



# Cultivating Eco-Urban Diplomacy through Urban Farming: Comparative Insights from Jakarta–Tokyo and Surabaya–Kitakyushu Sister Cities

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**Abstract.** Amid rapid urbanization and intensifying climate challenges, cities across Asia are embracing localized collaboration to pursue sustainable development. This study examines eco-urban diplomacy through sister-city partnerships between Jakarta–Tokyo and Surabaya–Kitakyushu, focusing on how urban farming and environmental horticulture advance climate resilience, social equity, and food security while contributing to SDGs 2, 11, 13, and 17.

Employing a mixed-methods approach, the research integrates geospatial analysis, policy review, and comparative literature. Findings show Jakarta–Tokyo collaboration promotes participatory urban farming and rooftop greening, enhancing food supply resilience and community well-being. Tokyo’s rooftop gardens and community plots have raised vegetable self-sufficiency from 4.27% to a potential 11.73%, strengthening resilience against supply disruptions. Meanwhile, Surabaya–Kitakyushu cooperation has achieved a threefold mangrove expansion (2000–2020), reduced waste volume by 20%, and introduced low-carbon, 3R principles through technology transfer and community-based programs.

Framed within polycentric governance theory, the study highlights how multi-level actors—municipal agencies, NGOs, communities, and universities—co-produce localized solutions. Urban agriculture emerges not only as a tool for climate adaptation but also as a platform for food justice and inclusive governance, addressing socioeconomic disparities in green space access. However, challenges such as financial constraints, communication gaps, and land insecurity persist, risking exclusion of marginalized groups.

This study concludes with tiered recommendations: short-term digital platforms and modular policy frameworks, medium-term co-funded grants and academic integration, and long-term standardized SDG indicators and joint governance bodies. These measures aim to institutionalize eco-urban diplomacy, turning symbolic partnerships into actionable, community-driven solutions for sustainable urban futures.

**Keywords:** Eco-urban diplomacy, sister cities, urban farming, climate resilience, SDGs, polycentric governance.

## 1 Introduction

Rapid urbanization across Asia has intensified a range of environmental crises, including urban heat islands (UHIs)—localized temperature increases in urban areas caused by heat-absorbing surfaces such as asphalt and concrete—alongside food insecurity and heightened climate vulnerabilities. In responding to these shared challenges, local governments in urbanized cities play a paramount—yet often underexamined—role in driving sustainable development and social transformation. Although national policies and international frameworks frequently dominate sustainability discourse, city-level diplomacy represents a potential avenue for collaborative problem-solving across borders.

Sister-city partnerships, traditionally focused on cultural and economic exchange, possess untapped potential to address common ecological challenges through localized, community-centered approaches. Cities such as Jakarta, Tokyo, Surabaya, and Kitakyushu exemplify the diverse environmental pressures that necessitate such cooperation: Jakarta lost approximately 40% of its green cover between 2000 and 2020, exacerbating flooding and heat risks (Bappenas, 2021); Japan's food self-sufficiency rate stands at 38% on a calorie basis (MAFF, 2022), reflecting systemic vulnerabilities in food security; Surabaya's urban sprawl has intensified UHI effects, with studies showing a 1.2°C temperature increase in densely built-up areas since 2000 (IPCC, 2021); and Kitakyushu, once labeled the "Grey City" due to its severe air and water pollution during Japan's post-war industrial boom, struggled with environmental degradation and unsustainable industrial practices.

Addressing such interrelated issues requires innovative, decentralized solutions that go beyond conventional municipal governance—solutions rooted in practices such as environmental horticulture integrated in urban diplomacy. As a specialized branch of horticulture, environmental horticulture centers on the cultivation, management, and strategic use of plants to enhance urban, suburban, and natural environments. As eco-urban diplomatic initiatives, it can integrate ecological science, urban design, and sustainability principles to improve both environmental quality and human well-being through international partnership in rapidly urbanizing regions. This study explores how sister-city partnerships—specifically Jakarta–Tokyo and Surabaya–Kitakyushu—function as platforms for eco-urban diplomacy, leveraging urban farming and community gardening to advance multiple Sustainable Development Goals (SDGs 2, 11, 13, and 17).

Importantly, the role of urban agriculture differs across contexts. In the Global North, where food systems are embedded in urban governance and shaped by strong civil societies, urban farming often promotes sustainable lifestyles, social cohesion, and resilience—as reflected in initiatives like the Milan Urban Food Policy Pact (2015). By contrast, in the Global South, urban agriculture is more directly tied to food security and survival. Households in Latin America and Africa, for instance, cultivate small spaces to feed families and meet nutritional needs (Taguchi et al., 2019). This divergence is also visible in Asian city partnerships: in Jakarta, urban farming responds to food insecurity, flood resilience, and livelihoods, while in Tokyo it supports rooftop

greening, sustainable living, and community well-being. Similarly, Surabaya emphasizes ecological restoration and waste management, whereas Kitakyushu contributes technological expertise and governance models.

These contrasts highlight the need for sister-city partnerships to tailor strategies to local realities, balancing sustainability ambitions with urgent demands for food justice and resilience. By examining the Jakarta–Tokyo and Surabaya–Kitakyushu cases, this research provides rich case studies for understanding how municipal actors mobilize resources, catalyze grassroots innovation, and co-produce knowledge across borders. Furthermore, this study analyzes their implementation processes, evaluates their social ecological impacts, and critically assesses the challenges and limitations encountered. By focusing on these multi-dimensional aspects, the study aims to contribute to a deeper understanding of how subnational actors operationalize cross-border environmental collaboration, and what conditions enable—or hinder—their effectiveness in fostering sustainable urban futures.

## **2 Methods**

This research synthesizes and builds upon existing studies that employ geospatial methodologies to assess the ecological implications of urban diplomatic initiatives. Drawing from comparative analyses in peer-reviewed literature and municipal reports, it integrates findings from prior research utilizing tools such as QGIS and OpenStreetMap to quantify changes in urban green spaces and urban farming sites patterns. High-resolution spatial data sourced from municipal datasets in Jakarta and Surabaya, alongside land-use surveys from Tokyo and Kitakyushu, underpin these analyses. In parallel, this study conducts a qualitative policy analysis through document review of Indonesia–Japan sister-city memoranda of understanding (MoUs) and policy frameworks. The sister city cooperation between Jakarta and Tokyo is based on the guidelines stipulated in the Ministry of Home Affairs Circular No. 193/1652/PUOD. The Surabaya–Kitakyushu sister city partnership is based on a Memorandum of Understanding concerning Green Sister City Cooperation, signed between the City Government of Surabaya and the City Government of Kitakyushu, which refers to the Joint Statement on Strategic Environmental Partnership signed in Kitakyushu on March 15th, 2011. This enables a deeper understanding of the institutional mechanisms and governance approaches that shape the implementation of ecological initiatives within these transnational partnerships.

## **3 Discussion**

This study redefines eco-urban diplomacy as a framework for decentralizing climate action through municipal partnerships. Unlike state-centric environmental diplomacy,

sister-city collaborations enable hyper-local innovation, as seen in Jakarta's community-driven flood mitigation and Tokyo's rooftop agriculture. These partnerships align with polycentric governance theory, a system where multiple governing bodies at different scales (local, regional, national, global) interact and make decisions independently but also collaboratively, rather than through a single centralized authority. It can be reflected in eco-urban diplomacy notion where multi-level actors in the cities or regions co-produce context-specific solutions including the urban farming and community gardening. The initiatives directly contributed to SDG 11 (Sustainable Cities) and SDG 13 (Climate Action), with co-benefits for SDG 2 (Zero Hunger) through urban food production. SDG 17 (Partnership for the Goals) will also be enhanced through the eco-urban diplomatic partnership.

Recent studies have examined the ecological implications of urban initiatives using geospatial methodologies. Research in Southeast Asian megacities revealed a strong correlation between land surface temperature and the density of impervious surfaces and green spaces, highlighting the importance of urban green areas in mitigating urban heat island effects (Estoque et al., 2017). In Surabaya, Indonesia, both horizontal and vertical urban expansion were analyzed using multi-spatial resolution data, showing a tendency towards vertical development and imbalanced growth between built-up and green areas (Handayani et al., 2018). The city has since embraced a rapid greening development concept, engaging in environmental diplomacy through multilateral and bilateral partnerships (Wardhani & Dugis, 2020).

Urban agriculture (UA) can play a crucial role in building water-resilient cities and managing flood risks. In flood-prone areas, UA can serve as a buffer zone, enhancing infiltration capacity and reducing flood damage. The Ciliwung River Basin in Jakarta has experienced increased flooding due to rapid urbanization and land use changes (Farid et al., 2022). Climate change and unplanned urbanization are expected to exacerbate future flood inundations in this area, with projections showing increases of 6% to 31% in flood-prone areas (Mishra et al., 2018). Implementing UA strategies, such as allocating flood-prone areas for agriculture and adopting the Sponge City Concept, can significantly reduce flood risks. For instance, this approach has demonstrated the potential to transform 100-year storm events into 25-year storm events (Ebissa, G & Desta, H, 2022). These findings underscore the importance of integrating UA into urban planning for flood management and resilience. This initiative also facilitated community-based flood mitigation by encouraging residents to transform underutilized spaces into productive green areas. These actions have led to not only ecological benefits but also social co-benefits such as enhanced local nutrition and urban food security. In particular, urban farming initiatives across these cities have been shown to occupy up to 21% of green space in Jakarta, supporting food security and climate adaptation (Chandra & Diehl, 2019). The sister city partnership between Jakarta-Tokyo has grown to address a wide range of urban challenges, including environmental sustainability, disaster management, and public service improvements to include innovative solutions for climate change and urban resilience. For instance, Jakarta's delegation attended the 2019 Urban Agriculture World Summit in Nerima City, Tokyo, engaging with global

counterparts to exchange insights on urban farming initiatives. This collaboration has facilitated the transfer of knowledge in urban agriculture and sustainability practices (The Japan Agricultural News, 2019).

Tokyo's rooftop gardens and community plots play a supplementary role in fresh vegetable production, enhancing resilience to global supply chain disruptions (MAFF, 2024), with Tokyo's current fruit and vegetable self-sufficiency at 4.27% and a potential of 11.73% (Sioen et al., 2018). These urban farming practices help maintain food supply during crises like the COVID-19 pandemic, supporting physical and mental health while providing a sense of purpose for gardeners (Shimpo, 2024). Urban horticulture, including community gardens and innovative techniques like vertical gardening and hydroponics, offers a sustainable solution to food security challenges in cities (Khan et al., 2020). Strengthening local production and consumption in Tokyo would reduce the risk of food self-sufficiency falling below 1% and decrease environmental impacts such as carbon and water footprints (Mitra et al., 2021). Overall, urban agriculture contributes significantly to Tokyo's resilience against supply chain disruptions and natural disasters, and is aligned with multiple Sustainable Development Goals (SDGs), including SDG 2, 11, 12, and 13.

Surabaya has made significant progress in environmental conservation, particularly through mangrove restoration and waste management. The city's mangrove forest area increased from 257.13 ha in 2000 to 753.48 ha in 2020, enhancing carbon sequestration and biodiversity (Hidayah et al., 2022). This expansion has helped reduce air temperatures and CO<sub>2</sub> emissions in the city (Sumarmi et al., 2021). Surabaya's environmental improvements were largely influenced by its sister city cooperation with Kitakyushu, Japan, which focused on implementing eco-city initiatives and improving waste management practice (Fitriana et al., 2022). The partnership, involving various Japanese entities, helped Surabaya redesign its urban waste disposal system, leading to significant environmental improvements (Gamaraalalage, 2012). These efforts have transformed Surabaya into one of Indonesia's best cities for waste management and increased its green open spaces, contributing to its reputation as a model for sustainable urban development in Asia.

Kitakyushu, an industrial city once known for severe pollution, has transformed into an international model of environmental regeneration through its Green Frontier Plan and environmental education programs. Its cooperation with Surabaya has led to significant environmental development gains, including improved waste management systems and the expansion of urban green spaces. The Surabaya–Kitakyushu partnership demonstrates how knowledge exchange and technology transfer can foster green infrastructure development even in rapidly urbanizing contexts. The sister-city collaboration highlights the power of international collaboration in advancing sustainable environmental practices. With technical support from Kitakyushu, Surabaya implemented joint wastewater projects, built waste separation facilities, and adopted low-carbon, 3R (reduce, reuse, recycle) principles. Kitakyushu provided infrastructure and equipment, while Surabaya contributed land and labor, ensuring local ownership. Public education

and pilot programs helped Surabaya reduce its waste volume by over 20% in four years and improve water treatment systems (Hayatunufus, 2024). This partnership exemplifies how city diplomacy can deliver impactful, community-driven solutions aligned with SDGs 11, 12, and 17.

As municipal leaders grapple with climate risks, urban inequality, and food insecurity, these partnerships offer not just symbolic goodwill but actionable models for scaling sustainable development through collaborative urban governance. Urban green spaces (UGS) provide numerous benefits, but their distribution often reflects socioeconomic inequalities. In Global South cities, high-income areas typically have greater access to UGS in terms of quantity and proximity (Rigolon et al., 2018). Urban agriculture can potentially address food justice and provide social benefits, but it may also reinforce inequities due to disparities in representation especially since urban agriculture today is sometimes dominated by already advantaged communities, leadership and funding, and insecure land tenure. (Horst et al., 2017).

While these collaborations within these sister cities also face challenges including financial constraints, communication issues, and the impact of the COVID-19 pandemic (Siregar & Rizqullah, 2022). To promote equitable access to green technologies and spaces, cities need effective planning instruments that go beyond ecological modernization to enhance social equity (Nguyen & Davidson, 2017), planners should prioritize long-term urban agriculture efforts, target investments in disadvantaged communities to foster food justice. Sister city partnerships offer opportunities for benchmarking and knowledge transfer, particularly in climate change adaptation and resilience building (Sitinjak et al., 2022). Hence, successful implementation requires active community engagement and robust strategies to ensure sustainability and mutual growth.

## 4 Conclusion and Recommendation

Sister city partnerships between Indonesian and Japanese cities have emerged as a significant form of paradiplomacy—the involvement of subnational actors, such as regional and local governments, in international relations through the establishment of formal and informal contacts, agreements, and networks with foreign counterparts (Cornago, 2010) —fostering sustainable development and environmental cooperation. The partnerships involve strategic planning, alignment of goals, and formal agreements like Memoranda of Understanding (MoUs). Sister-city partnerships between Jakarta–Tokyo and Surabaya–Kitakyushu exemplify the transformative potential of eco-urban diplomacy to advance the SDGs through hyper-local innovation.

This finding offers innovative frameworks for deploying city diplomacy as a lever for urban sustainability, enabling collaboration models as well as cross-cultural insights on how municipalities with distinct political cultures—Indonesia and Japan—synchronize efforts to meet shared sustainability targets. Although existing literature and practices

in eco-urban diplomacy—such as in the Jakarta–Tokyo and Surabaya–Kitakyushu sister city partnerships—primarily center on high-level environmental management and green city development, the research focuses Eco-Urban Diplomacy through Urban Farming to signal an important intervention into this discourse. Urban farming is not merely a localized sustainability practice but a collective, multi-actor endeavor involving NGOs, community groups, and often municipal support. These networks create opportunities for diplomacy from the ground up, fostering transnational learning, civic exchange, and participatory environmental governance

By highlighting urban farming, the study challenges the prevailing assumption that eco-urban diplomacy operates only at institutional or policy levels. Instead, it positions urban farming as a bottom-up tool of diplomacy—one that connects ecological goals with socio-economic benefits such as food security, community empowerment, and green job creation. These dimensions are crucial for sustainable international cooperation, especially in city-to-city partnerships that aim to be inclusive and community-oriented. To strengthen the effectiveness and sustainability of sister-city partnerships in addressing urban ecological challenges, this study proposes a set of tiered, scalable recommendations for metropolitan governments, NGOs, policymakers, academics, and environmental activists. These recommendations aim to foster inclusive governance, facilitate transnational learning, and enhance ecological and social resilience through urban farming and community gardening initiatives.

### **Tier 1: Immediate and Feasible Actions**

- Both city governments should institutionalize regular technical exchanges involving not only municipal agencies but also NGOs, academic institutions, and farming communities. These should be complemented by an open-access digital platform for cross-city dialogue and knowledge sharing—enabling real-time communication among urban farmers, environmental activists, and local authorities. The platform can host virtual workshops, manuals, case studies, and shared problem-solving tools.
- Develop flexible, modular urban agriculture policy templates co-created by policymakers and researchers. These frameworks should draw on Jakarta's strengths in community-led initiatives and Tokyo's experience with market-based incentives, allowing for adaptation to local socio-political and institutional conditions.

### **Tier 2: Medium-Term Initiatives**

- Create co-funded grant schemes by both municipal governments, with support from international partners, to pilot and scale climate-resilient agricultural projects. These grants should prioritize marginalized and climate-vulnerable communities, and be co-administered by a multi-stakeholder committee including NGOs and local community representatives to ensure transparency and inclusion.
- Universities and research institutions should be formally integrated into the monitoring and evaluation (M&E) process of urban farming initiatives. Their role can

include developing participatory research frameworks, assessing environmental outcomes, and providing evidence-based policy recommendations.

### **Tier 3: Long-Term Structural Integration**

- Design and adopt a set of standardized indicators to track sister-city contributions to the SDGs—particularly SDGs 2, 11, 13, and 17. These indicators should be embedded within both the digital collaboration platforms and the urban farming grant evaluation system, enabling consistent performance tracking and adaptive learning.
- Establish joint governance bodies comprising municipal officials, environmental NGOs, academic experts, and community leaders to guide the strategic direction of sister-city urban agriculture programs. These bodies would be tasked with aligning local actions with international climate goals, mediating interests, and securing long-term political and financial commitment.

By demonstrating how these emblematic Indonesia–Japan sister-city arrangements create fertile ground to deepen global partnerships and grassroots sustainability through innovative practices such as eco-urban diplomacy. Ultimately, it proposes a blueprint for how city-driven diplomacy can amplify local contributions to the SDGs, setting the stage for transformative development transitions in Indonesia, Japan, Asia, and beyond.

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