire departments). Due to the experiences described by participants, it may be useful for future research to explore how influential the 'natural asset' mindset may be for provoking change in land use decisions. The research themes show that the concept of NAM is having effects on the participants climate-related practices and policies and their communication behaviors surrounding ecosystem management. In a few situations, direct changes to decision-making and perceptions related to the protection of nature were linked to NAM by participants. The impacts of these effects have not been quantified here, as this research sought to better understand the experiences of participants in relation to NAM in a qualitative sense. Future research that quantifies different types of impacts would be useful for providing a better understanding of the progress of NAM in these Atlantic Canadian contexts over time.

6.5 Concluding Remarks

Natural asset management is a framework that promotes ecosystem services; this approach has recently reached Atlantic Canada and is unfolding and/or being engaged with as a practical approach in twenty-five local jurisdictions across four provinces. The results of this research provide insight into the experiences and perspectives of local governance actors associated to NAM within (at minimum) eight jurisdictions in Atlantic Canada. Documenting these early experiences with NAM may be useful to other practitioners involved in ES and/or in the NAM approach. For governance actors who are on the periphery of NAM, or not engaged in this practice, this work provides an opportunity to understand some of the common experiences and perspectives held in relation to NAM by the participants. These perspectives and insights are useful to those who seek to advance current and future discussions surrounding research, governance, and public engagement/ consultation in relation to NAM. In a broader sense, this

research is also useful to those who wish to explore the topic of NAM as it relates to ecosystem governance in general.

NAM is perceived by the participants as an approach that helps to enhance their current nature-based climate adaptation and mitigation activities. Future hopes held by the participants were also revealed in the thematic analysis, as the potential of NAM continues to be explored by practitioners. Actions relevant to biodiversity enhancement and Eco-DRR were also linked to NAM within these local contexts; this was most apparent in the actors' efforts to advance storm water management and blue-green infrastructure through projects and policy development. The further potential for NAM to be used for tracking changes to landscapes over time and across jurisdictional boundaries was commonly noted to be an important aspect of this approach; this was marked by the desire of participants to preserve and protect natural spaces through improved access to and use of data. A few participants also noted a desire for data standardization to assist with decision-making across geographic and political scales. As NAM data methods advance in these areas, the systematic aspects of asset management applied to natural features may have important implications for decision-making surrounding development at local and regional scales. Such activity will also assist communities with tracking climate-related losses and successes in relation to natural asset inventories. The participants value NAM as a tool to assist with land conservation, restoration, and planning; to realize the full potential of NAM in Atlantic Canada, however, this would require considerable organization across various societal groups and levels of government.

Like other approaches that promote ecosystem services, NAM comes with challenges, risks, and opportunities for the communities that choose to adopt this framework. The governance actors in these local contexts are in the early stages and have been moving forward with this approach, with varied accounts of self-reported progress. The communication themes highlighted by this research are perhaps the most significant because of their relevance to social inclusion in ecosystem governance. The presence of discussion regarding NAM across departments, sectors, and jurisdictions

was referenced in the statements of participants, showing that the diffusion of this innovation appears to be occurring in most⁷ of the local contexts explored. The limited aspects of the communication behaviors surrounding NAM found in these contexts are unsurprising given the early stages of NAM explored here; additionally, in relation to innovation Rogers (2003) notes that it is common for individuals to interact with others with whom they share similarities. Similar ecological goals held by NAM practitioners and community organizations (particularly ENGOs) appear to make it more typical for collaboration between these groups to occur. To advance these conversations further across society, it is important to reflect on the diversity of views shared regarding NAM. Increasing opportunities for open debate in the public realm would provide opportunities to consider alternative solutions to socio-political issues and/or adaptations to NAM. The tensions brought up by participants reveal that the NAM approach challenges the status quo of local governments and raises socio-cultural concerns. Accompanying these issues are also the highly positive associations held toward this approach and progress that participants reported linking NAM to nature-based climate adaptation; NAM can provoke motivation to organize and enhance existing efforts for the preservation of nature and community infrastructure. In closing, it is hoped that the findings and perspectives presented by this research will provide an opportunity for reflection and to stimulate further discussion about NAM between diverse groups across communities in Atlantic Canada.

⁷ In a few locations it was difficult to determine how or if discussion about NAM is continuing to happen across government departments; this especially true in situations where staff turnover has occurred or where predominantly one staff member is involved with NAM through their role.

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Appendix 1: Table of NAM Communities in Atlantic Canada

Table 2: Table of NAM Communities in Atlantic Canada

	Community Name	Population (2021)	Population change (%) 2016-2021	Settlement size	Sources confirming NAM activity
1	City of Dieppe, NB	28,114	10.8	Small city	City of Dieppe and KPMG, 2021
2	City of Edmundston, NB	16,437	-0.9	Small city	Eyquem et al., 2022
3	City of Fredericton, NB	63,113	7.5	Large city	Eyquem et al., 2022
4	City of Moncton, NB	79,470	10.5	Large city	Eyquem et al., 2022; NAI, 2023
5	City of Saint John, NB	69,895	3.4	Large city	NAI, 2023
6	Northwest Regional Service Commission, NB	n/a	n/a	n/a	Eyquem et al., 2022
7	Pointe-du-Chêne, NB	767	7.1	Rural	Eyquem et al., 2022; NAI, 2023
8	Southeast Regional Service Commission, NB	192,625	7.7	n/a	SERSC, 2024
9	Town of Florenceville-Bristol, NB	1,573	-1.9	Small town	Eyquem et al., 2022; NAI, 2023
10	Town of Riverview, NB	20,584	4.7	Small city	Eyquem et al., 2022; NAI, 2023
11	Town of Sackville, NB	6,099	14.4	Small town	Eyquem et al., 2022; NAI, 2023
12	Town of Saint-André, NB	1,794	-5.6	Small town	Eyquem et al., 2022

	Community Name	Population (2021)	Population change (%) 2016-2021	Settlement size	Sources confirming NAM activity
13	Ville de Saint-Quentin, NB	2,141	-2.4	Small town	Ville de Saint-Quentin, 2022; 2024
14	Town of Saint Andrews, NB	2,048	14.7	Small town	Eastern Charlotte Waterways & Town of Saint Andrews, 2019
15	Village of Drummond , NB	729	-1.1	Rural	Eyquem et al., 2022
*n/a	Village of Riverside-Albert, NB	348	-0.6	Rural	Eyquem et al., 2022; NAI, 2023; Government Representative
16	City of Saint John's , NFLD	212,579	2	CMA	Eyquem et al., 2022
17	Town of Logy Bay-Middle Cove-Outer Cove, NFLD	2364	6.4	Small town	Eyquem et al., 2022; NAI, 2023
18	Halifax Regional Municipality , NS	439,819	9.1	RGM	Eyquem et al., 2022; NAI, 2023
19	Municipality of the District of Lunenburg, NS	25,545	2.7	Rural	Eyquem et al., 2022; NAI, 2023
20	Municipality of the District of East Hants	22,892	2	Rural	NAI, 2024
21	Town of Mahone Bay, NS	1,064	2.7	Small town	Town of Mahone Bay (2020; 2022)
22	Town of New Glasgow, NS	9,471	4.4	Small town	Eyquem et al., 2022; NAI, 2023
23	City of Charlottetown, PEI	38, 809	7.5	Large city	Eyquem et al., 2022; NAI, 2023
24	Town of Stratford, PEI	10, 927	12.5	Small city	Eyquem et al., 2022; NAI, 2023

	Community Name	Population (2021)	Population change (%) 2016-2021	Settlement size	Sources confirming NAM activity
** 25/26	N/a	N/a	N/a	N/a	Two additional local governments were noted to be involved in NAM through interview sources.

Table Sources: Eyquem et al., 2022; Natural Assets Initiative, 2023; 2024; Town of Mahone Bay 2020; 2022; City of Dieppe and KPMG, 2021; Eastern Charlotte Waterways & Town of Saint Andrews, 2019; SERSC, 2024; Ville de Saint-Quentin, 2022; 2024.

Additional sources: Population Statistics accessed from: Statistics Canada, 2023; SERSC, 2022; Settlement sizes selected based on: Hodge and Gordon, 2014.

* This village was noted to have completed a natural asset inventory with NAI; a representative confirmed that they have since discontinued NAM (most likely due to staff turnover; the institutional memory appears to have been impacted in this case).

**Two additional local governments were identified as being involved in NAM, however, efforts to contact them directly and confirm their involvement through secondary sources were unsuccessful. Including these two potential communities, this would bring the number of NAM communities in Atlantic Canada up to 26. (This research provides an approximate number of 25).

Appendix 2: Document Analysis Table

Table 3: Document Analysis Table (Extended version)

Document Type	DOC #	Location	Author	NAM terms used (y/n)	Purpose/Description	Climate Actions (Policies/bylaws/programs) Interferences, interplays, interventions
Plan report	A2	PEI	Consultants and local government	Yes	Part of a climate action plan process; includes policy review, local consultation; Includes strong focus on natural assets inventory/mapping, risk assessments.	Emphasizes vision to include natural assets/infrastructure, asset management, risk reduction into planning -Links to 'food asset' map
Committee Report	B1	PEI	Town sustainability committee	Yes	Written to encourage improvements to urban forestry (protection and management), stating climate change as one of the driving factors.	-References examples of the NAM approach as potential method for managing urban forest -advocates for economic valuations of ecosystem services
Plan report	C5	NS	Local government	Yes	Background details for a community (Municipal) plan (in development phase). Linked to goals in the local climate change action plan. Mapping natural assets noted as part of the municipal climate strategy.	-Taking climate change into account in vision/priorities to shape future
Study report	C3	NS	ENGO	Yes	Wetland report (ecosystem services assessment). Prepared for a local government. Community participant notes they use these types of NAM initiatives to 'piggy back' off them in order to advance	Cross references local assessment with the NAM inventory data. -Provides condition assessments for wetlands

Document Type	DOC #	Location	Author	NAM terms used (y/n)	Purpose/Description	Climate Actions (Policies/bylaws/programs) Interferences, interplays, interventions
					collaborative wetland conservation work.	
Municipal Plan	D1	NFLD	Local government	Yes	Municipal plan. Includes official signatures.	-policy to preserve shorelines, watercourses, wetlands, and waterbodies and these associated wildlife and fish habitats -new goal to improve storm water management through hybrid NAM/engineered approaches (prioritizes natural drainage systems) -promoting protection and management of 'natural assets' in goals, policies, vision/mission; focused through the lens of municipal services
Study report	D3	NFLD	Consulting firm	Yes	Related to wetlands/watersheds. Prepared for local government. The report makes use of NAM terms right from the start and in other sections. The intro talks about how the town is linking this study information to their new municipal plan and development regulations.	Flood risk mapping and analysis conducted to provide rationale for local government's new policies and development regulations
Climate Plan	E1	NB	Environmental organization	Yes	Community-based climate adaptation plan, prepared for the municipality. Officially linked to a municipal plan (bylaw)	-Integrating climate change risks into asset management planning -recommends NAM approach

Document Type	DOC #	Location	Author	NAM terms used (y/n)	Purpose/Description	Climate Actions (Policies/bylaws/programs) Interferences, interplays, interventions
Climate Plan	H1	NB		Yes		<p>-policies to encourage climate adaptation practices using natural infrastructure, green spaces, and NbS/ES into development & design (considerations for storm water management)</p> <p>-contains economic valuation for specific natural assets (for storm water services)</p>
			Local and provincial government		Climate change adaptation plan (phase of action planning).	
Program materials	C1	NS		No	Residential tree planting announcement to give away 500 trees; linked to the local climate change action plan. Participant links these actions as being relevant to their NAM-related work in the interview	<p>-Provides details on the tree program (linked to the LCCAP goals).</p> <p>-Provides public with details on benefits to community well-being /ecosystem health</p>
			Local government			
Report	C4	NS		No	Tree planting event overview/ progress report: focus on tracking trees and invasive species management/ species diversity.	<p>-Discusses public communication about trees</p> <p>-Details on tree tracking system</p> <p>-progress on goals linked to the local climate change action plan.</p>
			Local government			
Program Materials	C2	NS		No	Food security project	-provides public with information to assist with
			Local government			

Document Type	DOC #	Location	Author	NAM terms used (y/n)	Purpose/Description	Climate Actions (Policies/bylaws/programs) Interferences, interplays, interventions
						networking for food security -invites public and targeted groups to fill out surveys to inform future action plan
Bylaw	H2	NB	Local government	No	Bylaw to establish requirements to include street tree planting in new developments; encourages canopy growth.	Development controls and requirements around tree planting for street trees
Program Materials	G1	NB	Local government	No	Tree planting program. Interviewee referenced this program as an important practice relevant to NAM.	* Informs public about the street tree planting program for businesses and residents (linked to beautification program goals)
Bylaw	A1	PEI	Local government	No	Tree permitting & protection (urban forestry); Encourages measures toward canopy growth, risk assessments for trees, tree preservation, and invasive species management.	-Development activities must comply with new bylaw to protect city owned and heritage trees -Preserves, protects and replaces protected trees -invasive species control across property lines (including private) -Requirements for tree risk assessments -Administered across five departments
Climate Plan	C6	NS	Local government	No	Local Climate Change Action Plan	-Actions for land and water conservation (land acquisition goals, conservation easements)

Document Type	DOC #	Location	Author	NAM terms used (y/n)	Purpose/Description	Climate Actions (Policies/bylaws/programs) Interferences, interplays, interventions
						-floodplain and flood risk mapping to integrate into zoning & land use
Regulations	D2	NFLD	Local government	No	Development regulations; includes amendments to protect coastal areas and other environmentally sensitive areas (noted in interview as related to NAM)	-Standards to enhance trails, green buffers, tree canopy, erosion control, shorelines -Protections for groundwater supply -New requirements for development permits associated with environmental zones (included flood risk areas)
Bylaw	E3	NB	Local government	No	Zoning. Interviewee links NAM as relevant to zoning changes here (green spaces/ environmental zones)	-New zoning to protect natural infrastructure, green spaces with development controls -Zoning in relation to sea level rise, coastal protection and development
Municipal Plan (Bylaw)	E2	NB	Local government	No	Municipal Plan (Bylaw). Includes official signatures. This document notes that it is officially linked to the community climate plan that preceded it (which does reference NAM as a strategy). Interviewee links this municipal plan and some of its policy changes as an example of NAM, particularly in relation to storm water management	-Policy to introduce new standards for flood and erosion control, shorelines (includes retaining vegetation, shorelines) -policy to consider nature-based solutions over hard engineering approaches when possible -Policy for risk-based asset management planning -Policy to encourage nature-based storm water management

Document Type	DOC #	Location	Author	NAM terms used (y/n)	Purpose/Description	Climate Actions (Policies/bylaws/programs) Interferences, interplays, interventions
Plan	J1	NB	Local government	No	Climate Change Adaptation Plan. Extensive use of the NAM terms and methods (tree inventory, service levels) in association with natural infrastructure, but without using the term "natural asset" specifically (terms used in a roundabout way, not included).	-Actions for tree maintenance and inspections (hazard reduction)

Appendix 3: Interview Guide & Questions

Summary of Content: For the interviews, participants were divided into two groups (Local Government and Community). While participants were asked similar questions that touched on certain themes related to NAM, some were phrased differently depending on which group the participant was from. Additionally, if a participant was less familiar with NAM, the interview guide contained options to re-phrase certain questions to meet the participant closer to their level of involvement/ experience with the NAM approach. The questions for the interview were created based on the objectives of the research. Ecosystem services literature was also reviewed prior to the interviews to gain a better understanding of some of the key issues that emerge when practitioners attempt to implement ES approaches (e.g. communication difficulties). While the ES literature was not used directly as a framework for the interview guide, reading these materials likely influenced some of the decisions surrounding the overall design of this research. While the research questions were in development, they were also searched to ensure that they touched upon topics relevant to Diffusion Theory (Rogers, 2003). For example, the questions ask participants about communication, collaboration, and the meaning of NAM; these questions help to illuminate both how the participants perceive NAM and how they are communicating with others about the NAM approach. Finally, the responses from participants about how they are engaging with others and conducting NAM are relevant specifically to the governance processes and climate change activities that they are performing in relation to NAM.

INTERVIEW GUIDE & QUESTIONS

Note: If they ask, when I say ‘natural assets’ I mean natural features on the landscape, anything from lakes, ponds, wetlands, coastlines, beaches, fields, forests, etc.

THEME 1: WHAT IS IT THAT HAS DRAWN THEM TOWARDS THIS MANAGEMENT APPROACH?

(Intro “grand tour question”)

1a. Can you describe what natural asset management is, in your own words?

Prompts: Is there anything that stands out to you that you think is particularly useful, or important for the community? How is this work needed? Why/ in what way? If not, why not?

Note: *If the participant is not yet doing tasks on NAM, but they have been recommended to interview, skip question 1b and go to question 2a. If they say they're involved directly, ask 1b too:*

1b. How did you come to be involved in natural asset management/ecosystem services? *-Prompt question: What was the municipality doing in relation to natural assets prior to being introduced to the new approach?*

Note: *If the interviewee is very far removed from the process, skip to question 2b and use alternative phrasing*

2a. Can you describe a bit to me what you understand about the natural asset management approach? *Prompt: In what ways might this approach be useful?*

Note: *Question 2b is for community interviewees only*

2b. After having a chance to look through the public report, can you describe to me what you understand about the natural asset management approach?

THEME 2: WHAT HAS THEIR EXPERIENCE BEEN LIKE WITH THE PROCESS SO FAR?

Note: *If they are in very early stages and the participant feels as though they are not really doing much work in this area yet, they might not be able to answer question 3, skip to question 4. If interviewee is external to municipality, skip to question 5.*

Note: *if question 3 is skipped, make sure to ask about policies in question 7.*

3. Can you describe what the process of natural asset management work has been like so far?

Prompt: Has there been any challenges or interesting moments so far? Have there been any practices, policies, etc. that have been adapted to align with this management approach? Is it (NAM) working?

Note: *Question 4 is better for participants who are still in very early stages/ less familiar with NAM*

4. What has the experience been like since the municipality became involved with natural asset management? *Prompt: Can you anticipate any potential challenges or opportunities? Has there been any exciting moments?*

Question 5 is for interviewees external to the local government

5. If you have been involved, can you describe what the experience of being involved with natural asset management has been like so far? *Prompts: Has there been any highlights or challenges that have come up? If there are challenges, ask if/how they've worked through them*

THEME 3: HOW IS THE LOCAL GOVERNMENT CURRENTLY CONSIDERING NAM WITHIN THE WORK AND DECISIONS?

Note: If they are in very early stages and have identified that they are not currently applying the NAM management approach yet, skip to question 7. If the interviewee is external to the municipality, skip to question 8.

6. Can you share details about how your department has been working on tasks related to Natural Asset Management? *Prompts: Have there been any tools that the department has been using to help with the process? Have the recent maps and GIS dashboards been used for any particular tasks or decisions?*

7. In what ways, if any, are existing approaches being adapted to consider natural asset management? *Prompts: Does your department have any decision-making or regulatory/development tools that are used/could be used to assist with this type of work? If yes, please describe. Are these methods working well? Are there any ways in which the process could be improved?*

Note to self: if they haven't mentioned policies yet, ask 'Have there been any policies, practices, etc., that have been adapted to align with the NAM approach?'

Note: Question 8 is for community interviewees only

8. From your perspective, can you describe how the natural assets are currently being managed in your community? *Prompt: Have you noticed any recent changes? Why do you think that is? Prompts: Are there any laws/land use decisions that have helped environmental goals? Any that have impeded them? Is there anything you can think of that might improve the management of natural assets?*

THEME 4: HOW ARE THEY COMMUNICATING AND COLLABORATING ON THE NATURAL ASSET MANAGEMENT?

Note: If they say no to question 9, skip to question 10.

9. Has your organization/department been collaborating with others on natural asset management? *(This could be people/groups within your department/organization/group or it could be external parties)*

If YES, Prompt: Can you tell me some more about those activities? What has that process been like?

10. If not, how might collaborating on natural asset management be useful? *Prompts: Are there any other departments or groups that would be useful to collaborate with? Why is that? Is there anything you can think of that impedes collaboration on NAM within your community?*

11. Has there been any stakeholder or public communication surrounding the natural asset management? *Prompt: If yes, Can you explain what has the experience been like so far, communicating internally and across groups about the natural asset management?*

Prompt for local governments: If not, are there any plans for upcoming stakeholder/community involvement in the topic of NAM ore related projects?

Prompt for community organizations: Is there anything that might improve communication about natural asset management?

THEME 5: WHAT ARE THE GOALS OF THE ORGANIZATION THAT ARE RELEVANT TO NATURAL ASSET MANAGEMENT?

Note: If the interviewee is a community participant, skip to question 13.

12. How might integrating the NAM approach into decisions assist the municipality with its sustainability goals? Prompts: this could be environmental goals or any types of sustainability goals? Any concerns with this approach?

Prompt: Has the municipality considered natural asset management in regard to climate change concerns? In what ways?

Community participants:

13. Are there any ways that you see this new management approach as being able to advance the goals of your organization? (Prompt: these goals could be environmental or any type). *Prompt: Any concerns with this approach?*

Closing Question:

14. Is there anything else that I missed that you'd like to mention that comes to mind?

Appendix 4: List Of Documents

Note: To help maintain the anonymity of participants, the following document titles have been adjusted to remove place names

Table 4: List of Documents Table

DOC #	Year Released	Title
A1	2021	Urban forestry tree permitting protection bylaw
A2	2023	Climate Action Plan: Phase 1 Discovery, final report
B1	2019	Protecting and Managing [the] Urban Forest
C5	2020	[Municipal] 2040 Plan
C3	2022	Conserving Canada's Wetlands: Wetland ecosystems protocol services assessment on five freshwater wetlands in the [municipality].
C6	2022	Local Climate Change Action Plan 2030
C1	2023	News Release: Municipality giving away 500 trees to residents
C4	2023	Tree Planting Event report 2023
C2	2023	News Release: Municipality launches food security project surveys
D1	2022	Municipal Plan 2021_ version 2022
D2	2022	[Municipal] Development regulations 2021
D3	2019	[Municipality's] Wetlands, waterways and waterbodies study
E1	2019	[Municipality's] community-based climate adaptation plan
E3	2022	Zoning bylaw
E2	2020/2021	Municipal Plan 2020: Bylaw
H1	2021	Climate Change Adaptation Plan: Phase 2 Adaptation Actions
H2	2020	Street trees bylaw
J1	2023	Climate Change Adaptation Plan
G1	n.d (accessed 2024)	Tree planting program

Appendix 5: Table of Affiliations

Table 5: Table of Participant Affiliations

Table 4 includes the broad affiliations of participants that have been quoted within the results. This is to provide more context to the audience in relation to the positionality associated with the voices that have been highlighted in this research.

Participant #	Broad Affiliation
0921	COMM/ENGO
0919	LG
1207	COMM (ENP)
1027	LG
1012	COMM (ENP)
1210	LG
1204	COMM (ENP)
1024	LG
0922	COMM (ENP)
0802	LG
0808	LG

Affiliation Categories:

LG= Local Government

COMM= Community

Additional community categories (non-government):

***ENGO**= environmental non-government organization

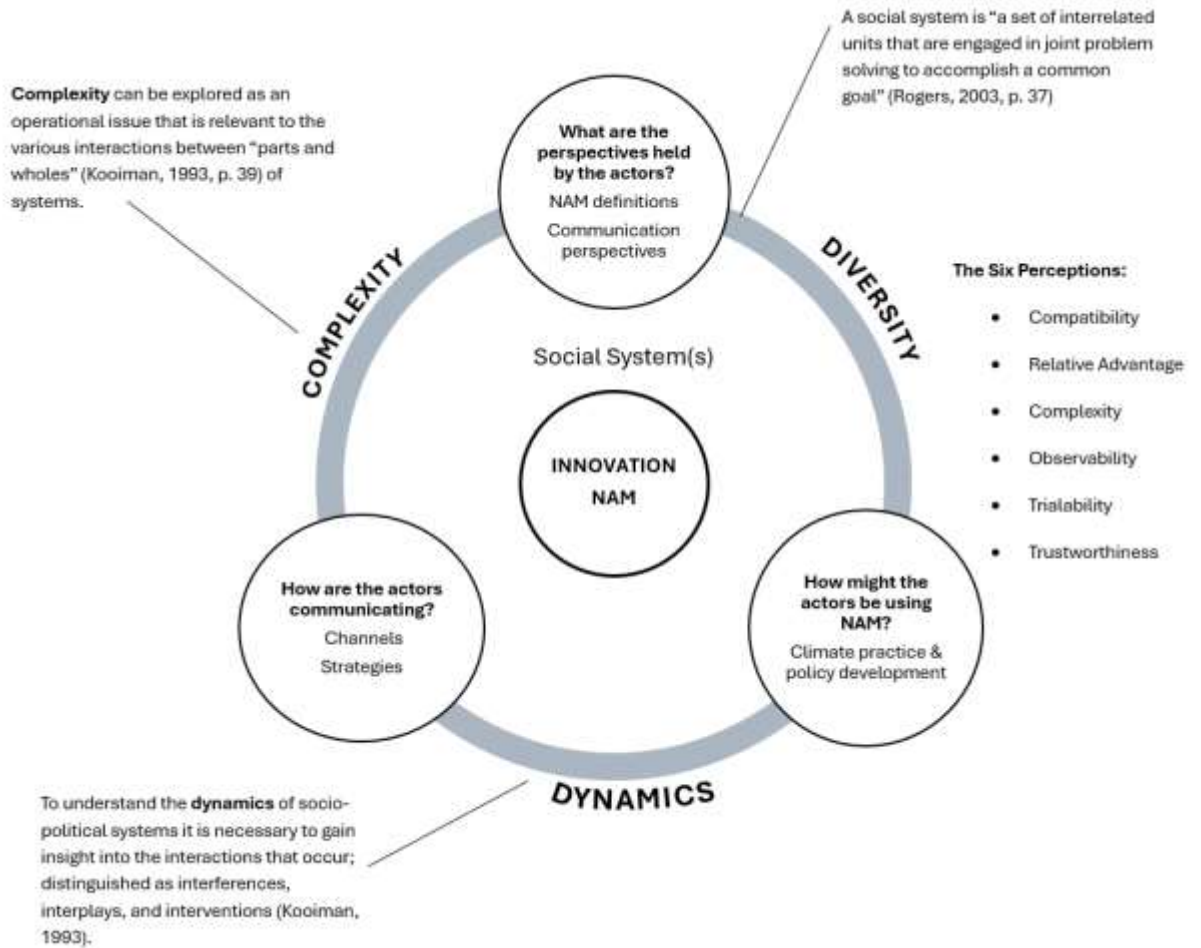
ENP= environmental non-profit organization

NGO= non-government organization

*Organizations whose core values/missions were specifically dedicated toward environmental protection/conservation and/or other ecological goals were classified here as environmental organizations.

Appendix 6: Theoretical Framework Visualization

Figure 2: Theoretical Framework Visualization



Appendix 7: Description of Themes

Table 6: Table of Themes

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
1	Deductive	Compatibility		Deductive code (one of the six perceptions in Diffusion Theory by Rogers). Stern (2018) describes this as " the new practice does not conflict with dominant social norms, personal norms, past experiences, or the needs of the adopter." Comments were coded generally here anytime participants made a statement that was relevant to NAM being either compatible or incompatible with their daily needs, practices, norms, etc.
1	Inductive	Tensions		Any comments made by participants that revealed areas of concern or issues with NAM that could potentially negatively impact the compatibility of this approach within their local context.
1	Inductive	Organization across communities		Comments where participants noted the need for cooperation at various levels and across boundaries to occur in order for the NAM approach to be effective.
1	Inductive		<i>Direction</i>	References where participants made statements relevant to direction, leadership, or governance surrounding NAM in general. The overall theme arose inductively.
1	Inductive		<i>Eyes on the ground level</i>	Statements where community participants discussed the need for community at the ground level making observations to inform decision-makers from a different perspective

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
1	Inductive		<i>Indigenous community inclusion</i>	This theme arose inductively while coding for perspectives on NAM. When participants were asked questions related to NAM, they would sometimes make statements about wanting to see more inclusion of Indigenous communities and First Nations.
1	Inductive	Complimentary aspects of NAM		Comments participants made that expressed ways that they perceive NAM as being complimentary to their current work practices.
1	Deductive	Complexity		Stern (2018) defines as "the new practice is not overly difficult to understand or implement." Statements where participants noted NAM in relation to its complexity were gathered under this code. Any statements specifically relevant to NAM tools were also collected here to provide more context.
1	Inductive	Finds NAM tools useful		Comments where participants noted that the NAM tools (e.g. inventory dashboards) they were using have been useful and helpful for them.
1	Inductive	Communication challenges		Comments where participants noted certain aspects of NAM being difficult to communicate to others, or where they noted struggles that impeded communication surrounding NAM
1	Inductive	NAM terminology		Comments where participants directly discussed the terminology associated with NAM
1	Inductive		<i>Implications of NAM terminology</i>	Comments where participants talk about the impacts (or potential effects) of natural asset language from their perspective.

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
1	Inductive	Difficulty understanding tools/approach		Comments where participants described having difficulties with using tools, economic valuation, and understanding the approach in general. This extended to comments where certain tools were not being used and where participants felt more comfortable with using their own in-house tools (such as GIS).
1	Deductive	Trialability		Stern (2018) describes trialability as "there is opportunity to experiment with the new practice on a trial basis at a low cost." While all participants who were involved with inventory projects would have had this opportunity, only a few participants made direct statements that were relevant to this category.
1	Deductive	Defining NAM		All phrases from the defining NAM question that relate to what participants describe NAM as being in their own words. Overarching category that includes themes about what NAM means to the participants, How do they define it, what they understand it to be, what they see it as including. Relevant to objective (2) for perspectives
1	Inductive	Addressing human needs focus		Statements where participants defined this approach through a specifically anthropocentric lens
1	Inductive	Caring for nature focus		Statements where participants defined this approach through a specific lens of stewardship and conservation
1	Inductive	Ecosystem focus		Statements where participants defined this approach through a lens of socio-ecological systems; their initial definitions identified both human and non-human needs in association with habitat, health, etc.

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
1	Deductive	Observability		Stern (2018) defines this as "there is opportunity to easily observe the results of the practice, either through demonstration or observing neighbours." Anytime participants made comments about observing or not having the chance to observe the impacts of NAM, statements were coded to this category.
1	Inductive	Unfamiliarity		Statements where they expressed that NAM was too new to them to really express strong perspectives and/or expressed a desire to learn more about it. Theme that arose inductively.
1	Deductive	Relative Advantage		Comments where participants noted NAM as having advantages over their previous or current practices. Stern (2018) defines this term as "the likely benefit of the new practice outweighs the costs and exceeds the value of current practices." Comments were coded more generally here as anytime participants made statements showing they perceived NAM to be an improvement or giving them a new advantage.
1	Inductive	Helpful to improve decision-making		Statements where participants expressed that they view NAM as being an approach that provides improvements to decision-making
1	Inductive	Helpful for advancement		Describes the NAM approach as being a way to advance their goals and efforts in positive ways
1	Inductive	Flexible Thinking		Phrases that came up during the perspectives analysis inductively. When speaking about or asked about NAM, participants began remarking on the need for greater flexibility and/or creativity in the way we think, view, and do things as a society.

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
1	Inductive		<i>The 'natural asset mindset'</i>	Inductive theme that came out of searching for perspectives. Relates to phrases when participants described this approach as a new way of thinking that assists in different ways. The title was derived from a participant who called it a 'natural asset mindset'
1	Inductive	<i>Communication successes</i>		Comments where participants noted advantages or advances with communicating in relation the management. Comments are in response to questions about NAM, and show areas where they perceive successes that are relevant to or in relation with NAM
1	Deductive	Trustworthiness		Statements where participants noted concerns or hesitancy regarding the NAM approach, often questioning how can we be certain of the data or approach. At times they would state things such as the need to apply caution. This theme also includes statements from government participants who note the need for ground truthing to fill data gaps
2	Deductive	Climate-related Policy		Phrases where the participants discussed NAM in association to climate related policy, law, regulations, (including plans). Relevant to objective 3.
2	Inductive	Climate-based policy		These phrases are about development and/or action in relation to climate policies and natural features

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
2	Inductive	Approaches in planning		Phrases where participant refers to various different types of municipal plans in relation to NAM. Could be existing plans, plans that are currently in review, or soon to be plan updates, that participants view as relevant to NAM or expect to adjust to integrate natural assets more specifically. The participants have linked the plans' relevance to climate change either directly in the statement or indirectly (e.g. mentions forest management plan after previously emphasizing the importance of managing forests for climate resilience). Includes statements in documents that refer to updated approaches within planning and management in relation to natural assets.
2	Inductive	Legal Mechanisms		Statements where participants discussed laws or legal mechanisms that are relevant to NAM (this could be existing legal measures that assist NAM through their perspective, or a desire to see new legal measures taken that they perceive as being helpful for the improve the management of natural assets). These statements are also relevant to and/or linked to climate adaptation or mitigation.
2	Inductive	Land conservation		Statements referring directly to land conservation targets and/or climate goals and policy tools/measures to achieve them. Responses are directly in relation to a question about NAM.

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
2	Inductive	Development controls (future development decisions)		Statements where participants note a desire to see (or are expecting to see) steps taken that will impact development decisions that the participant perceives will improve the management of natural assets. These statements refer to policy measures, such as new requirements for development, and include a climate focus. Includes both new and/or existing development controls noted in documents
2	Deductive	Climate-related Practice		Anything climate related in their practices that the participants associate with NAM. Relevant to objective 3
2	Inductive	Blue-green infrastructure		Practices noted by participants in relation to NAM that are adding to and/ or strengthening the vegetation in their areas. E.g: replanting activities. Comments where participants note activities occurring in relation to nature-based storm water management. Comments related to activities occurring to protect coastal areas mentioned in association with NAM.
2	Deductive	Community inclusion in NAM		Comments in association with NAM where participants noted community involvement. These activities are relevant to climate change adaptation/mitigation activities. Because diversity and inclusion is important to governance, I did ask direct questions to participants about who they were working with and to describe the activities they were doing together in relation to NAM.

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
2	Inductive	Collaboration		Statements directly about community-government collaboration regarding the natural features in general. Some direct examples of collaboration on NAM, including the statements that revealed the supporting role that community organizations provide.
2	Inductive		Tracking Activities	Activities where participants specifically noted tracking in relation to climate change in association with NAM (E.g. tracking CO2)
2	Inductive	Education		Statements directly about educational efforts relevant to the community surrounding NAM. Often these statements are regarding the natural features in general, with some being related to education for residents, and others being related to community organizations providing education and learning opportunities in relation to ecosystems AND/ or NAM. Some direct statements about of education on NAM were noted such as staff training and the desire to see more public education.
2	Deductive	Engagement		Statements relevant to engagement in relation to NAM. Most comments were relevant to general engagement about natural areas, rather than specific to NAM itself. Some statements include anticipated engagement on NAM in the future. In one of the interview questions I directly asked participants if any engagement was occurring in relation to NAM.
2	Inductive	Efforts to organize		Relevant to activities surrounding action planning, goal setting, tracking etc., in relation to working in a more organized manner across boundaries, communities, departments, etc.

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
2	Inductive	Managing for resiliency		Comments where participants note activities in relation to NAM that are specific to helping increase resiliency (e.g. invasive species management, food security, forest fire prevention, disaster reduction, etc.)
2	Inductive	Risk-based activities		Statements in interviews and documents that note specific activities being undertaken or planning to occur directly in relation to climate risk. This theme includes a wide range of activities that are relevant to eco-DRR.
2	Inductive	'Value' of natural assets		Various statements relevant to the 'value' or natural assets, which were related to economic valuation and/or non-monetary valuation or values in general (tree loss, equity consideration, caring about species, spiritual, cultural, intrinsic, etc.)
2	Deductive	Communication surrounding NAM		All references to communication in relation to NAM. Relevant to objective 1 (communication channels) and objective 2 (perspectives and experiences)
2	Deductive	Communication Channels		Avenues where participants specifically noted that communication on NAM has occurred/is occurring. Note that in some cases, this may be more relevant to the management of 'natural assets' in general, rather than the 'NAM' approach itself. Responses depend on how the participant defines NAM.
2	Inductive	Interpersonal Channels	Professional Networking streams	Descriptions where participants note communicating or information sharing about NAM through larger networks (example: special projects (includes emails and meetings), climate summits/conferences, funding applications

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
2	Inductive	Interpersonal Channels	Official Government Activities	Phrases where participants mention communication about NAM through official government activities (example: council meetings, engagement, etc)
2	Inductive	Interpersonal Channels	Community outreach	Phrases where participants describe sharing information or learning information from public sources (e.g. a newsletter sent out to residents, a public meeting, public education efforts, etc.). Sometimes directly relevant to NAM, but often related to natural features in general. Other examples include: educational signage, public meetings, community planting events
2	Inductive	Mass media	News media	Comments where participants specifically mentioned the news media in relation to NAM
2	Inductive	Mass media	Online sources	Where participant describe sharing, learning, or discussing information about NAM online. These included social media, online NAM reports, municipal websites, online courses
2	Inductive	Communication Strategies		Comments where participants noted strategies they are using to assist with communication in relation to NAM. These were not described by participants directly as 'strategies.' I interpreted them and described them as strategies because these were statements that described actions and communication behaviors they were taking in relation to NAM and were found to be re-occurring across several of the interviews. Government participants and community participants both made statements that were relevant to this theme (and the sub-themes).

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
2	Inductive		Delayed communication	Government participants would sometimes comment that no public communication, or very little public communication, was occurring specifically on NAM as a topic. These comments often circled around the early stages they are in (viewing it as too soon to communicate formally about this topic).
2	Inductive		Communication about 'specific natural assets' / features / Using projects as a specific avenue to communicate	Comments where participants noted specific projects and planning activities as an avenue to discuss the natural assets in general. (E.g. plans or projects specific to certain classes of natural features)
2	Deductive	Problem-solution space' of NAM		Overarching category used to organize the participant responses to the "why is NAM needed or not needed?" question. This phrase and concept is based on Kooiman's Governance Theory. Also inspired by the 'felt needs'/problems associated with DOI theory, merged together as one as was shown in Stern (2018). When participants respond to this question they described both the problems they are facing in their communities in reference to why they felt NAM is needed (or not needed) to help address those issues. Relevant to objective (2) for perspectives.
2	Inductive	Climate change concerns		Comments where participants note that they view NAM as a way to assist them with addressing climate change issues.
2	Inductive	Cultural Block/Shift		Comments where participants perceive inertia or a need to shift conventional ways and/or see NAM as shifting the way people view nature/ approaching nature

Results Paper	Code Type	Themes/Subthemes	Sub-codes	Description of Theme
2	Inductive	Financial concerns		Comments where participants note financial concerns that they perceive NAM as helping to address. This includes where they note this approach as having financial benefit in general (e.g. cost savings)
2	Inductive		Social benefits	Comments where participants see NAM as being useful toward or complimentary to addressing the needs of the public (e.g. public access to nature)
2	Inductive	Improved decision-making		Comments where participants noted that improved decision-making is needed surrounding natural areas and/or perceive NAM as being a way to assist or improve decision-making processes.
2	Inductive		Preservation of Ecosystems	Any comments referencing the need to strengthen, protect, or preservation ecosystems or components of ecosystems.
2	Inductive	Improved environmental management		Comments where participants see the management of natural areas as needing improvement and/or note their perceptions of NAM as a being a way to assist with improving the management of natural areas/features in their work/local areas
2	Inductive		Water management	Comments specifically referencing the need to consider the management of water more (drinking water protection, stormwater, watershed management)
2	Inductive	Rapid growth concerns		Statements where participants described concerns around rapid growth and development in their communities and perceive NAM as being an approach to help address this issue in terms of environmental sustainability.

End Notes

ⁱ **Graduate Theses on the topic of NAM released across Canada:**

Milligan, Z. E. E. (2019). *Enabling the Integration of Ecosystem Service-based Approaches into Planning Organizations: Municipal Natural Asset Management* (Master's thesis, University of Waterloo).

Mollame, L. (2021). *Advancing Municipal Natural Asset Management through Standardized Evaluation* (Master's thesis, University of Waterloo).

Pavsek, C. (2021). *Natural asset management and market-based conservation in Indigenous contexts*. (Master's Thesis, Simon Fraser University).

Sandhu, S. (2023). *Evaluating the Progress of Municipal Natural Asset Management through Monitoring & Evaluation* (Master's thesis, University of Waterloo).

Treger, Andrew (2019). *Approaching municipal natural asset management*. A Capstone submitted to the Faculty of Graduate Studies of The University of Manitoba.