Embracing the Role of Landscape Architects in Climate Change Mitigation: Insights from Conversations across Asia

text and interviews by
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The urgency of climate change confronts our world as a paramount challenge. With approximately 40% of energy-related carbon dioxide (CO_2) emissions attributed to infrastructure, buildings, and construction[1], the need for action is undeniable. In this context, landscape architects, situated at the crossroads of creative thinking and scientific knowledge, uniquely possess the capacity to address society’s imperatives without exceeding the planet’s ecological thresholds.

In 2020, a coalition of landscape architecture firms in Singapore united with fellow planners, architects, and aligned organizations in declaring a climate emergency[2]. This collective commitment extends to proactive measures, including acknowledging natural environments for carbon sequestration, advocating for the adoption of low embodied carbon materials, and embracing the principles of regenerative design. Nonetheless, the efficacy of nature-based climate solutions is challenged by knowledge gaps in urban biogeochemistry and a dearth of comprehensive appraisals regarding the role of green infrastructure within urban ecosystems.

This article encapsulates dialogues with three scholars, all actively engrossed in combating climate change through the integration of urban green spaces in Singapore, Korea, and Hong Kong. Through synthesis of their perspectives, this article underscores the critical role landscape architects play in tackling climate change within urban landscapes.

Q1. In practical and academic domains, a key challenge is the absence of a singular platform that adequately measures and assesses the role of urban green spaces in mitigating and adapting climate change. While environmental designers perceive these spaces as influential in curbing air pollution and countering urban heat, scientists often voice concerns over limited frameworks to comprehend their biophysical efficacy. These disparities might arise from knowledge gaps or a lack of cross-disciplinary insights. Considering your research, could you highlight the specific knowledge, or information that designers should acquire to tackle this issue?

Velasco: Urban green spaces, pivotal in climate change adaptation, often rely on benefits observed in natural ecosystems, overlooking the altered conditions of urban trees and plants within built environments when assessing their role in climate change mitigation. Assessments on carbon sequestration typically use forest-based equations, overlooking turfgrass and soil carbon contributions. Much of the carbon uptaken returns into the air through soil respiration, and only a small fraction enters long-term storage, subject to potential loss through leaching, which may end up in drainage systems[3]. Depending on the intensity of anthropogenic emissions and extent of green spaces and trees characteristics, studies reveal that urban vegetation can offset a small fraction of CO_2 emissions, and this is reliant on management of gardening waste, and incineration processes that can nullify carbon gains[4 5 6].

Skyrise greenery may require intensive maintenance and irrigation, involve increased energy consumption, and higher indirect CO_2 emissions. Furthermore, plant accommodation modifications in building design produce indirect CO_2 emissions since more concrete and cement are required, resulting in additional emissions. While urban vegetation may offset some CO_2 emissions, soil respiration and maintenance-related indirect emissions pose challenges, therefore understanding its limitations for climate mitigation is crucial. While plants filter pollutants, empirical evidence on their consistent service needs to be further developed[7]. Instead, they can enhance the thermal environment, if they are well-planned to consider their impact on microclimates and airflow in diverse urban settings[8]. Urban designers should acknowledge these limitations while recognizing the potential of urban greenery in enhancing thermal comfort.

Chon: Historically, landscape architects gathered data on urban thermal environments for planning and design, whereas the understanding of climate change mechanisms was in the realm of climate scientists. Spatial techniques like Geographic Information Systems (GIS) have been utilized by most landscape architects to analyze thermal vulnerability or propose land cover alterations, banking on the belief that green spaces can affect temperatures. However, this method lacks the biophysical understanding of how green spaces mitigate heat. In recent times, advanced models like ENVI-met, rooted in computation fluid dynamics and thermodynamics, have gained prominence in landscape architecture[9]. ENVI-met allows analysis of urban green spaces' heat mitigation capabilities by simulating ecological processes and microclimate mechanisms[10]. Its system includes soil models, vegetation, and artificial ground, aiding in understanding heat reduction mechanisms and facilitating the application of green infrastructure in research and practice[11] [12].

Jim: This issue highlights the persistent gap between scientific research and practical application. Scientific studies have produced a wealth of findings applicable across various urban and green space factors, encompassing climatic zones, city characteristics, venue types, vegetation attributes, and more, impacting cooling services and effects. However, the complexity of these variables, their temporal variations, and conflicting study outcomes pose challenges for climate scientists, let alone practitioners in other fields[13]. The knowledge is dispersed across numerous academic papers and reports, necessitating a cohesive and accessible synthesis for non-specialists.

It's crucial to translate this extensive research into understandable language and actionable guidelines for landscape practitioners. Collaboration between science and practice is pivotal for knowledge synthesis, translation, and application. Landscape designers, while having access to this knowledge, might require support in comprehending and utilizing scientific findings effectively. To bridge this gap, designers need to enhance their understanding of scientific concepts, fostering better communication with scientists. Simultaneously, scientists should grasp landscape design needs, facilitating the adaptation of research findings into tailored applications for climate change mitigation. Collaborative efforts and improved communication between these domains are imperative to address this challenge effectively.

Q2. Landscape architecture has been incorporated in the implementation of green infrastructure on larger scales, especially in landscape planning. Nonetheless, the responsibility for these endeavors has conventionally rested with engineers, developers, and urban planners. As we find ourselves in an era where green infrastructure stands as a fundamental facet of urban development, what obstacles and prospects should landscape researchers and planners bear in mind to ensure that they remain integral participants in this era of carbon-conscious initiatives?

Velasco: Landscape architects need to consider the limitations of urban vegetation in mitigating CO_2 emissions due to its limited coverage relative to the magnitude of anthropogenic emissions. Understanding the spatial and temporal scales at which urban greenery operates is crucial for its effectiveness in benefiting the local and regional environment. While vegetation at larger scales offers various benefits, some, like air purification and carbon offsetting, requires reforestation initiatives beyond city limits. Carefully planned strategies are necessary to ensure the long-term survival of trees in such large-scale reforestation efforts. Rather than relying solely on urban greenery for climate change mitigation, landscape architects should focus on its adaptation benefits. They must avoid overstating its capacity to clean the air and offset emissions, recognizing that these services are more effectively provided by natural forests. Proposing innovative designs integrating vegetation should be rooted in scientific evidence, not just good intentions.

While acknowledging the proven benefits of greenery on public health and well-being, it is crucial to avoid oversimplifying issues, such as trees' ability to solve all environmental problems. Green architecture should also not be used as an excuse for inaction regarding greenhouse gas reduction.

Chon: The historical dominance of engineers, developers, and urban planners in shaping urban areas resulted in traditional infrastructure. This tends to place landscape architects on the sideline despite green infrastructure falling within their domain. However, the global focus on sustainability, exemplified by initiatives like the 'UN Climate Summit,' aims to achieve carbon neutrality by 2050, prompts a shift toward multifunctional green infrastructure. In South Korea, the government's comprehensive plans, including the '2050 Carbon Neutrality Scenario' and 'Carbon Neutrality and Green Growth Promotion Strategy,' emphasize restoring carbon sinks like forests and urban spaces, and highlight the vital role of landscape architects in planning, designing, and managing these areas for carbon neutrality. Coastal areas, abundant in blue carbon resources like mangroves and salt marshes, underscore the expanding role of landscape professionals in mitigating carbon emissions, especially in South Korea which is surrounded by extensive coastal landscapes. As these spaces play a crucial role in global carbon initiatives, landscape researchers and planners foresee a growing opportunity to contribute significantly in both green and blue carbon contexts.

Jim: Improving urban green spaces covers the comprehensive enhancement in their quality, quantity, diversity, spatial arrangement, and integration within city landscapes. This enhancement demands a profound integration of scientific expertise, involving urban ecologists and horticulturists, to elevate the design of urban infrastructure significantly. The predominant reliance on gray infrastructure presents a major challenge in advancing green infrastructure planning, necessitating collaborative efforts from a cohesive team of professionals including landscape architects, urban ecologists, horticulturists, and urban planners. Integrating nature into urban settings remains a key objective, demanding a focus on understanding and implementing spatial patterns and connectivity within green spaces. Greater emphasis on spatial ecological planning principles and awareness of green infrastructure's crucial role in nature-based solutions, climate mitigation, sustainable development, and urban quality of life is essential. It's imperative to shift away from considering green infrastructure as secondary to gray infrastructure and to mainstream its incorporation intelligently and deliberately into urban development practices.

Q3. Over the past decade, various facets of landscape architecture have transcended the boundaries of conventional greening practices. From your perspective, which ground breaking technologies and techniques hold the potential not only to substitute but also to surpass traditional methods in the analysis and design of urban green spaces?

Velasco: Understanding the biogeochemical cycles and the local climate in an urban ecosystem is essential for determining the value of greening practices in terms of climate change mitigation and adaptation. This is probably more crucial than developing revolutionary tools and methods. We are only now starting to understand how plants and soil respond to urbanization in a changing climate. There are still a lot of unanswered questions that urban ecologists, biologists, atmospheric scientists, and landscape researchers should be able to address in the coming years.

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Q4. Do recent developments in global sustainability, including policies (such as EU Taxonomy, CSRD, EPBD), financial mechanisms, technologies, and reporting frameworks (like SBTI, GRESB, TCFD, REDD+), truly empower landscape architects? Can these resources effectively influence decision-making, and how can landscape architects integrate them seamlessly into political, financial, and economic sectors? Are there constructive criticisms or concerns that could improve decision-making processes? Lastly, to what extent should landscape architects expand their knowledge boundaries to navigate this evolving sustainability landscape?

Chon: In landscape architecture, information gathering traditionally encompassed human, social, and environmental factors through various means like documents, direct interactions, and data analysis. The advent of computer science introduced GIS extensively, and with the rise of digital technologies in the Fourth Industrial Revolution, methods like Building Information Modelling (BIM), virtual reality, and augmented reality are being widely applied in landscape planning and design processes. The scalability of Internet of Things (IoT) and Big Data offers vast potential. IoT automates data collection from natural environments while Big Data utilizes programming languages like Python and R to amass spatial and social information, leveraging social media platforms for experiences about outdoor spaces. These data, when merged with machine learning algorithms, can analyze preferences and environmental traits. Moreover, Augmented Reality, Virtual Reality, Digital Twin, and Metaverse platforms enable the creation of meaningful 3D environments, integrating information for simulating complex scenarios, predicting future landscapes, and addressing challenges like climate change and biodiversity shifts.

Jim: Recent advancements in landscaping technologies present significant opportunities to enhance urban greening efforts. Innovations in roof greening materials and techniques have notably expanded the availability of green spaces on buildings’ rooftops, addressing the scarcity of ground-level space for greenery, particularly in compact cities. Improved green wall technologies have complemented these advancements, extending green coverage across cities in three-dimensional spaces. This innovation utilizes building envelope resources that would otherwise remain underutilized, offering a practical solution to densely populated areas that lack greenery. Additionally, recent research on urban soil and its impact on tree growth holds promise for improving urban forestry practices. Scientific insights into soil limitations affecting tree health and growth due to insularity and compaction offer comprehensive solutions that landscaping professionals can integrate into their work to enhance urban tree performance and stability.

Velasco: Landscapes architects should use these tools with care. They can provide some insight, but cannot be the sole basis for decisions. Platforms such as i-Tree (https://www.itreetools.org/) can help to quantify the environmental benefits that urban trees provide, but we must be cautious when using their output. This tool, similar to others, was developed using the relatively limited information on urban tree processes available at the time, which may not be fully representative in some cases, such as for trees in tropical cities. This does not prevent their use, but users should be aware that the uncertainties in the outcomes may be significant.

Chon: The landscape architecture field is experiencing a significant impact from global sustainability and resilience trends. This is particularly evident in Korea’s response - we see initiatives like K-SDGs (Korea Sustainable Development Goals) and proposals for Resilience and K-Taxonomy that focused on climate change and carbon neutrality. This expansion into finance, technology, and policy realms presents diverse options for designers, emphasizing the necessity of Nature-based Solutions (NbS). NbS offer efficient solutions to societal challenges by leveraging natural infrastructure, offering economic, social, and environmental benefits. K-Taxonomy, facilitating eco-friendly activities like NbS, supports green financial investments, fostering connections among landscape planning, technology, finance, and policies. To navigate this, landscape architects must broaden their knowledge base through interdisciplinary approaches, extending beyond local environments to understand connections with finance, technology, policies, and global trends, necessitating holistic and multidisciplinary thinking.

Jim: The emergence of modern and powerful tools can significantly foster the work of landscape professionals' contributions to enhancing green infrastructure. It will help if more landscape designers adopt such new tools and are encouraged to proactively acquire the necessary knowledge and skills to modify their practice. Advocacy of the new techniques could be boosted by organizing training sessions, seminars, and workshops. The government or professional bodies can consider requiring the use of new landscape planning and decision-making tools.

Q5. As landscape architects increasingly adopt a more measurable and quantifiable approach, do you foresee potential hurdles in collaborating with other disciplines? If challenges emerge, what effective strategies can be implemented to foster integration within the broader Architectural, Engineering, and Construction (AEC) industries?

Velasco: As an atmospheric scientist who has worked with people from various professional backgrounds to solve air pollution and urban warming problems, I feel that some professionals may not be overly concerned with certain scientific facts, especially with those that contradict their artistic visions. There are also those who dislike field work. Unfortunately, it is becoming common practice to apply models and tools like those mentioned in the previous question to validate assumptions about the environmental benefits provided by urban greenery without any corroborating field or laboratory work. Furthermore, we are seeing a substantial increase in assessments based on automated approaches to analyze big datasets. The current interest in big data and machine learning, fuelled by the ease with which digitized data can be obtained nowadays, has led to some believing that conclusion may be drawn without substantial theoretical background in the field. This revolutionary trend of theory-free science is highly seductive to experts in informatics and visualization techniques, but without a solid grounding on the topic[14]. Landscape architects must resist the temptation to follow this trend. They must accept that both field observations and numerical modelling are required to determine effective solutions to improve the urban environment. I always encourage young researchers and practitioners to leave the comfort of their air-conditioned office, go out into the field, sweat a little, collect reliable data, and then run models to evaluate the effectiveness of potential new urban landscapes.

Chon: In Korea, through public datasets and open APIs, everything from human and social data such as population and land use to data related to the natural environment such as air, soil, and water quality are effectively constructed at the government level. However, if collaboration with other fields is necessary in the process of managing or technologically applying such data, an integrated approach and strategy may be required. These technologies and techniques hold the potential not only to substitute but also to surpass traditional methods in the analysis and design of our outdoor spaces. Because the landscape architecture field is actively using AI, Digital Twin, and BIM, just like in the existing AEC (Architectural, Engineering, and Construction) industry, landscape researchers and designers also need to advance their knowledge. Without an understanding of the trends in software and management practices that are actively being utilized within the AEC industry, landscape architects will not be able to effectively integrate them. Additionally, for effective integration, it is necessary to apply a decision-making process such as adaptive management. Adaptive management is a core principle of resilience-based management. It is a necessary process for a system to become adaptive under the resilience concept and provides an opportunity to apply flexible decision-making strategies to respond to disturbances or uncertainties. Adaptive management has the advantage of integrating various systems and learning continually to improve them in the long term[15]. Therefore, it is possible to effectively establish an iterative learning process for collaboration with architecture, engineering, and construction fields during the data collection, analysis, planning, and design process.

Jim: Developing measurable or quantifiable metrics may facilitate objective planning and judging of the deliverables, specifically to meet planting standards. However, the crux of landscape design remains principally and fundamentally a quality issue that any measure of quantification cannot substitute[16]. The differences between strands of urban development professions are due to deeply-seated structural problems that defy easy solutions. True to human nature, the tendency to specialize has engendered the corollary inclination to diverge and compartmentalize, creating silos and obstacles to effective communication and hybridization of ideas and practices. To bridge the glaring gaps between professions, we need to nurture a crop of champions with the penchant to traverse professions and facilitate communication and cooperation to generate cohesion and convergence. This process will take plenty of bold effort and time. We better trigger the process as soon as possible.

Q6. Amidst the evolving carbon market, what distinctive landscape policies and frameworks are in place within the contexts of Hong Kong (or China), Korea, and Singapore, that empower their educational institutions and professional sectors to respond to design green infrastructure for this shifting landscape?

Velasco: Singapore is renowned for seamlessly blending greenery into its urban landscape, epitomized by its moniker, 'City in a Garden', now 'City in Nature'. The efforts and achievements in this realm set a commendable example for other cities aspiring to enhance their green spaces. The Singapore Green Plan 2030 outlines ambitious goals to further augment greenery, emphasizing collaborative efforts between the government and the community. This strategic initiative focuses on extending Singapore's natural capital, intensifying green spaces, restoring nature into urban areas, and enhancing connectivity within Singapore's green spaces. Visible progress is evident in these strategies, buoyed by increasing community engagement and a growing acknowledgment that individuals are integral parts of the environment. This shift represents a significant departure from compliance-driven actions toward self-motivated participation in environmental initiatives. In the domain of urban greenery, authorities exhibit responsiveness and willingness to heed expert advice. Engagements with authorities have successfully influenced perspectives on urban vegetation's limitations, dissuading the use of narratives suggesting its capacity to offset CO_2 emissions. Similarly, authorities also take into account the preferences of the community. However, academia may not mirror this proactive stance yet. Despite supporting studies on urban vegetation, the focus primarily revolves around producing scientific papers for academic merit and monetizing the services provided by trees, often relying on numerical simulations and remote sensing data. There's a lack of emphasis on understanding the fundamental processes governing the benefits of urban vegetation, exacerbated by a decline in field and laboratory work due to an inclination to desktop studies and changes in academic programs. This trend poses a threat to the development of integrated urban landscapes that incorporate vegetation effectively.

Chon: In Korea, a proactive stance towards carbon neutrality is evident in the establishment of landscape policies and frameworks. Government ministries, including Education, Environment, Oceans and Fisheries, the Korea Forest Service, and the Korea Meteorological Administration, collaborated to create educational materials on climate crisis, ecological transition, and carbon neutrality. They also selected specific schools to act as regional centers for practicing carbon neutrality. Green infrastructure, crucial for achieving carbon neutrality, holds a central position in Korean settlement policies. National-level emission absorption factors are being developed, and measures to calculate losses and emissions are being instituted. The proposal for a 'green infrastructure comprehensive plan' seeks to enhance the active application of green infrastructure across cities. Moreover, Korea is considering additional carbon-related standards alongside existing park area and accessibility criteria for parks and green spaces. This concerted effort integrates green infrastructure into education and policy, aligning it with carbon-related objectives.

Furthermore, educational initiatives like the BrainKorea (BK) 21 project, supported by the National Research Foundation, focus on enhancing research competitiveness, fostering skilled personnel, and improving education quality. Through collaborations with universities and projects such as Eco-Up Innovation Convergence University, Korea actively supports research and design capabilities in landscape architecture, specifically addressing global issues like carbon neutrality and climate change.

Q7: Reflecting on the past decade, it's evident that the next 10 years are poised for remarkable growth in the realm of green infrastructure as a response to climate change within landscape architecture. As we anticipate this unfolding frontier, which aspects do you consider most vital for both academics and professionals in the upcoming decade, and what underpins their significance?

Jim: Hong Kong initiated its exploration of carbon market prospects by conducting a preliminary feasibility assessment in March 2022, jointly led by government departments, Hong Kong Exchanges and Clearing Limited (HKEX), and the Securities and Futures Commission[17]. This effort established the Green and Sustainable Finance Cross-Agency Steering Group Carbon Market Workstream (CASG) to probe the potential for several key initiatives:

1) Establishing Hong Kong as a global Voluntary Carbon Market (VCM), leveraging its international standards status and financial prowess;

2) Collaborating with stakeholders to align with Mainland policies and create the Greater Bay Area (GBA) Unified Carbon Market;

3) Recognizing compliance markets like the EU Emissions Trading System (EU ETS) and their role in allowing market participants to trade emission allowances; and

4) Noting that while ETSs cover only around 16% of global emissions, the VCM can serve as a starting point for corporations not covered by enabling them to neutralize emissions and direct capital towards carbon credit-generating projects.

Following this, HKEX launched the Hong Kong International Carbon Market Council in July 2022, collaborating with corporate and financial institutions to explore regional carbon trading opportunities[18]. The objectives are to leverage Hong Kong's financial prominence, contribute to carbon neutrality, foster green finance ecosystems in Hong Kong, Mainland China, and beyond, ultimately aiming to establish Hong Kong as a premier carbon hub in Asia and globally while aiding efforts towards a low-carbon economy.

Velasco: Globally, cities have launched expansive green infrastructure projects to combat urban warming and address climate change, with more initiatives underway. However, some of these efforts prioritize urban greenery may be based on emotional appeal rather than scientific foundations. While acknowledging the advantages of greenery—improved public health, societal well-being, and resilient communities—embracing reforestation programs is crucial. For instance, the widespread use of vegetation on city walls and roofs, while enhancing aesthetics and offering some communal benefits, might have less impact on local climates, air quality, and greenhouse gas emissions compared to ground-level vegetation, especially planting large trees. When proposing designs with greenery on roofs and walls, architect must balance potential benefits against drawbacks like indirect greenhouse gas emissions during construction, maintenance costs, and redirecting resources towards broader initiatives that expand urban greenery on a larger scale. This evidence-based approach requires collaboration with experts in urban ecology, climatology, and social sciences to ensure green infrastructure projects genuinely benefit society rather than serving as mere greenwashing.

Chon: Since the emergence of sustainability concepts from the seminal work 'The Limits to Growth' in 1972, it has been globally utilized to address multifaceted challenges, notably climate change. However, persistent environmental issues like natural disasters and biodiversity loss underscore the limitations of current methodologies. Sustainability seeks to harmonize economic growth, environmental preservation, and social welfare. Within green infrastructure and landscape architecture, the pivotal practical concept is 'resilience,' denoting a system's capacity to withstand and adapt to external disruptions.

Initially rooted in ecology in 1973, resilience has extended across disciplines, encompassing landscape architecture. Recognizing green infrastructure as an ecosystem providing essential human benefits, within the resilience framework, emphasizes an integrated social-ecological system where maintaining or enhancing resilience is essential for continual provision of ecosystem services. It's crucial to apply the resilience concept not only in research but also in landscape planning and design to address climate change impacts effectively. This coupling of resilience with sustainability emerges as a vital approach to navigate human-induced challenges in the coming years.

Jim: There's immense potential for enhancing green infrastructure design through up-to-date research insights, addressing key concerns at macro and micro scales. At the macro level, leveraging landscape ecology concepts can optimize spatial patterns, while incorporating greenways and blueways can enhance urban connectivity for both people and wildlife. Connecting urban and peri-urban green spaces with natural areas can facilitate ecological interflow, even using stepping-stone sites where continuous green space is not feasible. At the micro level, addressing socio-economic inequalities in green space provision and access is crucial. Designing socially inclusive green spaces to encourage interactions and providing walkable access to most urban residents are pivotal. Enhanced canopy cover for effective cooling, utilization of native and diverse plant species, as well as diverse vegetation types can maximize biodiversity. Integrating skyrise greenery, encouraging private developers' participation in public-private partnerships, and engaging citizens in planning and design phases are imperative. In new urban developments and renewal projects, optimizing spatial ecological planning is vital, avoiding dense, nature-deficient urban forms that exacerbate the urban heat island effect, and revitalizing town plans for greener, more sustainable urban spaces.

The responses cover a broad range of perspectives on urban green spaces, climate change mitigation, interdisciplinary collaboration, landscape policies, and evolving trends within the field of landscape architecture. It delves into the complexities and challenges faced by professionals, researchers, and policymakers while emphasizing the need for a multidisciplinary approach to address these issues effectively.

First, responses address the collaboration and knowledge exchange needed between diverse fields like landscape architecture, urban planning, and environmental and atmospheric sciences. This approach acknowledges the necessity for interdisciplinary efforts in tackling climate change and enhancing urban green spaces. Second, they highlight the challenges in collaboration between professions, especially regarding differences in perspectives, reliance on models without fieldwork, and the need for a balance between theory and practical experience. Third, it acknowledges the importance of integrating technological advancements and findings on urban ecology and biogeochemical cycles into landscape architecture practices, and emphasizes the necessity for landscape architects to stay updated on software trends used in the broader AEC industry. Fourth, it provides insights into specific regional policies and frameworks in Hong Kong, Singapore, Korea highlighting their efforts to address climate change through green infrastructure and educational initiatives. Fifth, it discusses future trends and considerations in the field of landscape architecture, including the significance of resilience, social inclusivity in green space design, and the necessity for evidence-based approaches in green infrastructure projects. Lastly, it critically evaluates the impact of green infrastructure initiatives, emphasizing the need for evidence-based decisions, especially regarding the effectiveness of urban greenery in responding climate change over time.

ABOUT THE INTERVIEWEES

ERIK VELASCO investigates the impact of urbanization and climate change on the atmospheric environment and biogeochemical cycles, and the conjuncture of these with the construction of sustainable, equitable and inclusive cities. He is interested in understanding the interactions between the urban ecosystem and its atmosphere as a means to devise effective solutions to improve air quality, mitigate climate change, and create cooler and greener microenvironments. He has conducted research in Asia and North America, but his main laboratories have been Singapore and Mexico City. He currently collaborates with the Molina Center for Energy and the Environment.

C.Y. JIM is Research Chair Professor at the Education University of Hong Kong, and formerly Chair Professor at the University of Hong Kong. His research covers the conservation, creation, and refinement of nature-in-city, encompassing urban ecology, urban forestry, urban soil science, and nature-based solutions for sustainable cities. He is ranked first among 30,711 forestry researchers by the Stanford University study in 2023.

JINHYUNG CHON is a professor at Korea University's Division of Environmental Science and Ecological Engineering, specializes in planning resilient ecological landscapes. His expertise lies in designing sustainable solutions that integrate climate change adaptation, emphasizing the strong connection between humans and nature as a single social-ecological system.

FOOTNOTES

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