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Towards SDG 6.6 and SDG 11: Exploring the Ecosystem Services Approach in water and watershed management in Canadian cities.

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Abstract

The 2005 Millennium Ecosystem Assessment, a global assessment of the world's ecosystems, found that 60% of global Ecosystem Services (ES) examined were being degraded or used unsustainably. Fast forward to 2022, the UNEP, UNFCCC and global leaders, are bringing attention to the triple planetary crisis – climate, pollution, and biodiversity loss. Noting that ecosystems support life on earth is cause for concern, more alarming however, is that current degradation rates further reduce available ecosystem services to combat the triple planetary crisis. Sustainable development has been instrumental in driving responses to protect ES at all scales. For water, SDG 6.6 targets the protection and restoration of water-related ecosystems and SDG 11 calls for sustainable cities and communities. This paper explores the Ecosystem Services Approach (ESA) to water and watershed management as a policy and planning strategy, to strengthen urban sustainability in an urban Canadian context. Findings from three Canadian studies are triangulated to explore water and watershed management and the use of the ESA to support SDG 6.6 in the context of SDG 11. These studies together reveal that sustainability and climate change planning are driving some improvements in water and watershed management, but it's not enough and not consistent across urban areas. It also revealed ecosystem services are neither a planning priority nor fully accounted for in land use decisions - a science-policy gap. A shift in environmental-ecological thinking and doing must occur, starting with a formal recognition of the Ecosystem Services Approach in urban planning. This would help to bridge the science-policy gap and foster multiscale (improved governance), and interdisciplinary (more inclusive), approaches to improve water sustainability.

Keywords: Ecosystem Services, Ecosystem Services Approach, Canadian Cities, SDG 6.6, SDG 11, water and watershed management, triple planetary crisis.

1.0. Introduction

According to UN Habitat (2016), since 1990, the world has seen an increased gathering of its population in urban areas. In absolute numbers, between 1990-2000 urban dwellers increased from a yearly average of 57 million to 77 million between 2010-2015 (UN Habitat, 2016, p.6). In 1990, 43 per cent (2.3 billion) of the world's population lived in urban areas, this number had grown to 54 per cent (4 billion) by 2015 (UN Habitat, 2016, p.6). For the rapidly growing cities, this signals an increased need to build and sustain adequate infrastructure and public services to support population growth. In addition, population projections to 2030 indicate the urban population of developing countries will triple in cities (Angel et al., 2011). This urban expansion implies intensive use of land and energy, increases in greenhouse gas emissions, and further alterations of ecological systems in cities (UNEP, 2007).

According to a recent IPCC report (2018, p. 6), human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels with warming levels projected to reach 1.5°C between 2030 and 2052 (ibid). Impacts currently observed around the world are droughts and heat waves, more intense hurricanes, sea level rise, and precipitation changes that negatively affect crops, water supplies, coastal cities, and oceans (IPCC, 2018). The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) have sounded the alarm on the rapid decline of nature and what it means for Agenda 2030 and the SDGs, meaning, the loss of biodiversity and ecosystem integrity undermine efforts on 80% of assessed SDGs targets. The COVID-19 pandemic is also a reminder of how closely tied we are to the natural world and the "disruption" taking place. Also disruptive is pollution tied to economic growth and its impact on natural systems, particularly water systems. Issues related to climate, nature and pollution is what the UNEP calls the triple planetary crisis (UNEP, 2022).

Managing the triple planetary crisis is a global challenge with cities at higher risk given resource demands and population growth. This study explores the Ecosystem Services Approach (ESA) in water management and planning in Canada's most urban centers and watersheds. The Ecosystem Services Approach can be used as a strategy to meet SDG 6.6 targets, the protection and restoration of water-related ecosystems, and SDG 11, sustainable cities, and communities. The Ecosystem Services Approach (ESA) offers numerous pathways to harness the power of nature to protect vital water supplies. In stormwater management, ecosystem services in the form of green infrastructure (e.g., green roofs, bioswales, urban gardens) support water absorption to minimize flooding and droughts. Ecosystem services support wastewater treatment as an alternative or supplement to conventional water treatment systems. The water purification process provided by aquatic and terrestrial ecosystems supply water for drinking, industry, recreation, and wildlife habitat (UN Water, 2022). Additionally, "resources embedded in wastewater, including valuable water, nutrients and organic carbon, can be used for ecosystem rejuvenation in appropriate circumstances, enhancing ecosystems services with major benefits for economies and societies" (UN Water, 2022, pg.1).

Findings from three ESA studies were triangulated to assess water management and the use of the ESA to support the protection of water and water-related ecosystems in urban centers in Canada. Study A reviewed the sustainability plans of 16 Canada cities, including advancements and challenges in urban water management as cities move towards sustainability (SDG 11). Study B and C examined the role of ESA in Canadian cities using survey research (study B) and in Ontario's most urban watersheds, using interview research (study C). The main question this study sought to answer was *"are Canadian cities and Ontario urban watersheds integrating the Ecosystem Services Approach to protect, conserve, and manage water resources to meet the goals of SDG 6.6 in the context of SDG 11?"* Additional questions that guided this study were "how are urban water managers protecting vital water resources?", "what ecosystem services can be leveraged by urban water managers to improve water management?", and "what are the opportunities to improve water management in urban centers and watersheds?".

2.0. Methodology

2.1. Data Collection

This study used a mixed methods approach using primary and secondary data collection methods. In study A, secondary research was used to evaluate the Sustainability Plans of 16 Canadian cities (Calgary, Charlottetown, Edmonton, Halifax, Iqaluit, Kitchener, Moncton, Montréal, Ottawa, Regina, Saint John (New Brunswick), Toronto, Vancouver, Victoria,

Whitehorse, Winnipeg, and Yellowknife). The primary document used to express a city's long-term growth and development and need for sustainability is the sustainability plan. It is often called the Integrated Community Sustainability Plan (ICSP) and formally defined as "any existing or new long-term plan, developed in consultation with community members, for the community to realize sustainability objectives it has for the environmental, cultural, social and economic dimensions of its identity" (Infrastructure Canada, 2006). Within these plans, water quality and quantity management strategies were reviewed.

In study B, primary data collection consisted of online surveys to city planners, managers and directors in the same 16 Canadian cities as study A. The survey explored a series of questions focused on ecosystem services in urban sustainability planning. The survey response rate was 19.5% (36 completed surveys). Each city completed at least one survey except for Iqaluit, Montréal, and Yellowknife. A total of 25 questions were asked, 24 multiple choice which included a placeholder for anecdotal feedback and 1 open-ended question. Questions were grouped into four categories on the role of ESA (1) in urban planning, (2) tools and methods, (3) in climate change and resilience planning, and (4) in governance and decision-making. Water management strategies were inferred based on survey findings and in conjunction with study A.

In study C, primary data was collected from semi-structured telephone interviews with Ontario watershed managers, called Conservation Authorities (CAs) in Ontario. The eight most urban watersheds or CAs were interviewed (Central Lake Ontario, Lake Simcoe, Toronto Region, Credit Valley, Halton, Grand River, Hamilton, and Niagara Peninsula). Ten questions in total were asked, questions ranged from (1) the importance of the ESA, (2) to knowledge of ESA, (3) ESA in land use planning and management, (4) ESA in climate change and resilience planning, and (5) ESA in local and regional planning. A semi-structured interview format was used to build additional dialogue into the responses. If specific responses required clarification or elaboration, the conversation was moved into that direction and reverted to the original line of questioning once a satisfactory response was received. Findings from this qualitative study provided evidence of issues and challenges in watershed management and collated with studies A and B.

2.2. Data Analysis

With attention to water and watershed management within the context of SDG 6.6 and SDG 11, this study employed methods triangulation to address the research question. Methods triangulation was used to combine qualitative and quantitative data to better understand ES in water and watershed management. Primary and secondary data collection methods were employed. Triangulation is typically used in monitoring and evaluation to confirm findings in one study with findings from other studies. It helps to validate different findings and perspectives in the same situation or phenomena and provide a more complete or comprehensive perspective (Nightingale, 2020).

Study A used a quantitative approach, scoring "water quality and quantity" approaches and initiatives outlined in the sustainability plan of each of the 16 cities out of 3. For this study, water quality and quantity is defined as *"the protection of watersheds to deliver safe and reliable drinking water, the collection and treatment of wastewater, water conservation, long-term sustainability to meet future water demands, innovation in water such as water saving technology, grey water reuse, improvement of water for recreational use, and the promotion of healthy aquatic ecosystems"*. A score of 3 indicated significant efforts towards the definition as outlined in sustainability plans, progressive, and innovative actions, as well as leadership. A score of 2 indicated some effort including defined goals, objectives, and targets. Finally, a score of 1

indicated early thinking or early stages of planning, and a score of 0 was assigned if plans were unclear or no stated direction or commitment.

Study B used an online survey approach, survey questions followed a linear approach, with each question leading to the next. Questions were grouped into four categories to support analysis and research objectives. Quantitative and qualitative research methods were used. Answers were analyzed using pie charts and bar graphs to observe trends and patterns. All questions offered a placeholder for anecdotal feedback, this was integrated with corresponding quantitative data as supporting or clarifying statements.

Study C used a semi-structured interview research approach. Interviews were recorded and later transcribed. The transcription was put into a table according to question and key ideas were extracted and sorted into similarities and differences. Interview responses were summarized or combined to connect related topics or issues. SWOT analysis (strengths, weaknesses, opportunities, and threats) was used to assess what was working, not working, and what could be improved at the watershed scale to enhance the functions, services, benefits, and values of ecosystems in Ontario's watersheds.

3.0. Results

3.1. Drivers for ecosystem services in urban water management

A major driver for cities to improve water management is sustainability. Sustainability can be driven by many factors such as water shortages, droughts, poor water quality, flooding, an increase demand for water, growing built infrastructure, the loss of important watershed features such as wetlands and forests due to urban population growth. Many of these impacts are associated with the climate crisis, but they are also due the "triple planetary crisis". Issues of 'pollution' and 'biodiversity loss' also have direct impacts on water quality and availability.

3.1.1. Enhanced stormwater management

Green infrastructure is one approach to stormwater management in urban areas. It's an adaptable term used to describe an array of products, technologies, and practices that use natural systems – or engineered systems that mimic natural processes – to enhance overall environmental quality and provide utility services (US EPA, 2018). It's becoming more common for cities to build resilience into infrastructure planning. Infiltration-based practices such as green streets, open space and bioswales, help to lower flood risks and replenish groundwater reserves (U.S. EPA, 2018). Living shorelines, wetlands and dunes help to reduce coastal erosion and storm impacts (U.S. EPA, 2018).

The city of Victoria had the most comprehensive green infrastructure plans, they sought opportunities to promote ecosystem management by enhancing and restoring terrestrial and aquatic habitats, enhancing the urban forest, and showcasing green infrastructure along greenways (City of Victoria, 2016). Urban forest for example, is managed as green infrastructure to enhance ecological services such as rainwater treatment, carbon sequestration, air purification and the maintenance of biodiversity. Plan policies recognized the ecological benefits of green infrastructure in climate change mitigation and adaptation.

Many cities such as Edmonton, Calgary and Toronto used Low Impact Development (LID), a green infrastructure approach used in stormwater management and land development. LID

emphasizes conservation and the use of natural features with engineered controls to mimic pre-development hydrology (TRCA, 2019). The goal of LID is to manage stormwater in a manner that helps prevent harm to natural aquatic systems from commercial, residential, and industrial development sites (UNEP 2002a). It also helps to avoid flash flooding, encourage rainwater infiltration for aquifer replenishment (UNEP 2002a). LID supports one of the Melbourne Principles of Sustainability, building on the characteristics of ecosystems in the development and nurturing of healthy and sustainable cities.

In Halifax, naturalized stormwater retention ponds and bioswales are the preferred approaches for stormwater management. In Montréal, green infrastructure helps to support the flow of water from gutters and spouts to permeable surfaces. In the National Capital Region plan, permeable surfaces were being integrated into new developments and bioswales were used to filter run-off and retention ponds helped to promote water infiltration and groundwater recharge (City of Ottawa, 2012).

3.1.2. Water quality and supply

Safe, clean and a consistent supply of drinking water in an urban environment requires the protection and management of watersheds to provide that service, wastewater treatment, water conservation which can include grey water treatment and reuse and the promotion of health aquatic systems. Vancouver leads in this category, exceeding the *water quality and quantity* definition provided above, to also include real time water quality monitoring for early detection of contaminants. They lead in advocacy, such as an integrated rainwater management plan for infiltration and rainwater capture, a zero-waste target on bottled water use, incentive and rebate programs, policy and regulations for metering, lawn sprinkling and building code revisions, audits on industrial, institutional and commercial water-use (City of Vancouver, 2012). They also promote the use of water-saving technology through incentives and retrofit programs to improve water efficiency in homes and businesses.

The National Capital Region focused on water conservation and urban watershed resilience through rain barrels, directing downspouts to planted areas, and planting rain gardens (City of Ottawa, 2012). Edmonton had a very comprehensive plan for water, situating it as part of a healthy broader ecosystem. Their plan to manage water was addressed through specific challenges such as reducing contaminant loadings from industry and stormwater runoff. Drought conditions, water conservation efforts and watershed management were given priority as Edmonton has one source for its water needs, the North Saskatchewan River. The Toronto Region Conservation Authority (TRCA) Living City Plan provided significant support for water and stormwater management, such as low impact development, on-site wastewater treatment technologies and green infrastructure.

3.1.3. Greenspace to enhance ecosystem services and water management

Grey to Green (G2G) Best Management Practices (BMP) such as tree plantings, greening streets, eco-roofs, re-vegetation, or the purchase of land for green space is becoming a priority for many cities, as they explore more climate resilience pathways. Greenspace offers many ecosystem services that support water management. Soils help to absorb rainfall, providing natural water filtration and replenishes aquifers. Soils support the stabilization of trees by anchoring complex root structures allowing for water uptake to support their growth.

The Vancouver plan outlined a clear vision for integrating green space. All residents to live within a five-minute walk to a park, greenway or other green space and 150,000 new trees to be planted

to enhance Vancouver's urban forest, increase wildlife habitat, decrease stormwater runoff, and increase food production. Edmonton's comprehensive plan aimed at preserving its natural heritage for residents to enjoy and experience a strong connection with nature. City strategies include growing their knowledge of ecosystems and ecosystem services upon which the city depends. This includes strategic actions such as an Urban Parks Management Plan, Natural Connections Strategic Plan, Biodiversity Plan, Urban Forests Management Plan and several others. The overall health of Edmonton's ecological network drives many initiatives. Toronto has a green space system made up of parks and open spaces, the natural heritage system and a variety of privately managed but publicly accessible spaces. The Toronto Living City plan documented specific strategies for maximizing the value of greenspace and creating complete communities that integrate nature into the built environment. Halifax's *Greenbelting: Building an Open Space Network* strategy secures public or privately-owned undeveloped land or water to be preserved for agricultural, forest, community form, ecological, historical, public safety, or recreational purposes (HRM, 2014). Victoria's plan to *Protect Regional Green and Blue Spaces* established policies to protect designated green (terrestrial) and blue (aquatic/marine) environments. This is similar to the Ontario Greenbelt plan.

3.1.4. Urban watershed management

In Ontario, thirty-six Conservation Authorities (CAs) manage the many watersheds of the province. In this study, the most urbanized watersheds were interviewed to determine the extent to which ecosystem services were prioritized at the watershed scale. There was general agreement that one of the basic functions of Conservation Authorities is the management of ecosystem services is to protect watershed health. CAs identified Ecosystem Services Knowledge (ESK) in understanding the hydrogeology and hydrology of the watershed, stream flow and event response, such as when to hold back water to minimize floods (in CAs with dams). They also explained that the role of ESK is helping to understand wastewater treatment, dilution, and assimilative capacity to support river health.

3.1.5. Climate Change

City officials across Canada (via survey) and Conservation Authorities (via interviews) found that climate change and resilience planning significantly increased the need for greening of cities. With climate change exacerbating ecosystem degradation (IPCC, 2007) and triggering disasters like flooding and reducing resilience (e.g., eroding coastal ecosystems and their protection capacity) (Munang, 2013). Ecosystem services support adaptation and disaster risk reduction in areas such as climate and water regulation, protection from natural hazards such as floods and avalanches, water and air purification, disease, and pest regulation (Munang, 2013). Climate change can also reduce carbon sequestration, thus turning ecosystems from carbon sinks to sources (Munang 2013). Anthropogenic climate change has elevated the importance and value of ecosystem services.

More than 80% of survey respondents agreed that climate change and resilience planning had either significantly or somewhat increased the need to understand and enhance ecosystem services in city planning and management. Extreme weather events caused by climate change have triggered flood management initiatives, including increased green infrastructure to absorb rainfall. Most respondents agreed that ecosystem services were an important consideration in selecting specific green infrastructure or Low Impact Development (LID) initiatives, and most used LID to manage city storm and flood water.

4.0. Challenges

4.1. Urbanization

CAs were asked about the challenges in managing ecosystem services as watersheds become increasingly urbanized. Almost all CAs identified issues with surface imperviousness associated with urbanization and the resultant flooding as a major concern. Surface imperviousness is also affecting ground water recharge, a pertinent function for maintaining drinking water supplies. Associated with this is chlorine-laden road run-off from road salting, industrial and commercial pollutants that contaminate surface and subsurface water systems.

One CA indicated that the full benefits of ecosystem services were not being considered by municipalities when integrating Low Impact Developments and other green infrastructure. CAs discussed the land use intensification mandate provided by the Provincial Policy Statement and policy documents such as the Growth Plan for the Greater Golden Horseshow and the Metrolinx Regional Transportation Plan for the Greater Toronto and Hamilton area, as contributing to increased land costs. This has impacted the land acquisition strategies of CAs to protect natural spaces in their watersheds. With the high cost of land and developers wanting to develop every inch of developable land, watershed ecosystem services can be compromised.

4.2. Policies and Politics

In Ontario, water quality can be a shared function between the CAs and other levels of government. While ecological and hydrological functions are commonly used in key policy documents, in studies such as Environmental Impact Studies, ecosystem services are not always integrated in practice. CAs work alongside developers, consultants and municipalities to provide watershed and sub-watershed data to support land use decisions. They comment on development plans, environmental impact studies, policies and amendments to official plan policies, natural hazard policies and regulations and issue permits for works within the watershed. Despite this progress, the consensus across all CAs is that policies ultimately dictate land-use, and policies do not make ecosystem services explicit. Decision makers understand provisioning services but may not understand how their decisions impact nature's regulating, supporting and cultural watershed services.

One CA provided an example where policy clarity limits the protection of natural features due to the lack of specificity in policies to make clear the value and importance of natural features in an area slated for development, when contested by development interest groups, the decision was skewed toward development. Another CA which is largely agricultural due to the region's wineries and grape sector, referenced the influence of grape growers who have a strong political voice in greenbelt planning. With ecosystem services not strongly referenced and detailed in plans, communicating to politicians, developers and the public about ecosystem services is a challenge identified by some CAs. CAs continue to make significant progress in the planning, management and maintenance of watershed health and integrity, by communicating their scientific knowledge, experience and detailed knowledge of ecosystem services and functions within their watersheds. However, all CAs agreed that watershed ecosystem services and functions continue to decline due to the strength of competing actors, forces, and factors.

4.3. Lack of rigor in planning

The sustainability plans of some of Canada's largest cities revealed a lack of rigor in water management. For example, the Regina plan did not address water as a specific priority as other leading plans. Water management was referenced throughout the plan such as reducing demands for potable water and reducing and diverting stormwater but no specific plans or targets for how that will be accomplished was provided. Victoria's sustainability framework highlighted the importance of potable water, rainwater and maintaining healthy aquatic systems, but their plan lacked clear direction on how they would achieve those priorities. More remote cities like Whitehorse had clear goals and targets for stormwater management and consumption but lacked a more rigid framework for overall water management. Iqaluit identified many challenges with drinking water contamination and wastewater treatment and their five-year municipal plan hoped to improve these areas to ensure safe water delivery and security in the north. The Yellowknife and Charlottetown plans lacked sufficient detail to adequately assess their water quality and quantity efforts.

5.0. Discussion

5.1. The Ecosystem Services Approach as one approach to integrated water management

The "Ecosystem Services Approach" is synonymous with sustainability, providing a holistic or systems way of thinking about the linkages between the environment and other parts of the system (Imagine Calgary, 2007). Ecosystem services uncover the complex relationships between nature and humans, offering an integrated approach to manage land, water and living resources to promote conservation and sustainable use in an equitable way (CBD Secretariat, 2000; Beaumont, 2017).

Ecosystem such as forest, wetlands and grasslands are a critical part of the global water cycle. All freshwater ultimately depends on the continued healthy functioning of ecosystems and recognizing the water cycle as a biophysical process is essential to achieving sustainable water management (UN Water, 2022). Ecosystems mitigate the effects of floods and drought and ecosystem services support wastewater treatment. The water purification process provided by aquatic and terrestrial ecosystems supplies water suitable for drinking, industry, recreation, and wildlife habitat. The resources embedded in wastewater, including valuable water, nutrients and organic carbon, rejuvenating ecosystems and enhancing ecosystems services with major benefits for economies and societies (UN Water 2022).

In working towards SDG 6.6, "by 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes", the Ecosystem Services Approach can help decision-makers see water not as a single entity but as a system with many connected parts. Changes in one part of the system can impact the flow of services and benefits received in other parts of the system. With population growth, urbanization and competing demands land and water putting additional stress on our natural resources, this is particularly important for urban areas and for current and future water management.

In Canada, there have been several studies on Canada's natural capital values and benefits at regional and local scales, with cities such as Vancouver, Toronto and Edmonton leading in measuring ecosystem services and applying the ecosystem services approach. Despite the progress of some Canadian cities, there is no national or provincial strategy driving the adoption of the ecosystem services approach. The Canadian government has a voluntary multilateral

agreement with the Intergovernmental Platform of Biodiversity and Ecosystem Services (IPBES) to help bridge the science-policy gap, but these efforts still appear to be exploratory. Canadian cities, however, are lagging behind leading global cities in their efforts to achieve urban sustainability using the ecosystem services approach.

5.2. Comprehensive planning

With cities deferring to the short and long terms strategies defined by their Sustainability Plans, water management that prioritizes the following but not limited to: the protection of watersheds to deliver safe and reliable drinking water, green infrastructure to filter and absorb rainwater, pivoting from grey to green spaces, the collection and treatment of wastewater, water conservation, innovation in water such as water saving technology, grey water reuse, improvement of water for recreational use, and the promotion of healthy aquatic ecosystems must be a priority for cities.

The literature review of Sustainability Plans of cities found that among comparable cities in size and population, there is a lack of consistency across water management strategies. The most innovative cities are integrating circular systems that conserve water such as grey water reuse or optimizing water management by reducing the use of drinking water for irrigation and integrating xeriscaping particularly in water stressed areas. Stormwater management planning strategies were evident across cities, but a variety of approaches are required such as low impact development, on-site wastewater treatment technologies and green infrastructure. Water management at all scales can be improved from urban resiliency efforts using rain barrels, directing downspouts to planted areas, and planting rain gardens to the watershed scale, where management strategies focus on conserving and protecting natural features for ensure long term water security.

5.3. Better governance and comprehensive policies

One of the main findings from the watershed study in Ontario with Conservation Authorities was that policies dictate activities and actions to support watershed health and security. An issue evident across all watersheds was that the ecosystem services approach is not widely adopted across all scales, therefore not reflected across policies. According to one CA, if it does not get measured, it does not get managed. For watershed management, this means that many of the co-benefits found in ecosystem services is not accounted therefore may not get protected. This lack of accountability for ecosystem services has led to its omissions in many policies. Since watershed management in Ontario is governed at the provincial, municipal and watershed scale, policies on ecosystem services need to be consistent and integrated across all scales.

Rapid land use changes (conflicting issues mentioned include, *inter alia,* development, intensification, infrastructure, greenfield development, fragmentation of natural areas, stormwater, flooding, and changes in rural agriculture) present further complexity in watershed management, and further restricts the ability of the watershed to provide vital ecosystem services and functions. Collecting land use changes that integrates ecosystem service changes in both biophysical and monetary terms, can help to better inform sub-watershed form, function, and interconnections from baseline conditions to current or future states. Building this into policies and governance process can be helpful in protecting and conserving watersheds at local and regional scales.

6.0. Conclusion

Urban water management has shown significant progress overtime, particularly with the integration of river basin inspired management approaches such as Integrated Water Resource

Management (IWRM) or Integrated Water Resources Allocation and Management (IWRAM). The sustainability plans of cities also serve to guide best management practices in water management as was evidence is some of Canada's largest cities such as Vancouver and Calgary. As cities tackle the triple planetary crisis, understanding nature services, its flows, benefits, and values is ever more important and necessary not only for the environment, but also for the economy and society. There is a gap, the ESA is not rigorously applied in sustainability planning and policy across all Canadian cities and watersheds studied. This gap has resulted in ecosystem services being left out, hence the rapid degradation of ecosystem observed across the globe. A shift in environmental-ecological thinking and doing has to occur, starting with a formal recognition of the Ecosystem Services Approach (ESA) in city planning. By doing so, cities can harness not only ecosystem services that support clean and consistent water supply but a host of other services to support a healthy and sustainable planet.

Integrating the ESA will help cities bridge the science-policy gap and support multiscale and interdisciplinary approaches, to allow for ES in policy and planning decisions. The challenges that hinder wider adoption of the ecosystem services approach are possible to overcome. We saw that many cities are already moving in the right direction working towards a variety of water management strategies in conservation, protection, innovation at the local and river basin scale. Sustainability plans, comprehensive and inclusive governance and policies are some of the ways to better integrate the Ecosystem Services Approach to ensure long-term water sustainability.

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