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Perspective

COVID-19 Pandemic and Sustainable Urban Transformation: Perspectives on City-Level Actions and a Framework for the Future

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Abstract: Cities were at the center of the COVID-19 pandemic due to the concentration of affected populations and economic activities that needed to be revived to support global recovery. While cities offer strong economic and social benefits due to density, proximity, and global connectivity, the pandemic had a tremendous impact on their vital functions. It resulted in lost lives and livelihoods and deepened economic and social divides. Furthermore, the pandemic exacerbated many existing environmental challenges in cities. This presented an opportunity to tackle these interlinked challenges in an integrated manner. Evidence suggests that many city leaders integrated environmental sustainability as an important element to complement their emergency responses. Drawing from experiences in cities around the world, particularly those participating in the Sustainable Cities Program supported by the Global Environment Facility (GEF), this paper describes how integrated solutions were applied to tackle the COVID-19 pandemic. Consistent with a Healthy Planet Healthy People concept, a framework is proposed for sustainable urban transformation and to build cities that are resilient to shocks and stresses. With global environmental benefits at the core, the framework highlights the importance of integration, inclusion, and innovation as key approaches in steering the future green growth and prosperity of cities.

Keywords: COVID-19 pandemic; urbanization; sustainable cities; global environmental benefits; resilience; health; integration; innovation; inclusiveness; urban transformation; knowledge and learning

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1. Introduction

Cities are drivers of economic growth and contribute to 80% of global GDP. The economic opportunities are driving rapid urbanization globally, and cities are expected to be home to over two-thirds of the world's population by 2050 [1], with 35% of the growth between 2018 and 2050 projected to take place in Asian and African cities [2]. This increase in urbanization is largely happening due to higher population growth rates in urban compared to rural areas, but migration into cities and the transformation of previously rural land into urbanized regions is also playing a significant role [3].

Unsustainable urbanization, characterized by urban sprawl and growing inequalities, is a major source contributing to climate change, biodiversity loss, land degradation, and pollution. Cities generate two-thirds of global greenhouse gas (GHG) emissions [1], produce 50% of global solid waste [4], and put increased pressure on natural resources. Urban land cover is also expanding rapidly, visibly, and often irreversibly. Sprawling urban areas can potentially lead to the loss of 290,000 square kilometers of natural habitat by 2030 [5], and the fact that many environmental aspects cannot be restricted within city borders adds complexity. Clean air, water supply, and temperature regulation are some of these transboundary examples. Further, cities are highly vulnerable to climate change impacts

such as flooding, sea level rise, heat waves, and droughts, which contribute to recurring development challenges as well as acute shocks from extreme weather events.

Over the last decade, there has been an increased focus on addressing urban resilience, as the concept has received growing attention among policymakers, practitioners, and researchers [6]. Today, this is a cross-cutting theme in urban and territorial plans, risk management strategies, and infrastructure investments. The initial concept of urban resilience was largely centered around natural disasters, but in the last decade, it has been broadened to include aspects such as urban poverty and inequality to reduce vulnerability and exposure to hazards [7].

At the same time, sustainability and environmental challenges in cities and their ability to find solutions to these challenges have received growing recognition, especially in developing countries [8–10]. This can also be observed in the international conventions space. While it has yet to gain global momentum, a dedicated urban Sustainable Development Goal together with an increased emphasis on sustainability in the New Urban Agenda of the Habitat III, the acknowledgment of local-level action for addressing climate change, and lastly, a very recent urban-specific target under the Global Biodiversity Framework, support this global trend in cities.

Urban planning and design affect public health dimensions in cities, with human health and wellbeing being strongly impacted by the natural, physical, and social environment of the cities we live in. Research suggests that the environment around us stands for as much as 50 percent of the factors that determine our state of health [11]. Throughout history, health concerns have had a large impact on city planning and design, with major pandemics such as the plague, the Spanish Flu, and cholera leaving their mark on the shape of urban areas [12]. Today, we see pollution, overcrowding, and other determinants significantly affecting health and the local environment. While these issues are more pressing in the Global South, developed countries also face widespread problems [13].

Vast disparities can be observed in many cities, where the most disadvantaged urban population groups often face inequalities linked to urban sprawl, informal settlements, segregation, and gentrification [13]. In developing countries, in particular, informal settlements make up a large share of newly urbanized areas, and globally, one billion people currently live in such unplanned neighborhoods. This population is projected to rise to three million in 2050 [14]. Informal settlements often lack basic infrastructure and adequate housing [1] and are more often located in zones prone to hazards such as floods, earthquakes, and fires [15]. In terms of livelihoods, informal jobs stand for around 90 percent of the employment in cities in low-income countries [16].

Amid tackling the climate, nature, and inclusion-related challenges, cities across the globe were faced with a severe health shock as the COVID-19 pandemic began in late 2019 and then was declared a pandemic in March 2020. This had a tremendous impact on vital city functions. The health hazard resulted in significant loss of lives. Lockdowns and various restrictions led to the loss of livelihoods and deepening economic, social, and health divides, with a greater impact on disadvantaged groups such as the urban poor [17].

As economic powerhouses and centers of population, cities were pivotal in responding to the challenges posed by the pandemic and in propelling a global economic recovery following the health crisis. While this shifted the attention of cities from their continued efforts to tackle environmental challenges in the short term, it presented a unique opportunity to steer urban development towards a more resilient path, enabling cities to better prepare and respond to future shocks and stresses. Cities with well-planned density, equitable integration of services, local leadership, quality urban transportation, enhanced green spaces, and efficient waste management demonstrated a more effective response to the pandemic [12,18]. Cities and national governments effectively coordinated in managing the pandemic, with non-motorized transport receiving attention and green spaces becoming highly desirable for citizens. Overall, the importance of environmental sustainability and resilience gained momentum.

In the initial phases, the COVID-19 pandemic put a spotlight on certain urban aspects as contributors to the virus's spread. However, it ultimately became evident that cities are spaces for long-term resilience and prosperity. The reversal of outmigration from cities and sustained leadership by several cities for green and resilient recovery were clear signals towards this. Urban areas are predicted to expand in size and population, and the question is not if but how future urbanization will take shape in a post-COVID-19 world [7,19].

As various stresses, especially climate change, reach their peak, it is critical for cities to adopt approaches that allow them to address climate, nature, and inequality issues and to better prepare for future shocks like COVID-19 in a systemic way, leveraging the inherent benefits of urban areas. Urban advantages such as density, local political leadership, direct control over planning, global connections with other cities and stakeholders, innovation climate, and investment potential are poised to support sustainable urban transformation. The global recognition in multilateral conventions and strategic support to cities through global sustainability programs such as the GEF's Sustainable Cities Program (GEF-SCP) [20] can give cities the motivation to act. Guided by an integrated and holistic urban sustainability framework, cities can advance resilience and health both in the aftereffects of COVID-19 and beyond.

2. Aim and Objectives

Building on the experience and the evolution of urban responses and investments during the COVID-19 pandemic, this paper aims to capture lessons learned from cities based on the solutions that they put in place to cope with the COVID-19 pandemic and for long-term green, resilient, and sustainable growth. The findings highlight various impacts of COVID-19 on urban planning, governance, policies, and investments. Such changes to approaches and priorities were observed among the major impacts that the pandemic had on cities and a relevant theme for research in relation to the GEF-SCP. As such, the paper looks into how the urban processes and solutions were affected by the COVID-19 pandemic rather than assessing the quantitative results and outcomes of these solutions.

Based on the findings, the paper proposes a conceptual framework for urban sustainability and resilience guided by a Healthy Planet Healthy People [21] concept. The framework is centered around key approaches that cities can take to support human and environmental health and resilience, as well as the enablers needed to support these approaches in practice. Drawing on the experience of tackling the pandemic primarily, the proposed framework can be adapted to a wide range of stresses and shocks that cities may potentially face in the future. It is intended to inform future urban planning and generate interest from the research community by sharing learnings from projects on the ground and highlighting how programmatic approaches can make it possible for cities and countries to learn from each other and scale up best practices.

3. Materials and Methods

The paper synthesizes experiences from projects and initiatives in cities across the world, specifically those under the Sustainable Cities Program of the Global Environment Facility (GEF-SCP). The GEF-SCP was launched in 2016 to address the growing interest from developing countries to tackle multiple challenges emerging from rapid urbanization. It was designed to promote an integrated and system-based approach to urban transformation, with an initial cohort of 11 country-level projects covering 28 cities in Africa, Asia, and Latin America. The cities were supported to develop innovative sustainability solutions and strengthen institutional capacity to build resilience and tackle urgent urban challenges of climate change, biodiversity loss, land degradation, and pollution. An additional cohort of 23 cities was added through a second program in 2020, bringing the total to 50 cities in 17 countries (Figure 1). The cities are connected through a global knowledge and coordination platform [22,23] and take a programmatic approach to ensure that the results coming from individual investments are more than the sum of the parts. A new

funding phase is underway, which will increase the number of cities and scale up integrated urban approaches.

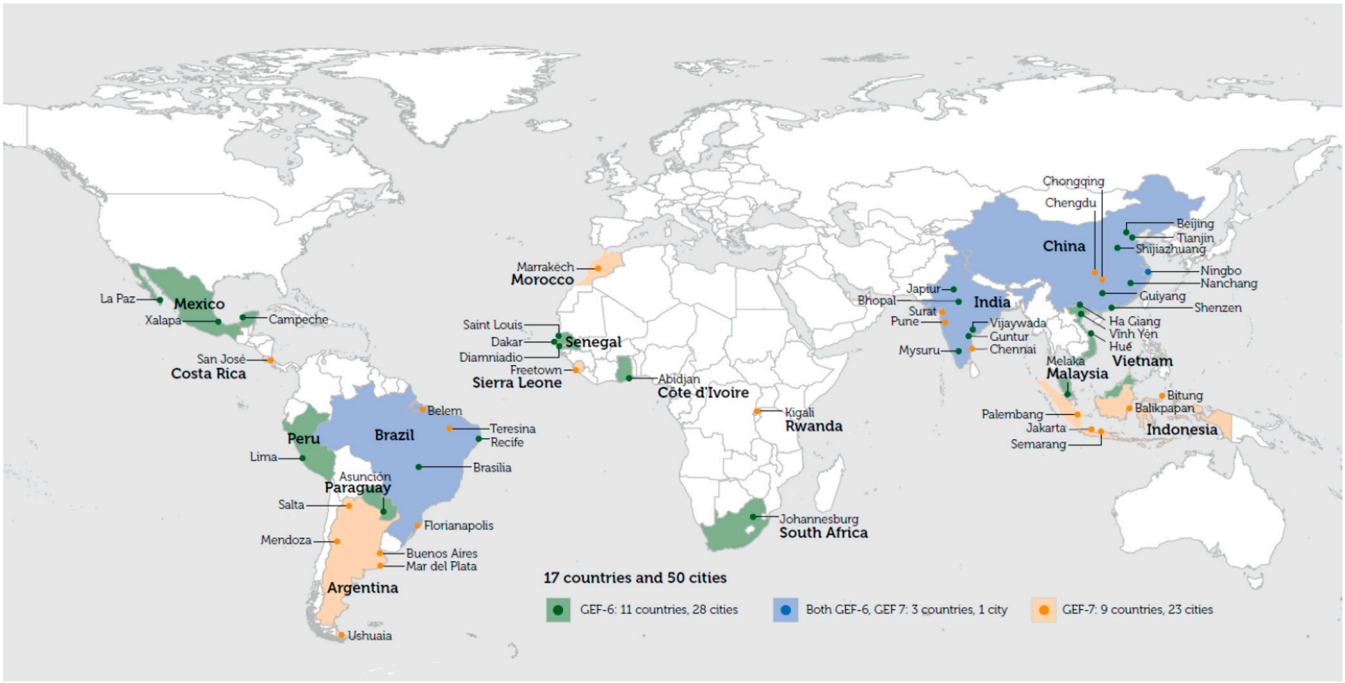

Figure 1. Global distribution of cities and countries in the GEF Sustainable Cities Program.

The focus on these cities as part of this study was motivated by two main factors. First, the GEF-SCP was under implementation when the COVID-19 outbreak took hold, and most of the participating cities developed context-specific responses to the challenges by harnessing their urban sustainability initiatives under the program. This overlap presented a timely opportunity for an assessment and documentation of the experiences to help inform the design of future programs.

Second, the GEF-SCP has amongst its objectives a focus on fostering transformational change and building resilience in cities. Therefore, the program was not only affected by COVID-19 but also offered possibilities to contribute to a green recovery by addressing issues of governance, finance, and innovation. Hence, the COVID-19 pandemic presented an opportunity to understand how cities demonstrate resilience to shocks and stressors by prioritizing their most pressing needs.

The selection of city case studies included in this paper was based on these two factors, and with a geographical coverage offering a wide range of perspectives and challenges. Useful examples from cities other than those in the GEF-SCP provide additional perspectives based on information provided elsewhere in the literature.

The study was conducted as a qualitative assessment of the findings and learnings that cities have gained before, during, and after the outbreak of COVID-19, drawing from documented experiences of projects. We reviewed original project design documents, project implementation reports, and unpublished case studies of city-level experiences. The focus was on identifying solutions and practices by cities as part of their COVID-19 response and blending them with a review of literature on impacts and responses by cities globally. No quantitative analysis or data collection was included in the study, as the focus was on the approaches and priorities made by cities because of the COVID-19 pandemic.

The assessment considered the effect of COVID-19 on urban sustainability solutions and its implication in future planning and investments. The ambition and leadership of many actors in the urban sphere, especially city leaders and financial institutions, international development organizations, academics, technical experts, civil society, and the private sector, was a particular focus.

Based on the findings, a conceptual framework for urban sustainability and resilience is proposed that draws on previous work [24] and articulates how cities can advance and integrate solutions while thriving in the face of hazards such as the COVID-19 pandemic. As cities around the world aspire for urban development pathways that are net-zero carbon, nature-positive, climate resilient, and inclusive, there is a need for more evidence on how solutions can be integrated to harness synergies and minimize negative trade-offs.

4. Results and Discussion

Amid the challenges posed by the COVID-19 pandemic, the experience gained from the GEF-SCP indicates that cities, for the most part, continued to advance sustainability solutions enabled by integrated solutions. The GEF-SCP promotes a holistic and integrated approach to urban sustainability with a focus on enabling policies and governance, land use planning, investments in innovative solutions, capacity building, and knowledge management. The approach enables cities to address multiple sectoral priorities in a cross-cutting manner and across governance levels. With urban governance taking place from the local to the national levels, it is essential to have clear roles with collaboration between the governance levels to achieve sustainable urban development [25]. While the relation between the sub-national and national development can be of very different natures depending on the country context, cities are actors that can accelerate sustainability and progress towards the SDGs by governance and policies that protect local and regional ecosystems, reduce pollution and GHGs, and alleviate poverty amongst others [26,27]. With better alignment between departments or sectors at the same governance level, the program aims to yield co-benefits from investments in sustainability solutions, hence helping to close the financing gap faced by many cities in the Global South.

Through its support for both vertical integration between levels of government and horizontal integration between sectors, the program is embracing a city-wide strategy for planning and implementation of sustainability solutions aligned with economic and social development objectives. The integration element and flexibility within the program allowed cities to incorporate health aspects in their interventions and customize their interventions to directly address COVID-19-related impacts while advancing sustainability solutions.

We recognize the inherent limitations of the overall findings because they are largely based on qualitative information provided by cities' and implementing partners' project implementation progress reports. We also acknowledge that there are many practical challenges and barriers to the implementation of integrated urban solutions, such as lack of financing, incoherent policies, siloed government structures, or a low capacity of cities to act on their priorities due to a lack of expertise and authority. The paper includes case studies that apply innovative solutions to overcome these challenges through, for example, mobilization of finance to cities, integrated governance structures, and increased policy coherence, but we do acknowledge that many cities face limited possibilities to address these issues and that the challenges can be very contextual.

The cities participating in the GEF-SCP have all demonstrated a willingness from both local and national governments to pursue integrated approaches. They have also received funding for these solutions, which can be a limiting factor for many other cities. The findings and conclusions should, therefore, be interpreted with these limitations in mind. Lastly, the GEF-SCP provides grants specifically for investments in solutions that generate global environmental benefits, which may affect the solutions observed under the program. At the same time, the program is not prescriptive but allows for the flexibility of cities to decide on the methods and solutions used.

Based on our more detailed report of the assessment entitled "Advancing Urban Sustainability for a Green Recovery" [24], we present a synthesis of city actions and interventions during the COVID-19 pandemic. Specifically, the city actions and interventions aimed at promoting environmental sustainability through the integrated approach predominantly focused on solutions in three key areas:

- Adoption of urban nature-based solutions;
- Incorporation of density and mobility in urban planning;
- Accommodation of circular economy approaches.

In the following paragraphs, we highlight and discuss specific experiences from cities in implementing these three solution areas during and post-pandemic and present observations that can inform future urban planning and design strategies. Our discussion primarily draws examples from cities under the GEF-SCP while also incorporating relevant experiences from other cities. The diversity of actions by countries under each solution category increased during the COVID-19 pandemic, as illustrated by the GEF-SCP examples shown in Table 1 below. We then highlight the implications of these city-level experiences for future efforts aimed at advancing urban sustainability and resilience.

Table 1. Summary of GEF-SCP urban responses by category of actions.

Category of Actions	Number of Countries Implementing Actions (*N* = 20)	Examples from the GEF-SCP
Nature-based solutions	12 (60%)	• Sierra Leone is supporting reforestation and increased vegetation cover in Freetown to prevent floods and landslides and create new green jobs. • Rwanda is rehabilitating wetlands in Kigali to strengthen biodiversity, climate resilience, and human recreational spaces. • India is restoring land around an important lake to promote ecosystem services of clean water and flood control and provide green spaces for citizens. • Brazil has introduced filtering gardens in Recife to improve river water quality thanks to natural plants and vegetation.
Density and mobility planning	12 (60%)	• China is promoting sustainable mobility and transit-oriented development to drive compact, vibrant, and better-connected urban development. • Paraguay is connecting urban neighborhoods and natural spaces through an extensive bike lane network across the metropolitan area. • Cote d'Ivoire's new zoning regulations for Abidjan are promoting planned densification of informal settlements with accessible non-motorized transport and more compact land use.

Table 1. *Cont.*

Category of Actions	Number of Countries Implementing Actions (*N* = 20)	Examples from the GEF-SCP
Circular economy	5 (25%)	• Costa Rica is carrying out legislative reforms, mapping existing circularity initiatives, and financing new business ventures with a circular approach. • Argentina is piloting sustainable neighborhood models in the center of Mendoza, prioritizing enhanced waste management through a circular economy approach. • South Africa is piloting new eco-districts in Johannesburg with decentralized infrastructure, waste management, and local food systems, including on-site management of biological waste and rainwater harvesting for reuse.

4.1. Cities That Put Nature at the Heart of Urban Planning Benefitted from Ecosystem Services to Improve the Health of People and the Environment

Nature-based solutions (NbS) include "actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature" [28]. NbS can bring social and economic opportunities, such as new green jobs for cities through investments in open green spaces, urban forests and agriculture, wetlands, and other green and blue infrastructure. The importance of linking nature with essential social aspects of jobs, services, and commodities was emphasized as one of the conclusions of the acclaimed Dasgupta Review, which was published in 2021 [29]. In addition, the strategic use of NbS in and around cities can help reduce risks related to nature-humans interactions, helping to overcome challenges of overexploited land, unsuitable wildlife trade, and ultimately aid the prevention of zoonotic diseases and pandemics such as COVID-19 [30]. Various research during and after COVID-19 found evidence that NbS contributed to cities' ability to handle the pressing challenges of both COVID-19 as well as existing environmental threats of climate change and land degradation [12]. Examples from the GEF-SCP and elsewhere suggest three different but related approaches by cities implementing NbS in the cityscape.

First, cities strengthened their resilience by using nature as a driving force to support safe and healthy lives for vulnerable urban groups. With COVID-19 came a debate around how access to nature relates to social inclusion and equity. This logic is also applicable to other environmental issues, such as climate change, that often have an unfair impact on city residents [31]. In Freetown, Sierra Leone, the "Freetown the TreeTown" program has as its objective to scale up the coverage of vegetation and green spaces to prevent landslides and floods in exposed areas. This came as a direct response to the 2017 landslide that caused many casualties and includes the goal to plant an impressive one million trees by the end of 2024 [32]. Kigali in Rwanda is making use of urban wetlands to create better living-conditions in unplanned neighborhoods, benefiting from green infrastructure to mitigate and adapt to climate change by controlling and promoting ecosystem services and biodiversity in these prioritized areas [33]. When it comes to youth engagement, nine different countries in Latin America and the Caribbean have developed free online training on urban afforestation called Doc Árbol [34], which was implemented as an alternative training method during COVID-19. The initiative is still ongoing and has so far helped 200 young people build their technical capacity and improve job opportunities [35].

Second, cities that applied a "transboundary" planning process managed to better link urban areas with surrounding ecosystems for multiple benefits. For instance, the metropolitan area of Greater Asunción in Paraguay is working to connect urban green spaces with peri-urban and rural nature reserves through the creation of green corridors. By bringing nature into the city, urban citizens can learn about its services and enjoy it for recreation. The natural area around the city also serves as an important meeting point for several globally significant ecoregions, and actions are taken by the city to support valuable biodiversity [36]. Similarly, in San Jose, Costa Rica, the development of interurban biological corridors aims to reduce biodiversity loss and restore critical natural areas in the city while simultaneously building the resilience of urban populations, promoting human health and socialization, and contributing to the mitigation of climate change [37]. These efforts are guided by a new decree on urban protected areas, highlighting the need for coherent policies across various sectors and levels of governance.

Third, cities have invested in urban green spaces and biodiversity conservation to boost the economy and strengthen social and health aspects. The value of working with nature has been seen as part of many government's efforts to support their economic recovery, with green job programs and initiatives such as New Zeeland's scheme Jobs for Nature [38] and C40's research on South Africa's potential to create local green jobs [39]. In many cities, communities lacking safe access to nature and greenery started influencing mayors and local leaders to invest more in urban parks after the COVID-19 pandemic. South Korea was one of the countries that benefitted from this growing public demand and focus on health, and saw several cities transforming roads into linear parks with pedestrian priority and very restricted vehicle traffic [40]. Lastly, the Indian city of Chennai is being supported by the GEF in upgrading 55 hectares of land around its Lake Kadapakkam to meet the needs of citizens and provide recreational spaces, walking paths, and play areas. At the same time, these interventions are intended to help retain floods and supply clean water—and create a safe resting point for migrating birds thanks to a revegetated island in a critical location between two important regional wetlands [41,42].

4.2. Strategic Density and Mobility Planning Helped Cities Deliver and Maintain Essential Services in a More Equitable Way

In spite of the advancement of new low-carbon technologies, GHG emissions are still increasing in many cities. This is primarily driven by large spatial expansions and urban sprawl, particularly in developing countries. To reverse these trends and ensure good living standards for urban populations, cities are bound to plan their density and mobility more strategically. Although density itself did not directly cause increased infection rates of the COVID-19 virus [43,44], the spread was fueled by inadequate urban services together with deficient hygiene and living standards. Several regions witnessed the highest infection rates in unplanned and sprawling areas [45]. For example, a World Bank report concluded that numerous dense Chinese cities were suffering a lower number of COVID-19 cases per capita than significantly less dense cities in the same country [46]. Hanoi, Singapore, and Seoul are other examples of dense cities that managed to control the spread of the pandemic well [44,47]. This indicates that cities with carefully planned land use for strategic expansion and densification are better placed to build resilience, and such thriving cities will keep GHG emissions at bay [48]. Three key trends were observed as evident in cities' efforts to promote livable density and sustainable mobility solutions.

First, cities strengthened their spatial connectivity by prioritizing clean mobility and compact urban forms for more vibrant and inclusive neighborhoods. In China, several cities, including Shenzhen, Tianjin, and Ningbo, have focused on Transit-Oriented Development (TOD) to reduce GHG emissions by reversing urban sprawl and associated car dependency. These cities have favored a walkable, mixed-use development centered around public transport [49]. As a result, they continued to promote low-carbon solutions during the pandemic and keep the local economy going as people could access jobs and meet their needs within short travel time of their homes. Also, during the COVID-19 period,

the metropolitan area of Asuncion in Paraguay involved communities and urban planning experts to co-design an extensive bike network with over 600 km of bike lanes [36]. With the increase in non-motorized transport that was seen during the pandemic, other cities can make use of this momentum to promote similar infrastructure solutions, supporting clean mobility options and encouraging a more active lifestyle. In Medellín, Colombia, the construction of a cable car in a low-income area has saved both time and money for the low socio-economic class who live near the station, including women. The installation has facilitated vocational job changes, which have led to higher incomes and increased the sense of pride that they feel about their neighborhood [50].

Second, cities that managed their expansion and growth in a planned and orderly manner strengthened their environmental equity and inclusivity. As an example, Cote d'Ivoire's coastal city, Abidjan, has identified its most vulnerable areas for targeted upgrades of road and drainage infrastructure in its local climate adaptation strategy to prioritize investments that will benefit those who need it the most. Further, to protect areas that are prone to shocks of sea level rise and flooding, the new zoning regulations are promoting a more compact land use with planned densification of informal settlements and better access to non-motorized transport [51]. In Bangkok, Thailand, a collective housing program called 'Baan Mankong' places residents in informal settlements at the center of decision-making linked to housing, environment, and services to tackle long-term development issues at the neighborhood scale [52].

Third, cities favoring mixed-use neighborhoods and eco-districts have been able to support communities to better meet their needs locally. As part of its economic recovery plan, the city of Lima in Peru prioritized the most vulnerable groups by bringing essential services closer to them. Through increased collaboration with the national government during the COVID-19 period, the city is now looking to improve public transport, waste, and security at the local scale and advance its green vision through measures such as bike paths and plantation of two million trees by 2022 all across the city [53]. These efforts demonstrate that with stronger local governance and more empowerment to act, cities are well-positioned to go beyond responding to challenges and converting these into opportunities. In Johannesburg, South Africa, new eco-districts called "Corridors of Freedom" are designed to integrate housing, transportation, infrastructure, and food systems in a decentralized manner. Using innovative and environmentally friendly technologies, the city aims to create low-carbon zones that can sustain its own needs while also lowering operational costs and harmful environmental impacts [54].

4.3. By Adopting Circular Economy Approaches, Cities Used Their Scarce Resources in a More Efficient Way to Reduce Dependency and Increase Resilience

Cities have a unique opportunity to promote resource efficiency and transition towards a circular economy due to the close relationship between industry and urbanization. This can enable them to effectively manage their waste, reduce resource demand, and alleviate the "weight of cities" [55]. By considering the local context and targeting strategic entry points, cities can initiate a much-needed shift towards a more circular urban metabolism model. In this regard, the pandemic put light on the importance of regional supply networks and urban production in reducing cities' reliance on imports. Although much of the underlying science required to increase circularity already exists, there is still a need for further efforts to operationalize and scale up circular practices in cities. To achieve this across increasingly complex value chains, more work lies ahead to enhance transparency and showcase the interconnectedness of production, consumption, disposal, and green livelihoods. Here, cities can learn from the informal sector, where many existing circularity solutions can be found. Based on examples identified during the assessment, circular economy approaches in cities are demonstrated through three actions.

First, innovative models for waste management and recycling created new jobs in collaboration with the private sector. In Nigeria, Lagos is seeing increased quantities of imported e-waste, with burning and improper end-of-life management leading to issues of

polluted air, water, and soil. Therefore, an Extended Producer Responsibility Organization (EPRON) has been set up as a platform uniting relevant stakeholders, from government bodies to international businesses and local waste-pickers. To cover the costs of managing the e-waste in a safe and sustainable way, fees will be collected through a new levy system. An economically self-sustaining model, this aims to boost circularity approaches that can generate new green livelihoods, support economic recovery, and, not least, improve urban public health locally [56]. Elsewhere, in Türkiye, a government led Zero Waste Program collaborates with international organizations through Public Private Partnership (PPP) ventures to combat pollution and protect the environment and public health. Through a partnership between France's Suez Group, Turkish waste management firm Altas, and the European Bank for Reconstruction and Development (EBRD), Türkiye secured a 29-year concession for circular economy waste services in several cities, including Canakkale [57].

Second, land use planning with spatial optimization has helped cities increase urban circularity by creating practical examples on the ground. COVID-19 challenged waste management as many cities in the Global South closed recycling facilities. And while waste management has suffered in many places, cities where circular approaches are already part of the culture were better placed to maintain or advance their systems [58]. This resilience in circular economies enabled these cities to keep many jobs, often in the informal sector, and avoid the deterioration of local environments. The city of Indore in Indian has shown how regulations and policies can support localized solutions such as upcycling waste into usable products or co-locating industries and food outlets with recycling facilities and composting plants [59]. European cities are now starting to include circularity aspects in their formal spatial planning processes. As an example, Amsterdam's spatial plan supports the creation of waste- and bio-clusters in the port to enable local looping actions where cooperation can emerge between proximate actors [60].

Third, cities that incorporated sustainable urban food production as part of their circularity solutions could reduce their dependency and support local green livelihoods. Growing populations and dietary changes mean that the world is expected to need a 60% increase in food production by mid-century [61]. COVID-19 exposed how fragile many food supply chains are, and low and middle-income countries are facing a higher risk of food insecurity as they urbanize due to their relatively greater dependency on imported food [62]. In the Brazilian capital, Brasilia, the Environment Secretariat is collaborating with civil society groups and local NGOs in piloting innovative land management solutions in highly vulnerable water catchment areas. Together with smallholder farmers, the city is promoting principles of agroforestry, carefully combining food crops and native trees, which has promoted local food production, lowered agricultural water demand, and created sustainable livelihood opportunities [63]. On the African continent, Cape Town, South Africa, witnessed how COVID-19 responses with alternative food distribution networks, electronic voucher systems, and urban agriculture support resulted in new and adaptive food supply chains that could boost preparedness for future crises. These novel structures emphasized the important role of civil society and community networks, encouraging government bodies to collaborate more with these groups [64].

5. Implications

The three categories of interventions described and discussed in the previous section were largely conceptualized by cities pre-COVID but obtained a significant momentum and scale during and the post-COVID-19 period due to their potential environmental, health, and economic recovery benefits.

For example, the integration of nature and application of nature-based solutions gained a very strong push from all around, including from policymakers, urban planners, and citizens who realized its value the most during the COVID-19 period. As an example, in the first phase of the GEF's Sustainable Cities Program, 50% of participating cities included nature-based solutions in their projects, whereas, in the subsequent phases, which overlapped with the COVID-19 period, all new participating cities included nature-based

and green infrastructure initiatives as part of their project components. Recent studies confirm that there has been a transformative shift in the approach to urban environments, where cities, instead of being held accountable for environmental degradation, are now recognized for their potential to nurture biodiversity and culture [35], recognizing that access to outdoor green space is a demonstrated public health asset in a post-COVID world [19]. Large open spaces could be used for evacuations during emergencies or for staging shelter and relief activities during COVID-19 and would also be beneficial in case of other disasters and shocks [65]. More systematic inclusion of nature in urban plans will be essential, especially since many of the most rapidly urbanizing regions in the world are threatening to grow into nearby biodiversity hotspots of global importance [66]. Encroachment of urban land to these important biodiversity regions could lead to natural disasters and resource depletion, affecting the well-being of people.

The COVID-19 pandemic triggered many discussions around the optimal size and morphology of cities, with many studies suggesting that a multi-core city may benefit from both proximity to services and economies of scale while overcoming issues with urban sprawl and long travel distances [7,19,67]. Transit Oriented Development (TOD) and the widely discussed concept of a 15-min city could help build stronger communities and raise their quality of life while at the same time addressing the causes and impacts of climate change and supporting greener cities post-COVID-19 [52].

These planning models have the potential to enable citizen's access to key services and amenities within proximity of their homes, thus minimizing redundant transportation within cities and enhancing the feeling of unity within urban communities [68]. In the aftermath of COVID-19, the shift towards more hybrid work solutions appears to have had a lasting impact on how urban populations view work [19]. With the pandemic already prompting a trend towards more local living, cities now have the chance to revitalize underprivileged areas and, in a decentralized fashion, enhance their access to services.

Predictions on the long-term economic impacts on cities after COVID-19 suggest a shift in economic activities that can result in vacant sites and unemployment. By creating adaptive and recyclable urban environments, cities can reduce waste and provide new sustainable jobs thanks to resource looping, ecological regeneration, and adaptation [69]. One positive aspect of the crisis response that is often highlighted is the change in social and political perception around circularity solutions, which allowed local governments to implement already existing policies and demonstrate their feasibility. Successful examples have emerged from city food hubs in Milan and Glasgow to avoid food waste [70]. The 2021 G20 Environment Communiqué also underscored the importance of cities in enabling and promoting a circular economy, emphasizing the importance of coordination across government levels of government and appropriate incentives to support cities advance towards this quest [71].

City leaders globally, especially those part of the GEF-SCP and connected through global city networks such as ICLEI [72] and C40 Cities [73], emphasized that the recovery from the pandemic needs to be beyond purely economic terms to one that also supports a more sustainable environment—arguing that healthy environment is essential for healthy people and for sustainable economic growth. The pandemic thereby brought to the forefront the concept of "Healthy Planet Healthy People". Its application was particularly strong in urban systems where people and nature are defining aspects, and people's well-being is directly dependent on the availability of natural resources and their services. Green spaces within cities, as well as trees and biodiversity around cities, provide clean air, water supply, flood management, food security, and other services that directly contribute to the resilience, health, and well-being of citizens.

Building on this notion, the authors propose a conceptual framework for sustainable and resilient cities that builds on the initial integration approach of the GEF-SCP and that aligns with the Healthy Planet Healthy People concept. It aims to broaden the integration aspect to prepare cities for a wide range of stressors and shocks in the future, such as the health shock they faced due to COVID-19.

5.1. The Initial Conceptualization of Integrated Approaches for Sustainable Cities and Its Evolution Post-COVID-19

The environmental challenges related to high GHG emissions, loss of natural resources, climate vulnerability and pollution are interconnected in urban systems with direct implications on social and economic aspects. Therefore, urban planners and experts have long been advocating for integrated approaches to tackle urban sustainability challenges in a coherent manner through integrated urban planning, cross-sectoral solutions, and multi-level governance, going beyond siloed sectoral approaches. Integrated urban planning considers interrelationships among housing, transportation, economic development, education, environmental sustainability, inclusivity, and other policy areas, including climate change [74]. Cross-sectoral solutions and approaches enable cities to factor in synergies and trade-offs of sustainability solutions with an overall objective of delivering well-being and effectiveness of solutions. Multi-level governance enables cooperation between national ministries and departments with their respective sectoral or thematic function and local governments to align plans, investments, and goals to achieve a wide set of sustainability goals at local, national, and global levels. These dimensions formed the basis of the GEF's Sustainable Cities Integrated Approach Pilot program, which was conceptualized and launched in the GEF-6 financing period (2014–2018) with the objective of delivering multiple and large-scale global environmental benefits. As naturally integrated systems, cities were in the right position to adopt this integrated approach to urban planning and signaled a paradigm shift to use GEF funding from single sector and focal areas to integrated and systems-based programs.

The integration framework conceptualized in the GEF-SCP in its pilot phase is shown in Figure 2. The paradigm shift involved focusing on drivers of environmental degradation, bringing development and environment agenda together, and connecting cities under one program to learn from each other and for collective global leadership on sustainability. The approach also enabled action at multiple scales and across different sectors and along with multiple partners. The multidimensional aspect of the approach enabled a diverse set of stakeholders to come together and work collectively toward sustainability. These stakeholders and decision-makers began to visualize the inherent linkage of local investments and policies in cities with national goals and the eventual global goals of sustainability and the environment [27].

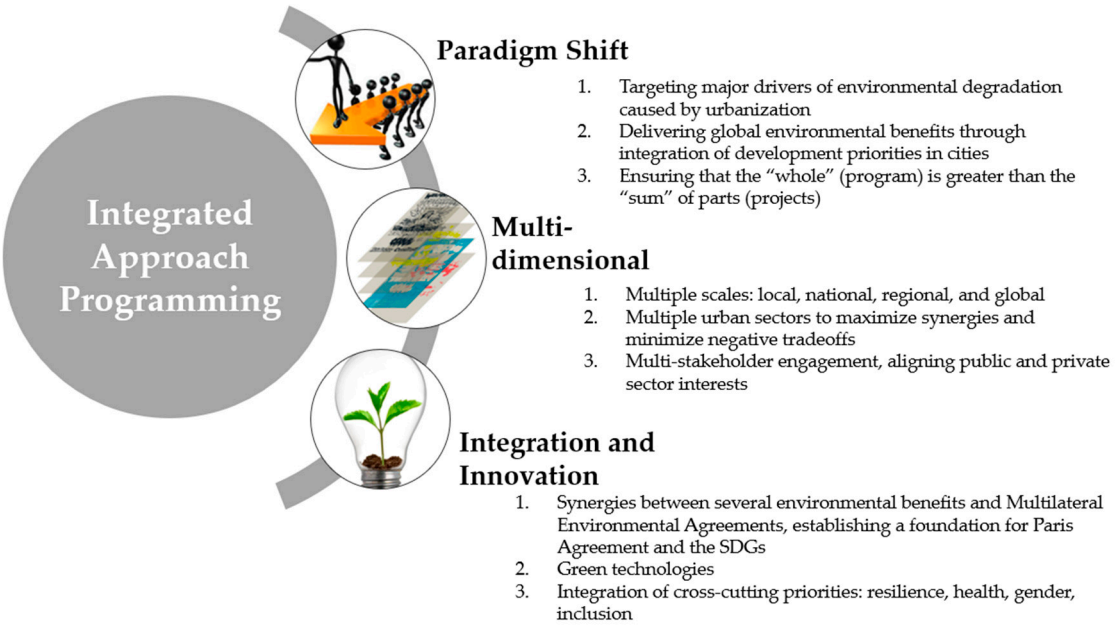

Figure 2. Key features of the Integrated Programming Approach adopted by cities pre-COVID-19.

Integrated and innovative sustainability solutions, such as nature-based solutions, strategic density planning, and circular economy approaches, started to emerge and gradually mature as effective entry points for urban sustainability for cities participating in the GEF-7 phase of the funding cycle. They were then reinforced as strategic priorities in the GEF-8 funding cycle (2022–2026) of the Sustainable Cities program [75]. Adoption and scale of these integrated solutions, which cut across spatially and across sectors and institutions in cities, led to the establishment of these solutions as opportunities to build synergies between different sectors and actors to tackle drivers of environmental degradation as well as other systemic urban and peri-urban challenges such as resilience, inclusion, and health.

By directly targeting drivers of environmental degradation in an integrated way, cities were able to maximize synergies and integrate different development priorities, as well as cross-cutting priorities of resilience, health, gender, and inclusion. This holistic approach generated both local and global environmental benefits and allowed cities to increasingly contribute to the goals of several Multilateral Environmental Agreements and the UN Sustainable Development Goals (SDGs). Thereby, the Integrated Approach Programming that was adopted by the GEF-SCP helped ensure that the program as a whole was greater that the individual projects—meaning the "sum was greater than its parts".

While this integrated approach was not specifically designed to factor in external non-environmental shocks such as pandemics, the solutions implemented during COVID-19 demonstrated how integrated programming helped cities respond more efficiently and tackle multiple challenges simultaneously. The pandemic has revealed the significant interlinkages of urban environmental, economic, social, and health systems, highlighting the necessity for more integrated solutions in cities. Projects that were designed and developed in an integrated and holistic manner prior to COVID-19 have offered cities under the GEF-SCP the flexibility and opportunity to respond effectively to the challenges posed by the pandemic.

Efforts made by many cities and countries toward institutional integration prior to COVID-19 contributed to better collaboration between different levels of government in dealing with the pandemic. These efforts laid the ground for cities to act on their priorities and access funding for their green recovery through better alignment with the national government agenda. Beyond the recovery phase, this harmonization will help in the effective recognition of innovative local interventions for their contribution to country-wide targets on sustainability and environmental performance. Moreover, it was observed that more empowered local governments prior to the pandemic were better placed to integrate crucial environmental parameters into their local plans, with specific consideration given to land use planning, resource efficiency, and biodiversity. This allowed these crucial sustainability aspects to progress even during the health crisis. The engagement and collaboration with a wider range of urban actors, such as civil society and the private sector, also proved invaluable and was further reinforced as a direct response to tackle the challenges that arose during the pandemic and allowed for better mainstreaming, inclusion, and innovation.

5.2. A Conceptual Framework for Sustainable and Resilient Cities

The experience of cities during the COVID-19 pandemic highlights the importance of the Healthy Planet Healthy People concept and reinforces the critical need for advancing integrated urban planning to support cities as they pursue aspirations for resilience and health. The Healthy Planet Healthy People framework is underpinned by principles for "inclusive, multidisciplinary, and cross-sectoral efforts that consider the shared costs and benefits of human, animal, plant, and ecosystem health and help readjust humanity's pursuit of a green, just, and equitable sustainability pathway" [21]. This framework can make cities better placed to tackle both shocks and stressors in the future—without knowing the exact nature of these. Building on this, we propose a conceptual framework for Sustainable and Resilient Cities, which articulates challenges, responses, and their links to transformational goals in cities, informed by the experience of tackling COVID-19 (Figure 3).

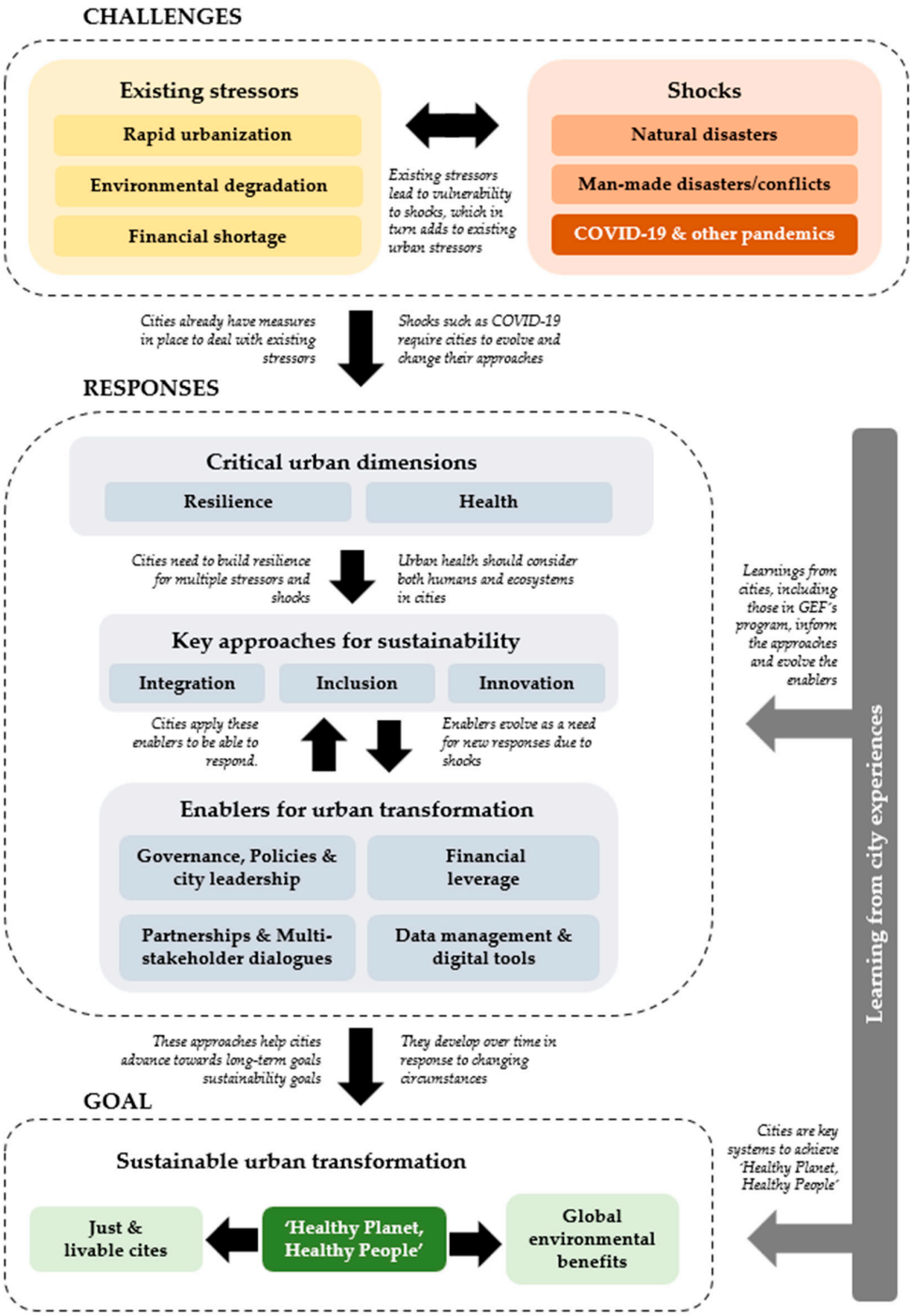

Figure 3. A Conceptual Framework for Sustainable and Resilient Cities.

As pictured in the diagram, cities were already dealing with several stressors prior to COVID-19 caused by rapid urbanization, environmental degradation, climate change, and financial shortage. These existing and persistent pressures have required cities to put in place measures and responses that can tackle them. Cities with a large proportion of the global urban population must adjust and adapt to face the new challenges that arise from both internal and external shocks. COVID-19 was an example of such a shock that pushed many cities beyond the edge of their capacity.

A major implication of the pandemic was the way that urban health and resilience were viewed in the urban space. While resilience was a key priority for mayors and local leaders also before the pandemic, the scope of what urban resilience needed to include

was redefined, and it became clear that many of the critical resilience aspects were, in fact, linked. Amongst these, health emerged as a component of resilient cities which underpins all urban life.

Integration, inclusion, and innovation, all recognized as important elements of the integration approach prior to the pandemic, were further advanced by cities and needed to be supported by enablers or levers that can facilitate sustainable transformation. Some crucial enablers include governance, policies, and city leadership; financial leverage; partnerships and multistakeholder dialogues; and data management and digital tools. These enablers will evolve as a need for increased or new responses to shocks, and many were accelerated by the pandemic. Learnings and lessons from cities, including those in the GEF-SCP, continuously inform actions and enablers used by cities, which will advance the integrated approach and provide the flexibility needed to tailor solutions to specific circumstances. Together, the responses outlined in the framework will help cities advance towards local and global long-term sustainability goals in a continuous response to various shocks and pressures. This transformation, centered around a Healthy Planet Healthy People concept, will not only benefit the global environment but also just and livable cities with better quality of life for urban populations. The implications of this evolution are summarized in Table 2.

Table 2. Evolution of city responses informed by the COVID-19 pandemic.

	Situation Prior to COVID-19	Evolution Informed by COVID-19 Responses
Critical Dimensions	**Resilience**	
	• Urban resilience is primarily looked at from the angle of climate change and natural stressors. • Linkages between different shocks and stressors are not always recognized or tackled simultaneously.	• The perspective of resilience broadened to multi-hazard resilience centered around flexibility and adaptation. • Awareness of existing vulnerabilities and weak links in cities is exposed, allowing more targeted city responses.
	Health	
	• Health is seen as an isolated issue mainly centered around human public health. • Contributions to human health and well-being promoted by cities taking an integrated approach were often viewed as a co-benefit to other investment focuses.	• The connection between health and resilience is made clearer. • Linkages between human and ecosystem health are strengthened, in line with the emerging Healthy Planet Healthy People concept.
Approaches	**Integration**	
	• Integrated approaches are increasingly adopted by cities, but siloed interventions with gaps between different sectors are still common. • Local, regional, and national governments have different agendas and do not always collaborate to reach their goals.	• Coordination between different departments and levels of government further advances as a necessity to be able to respond to the pandemic, which affected all parts of society. • A need for the integration of people and nature in urban planning became evident.
	Inclusion	
	• Growing inequalities in urban areas. • Access to basic services is not fairly distributed in cities. • Planning processes exclude certain groups in cities.	• Local leaders saw the need to provide basic services for all. • Growing momentum for increased equality in cities, with advocacy for "a just transition" at the global scale.
	Innovation	
	• Innovation is primarily seen as new technology solutions. • Challenges to implement new solutions due to reluctance by citizens and institutions.	• Speeding up of new ideas and mindsets observed as a result of the pandemic, with emphasis not only on technology but on behavioral and cultural change. • Increased acceptance of change amongst citizens. • Many temporary innovative solutions implemented during COVID-19 are here to stay.

Table 2. *Cont.*

	Situation Prior to COVID-19	Evolution Informed by COVID-19 Responses
Enablers	**Governance and Policies**	
	• Cities and local governments are challenged by limited space to act and access finance. • Efforts from communities and civil society operate outside of formal processes, often without recognition.	• Decentralization efforts and metropolitan scale coordination are on the rise. • Community-driven and local initiatives become more valued and counted on in addition to formal governance structures.
	Partnerships and Multistakeholder-Dialogues	
	• City networks and platforms are growing momentum and uniting cities around sustainability action. • The role of cities is slowly starting to receive recognition at the global scale. • Private sector engagement is absent in many urban sectors and processes.	• City networks and platforms kept cities connected and continued to offer support, sharing lessons during a very challenging time. • The importance of private sector engagement was realized as local economies suffered. • Cities are increasingly seen as key players in achieving global environmental and sustainability goals, thanks to united efforts. • Programmatic approaches make the sum of single projects and interventions "greater than its parts".
	Financial Leverage	
	• The urban financing gap is growing, and sources of finance are often limited. • Cities face limited capacities to access funding.	• Stronger alignment and collaboration between national and local governments have proven crucial to channel funds to cities. • Innovative market-based measures helped fill financing gaps. • Cities are increasingly supported to build capacity to access funds from various sources, including from global institutions.
	Data, Digital Tools, And Indicators	
	• Lack of reliable data in many developing countries. • Institutions and departments are not always sharing data between them. • Digital tools are emerging but not fully in use in urban planning processes. • Indicators to measure progress are missing for many aspects of urban sustainability.	• Stronger collaboration around data sharing to respond to COVID-19. • Recognition of the importance of indicators and measurements to track spread (and, in the future, track progress). • Lockdowns accelerated the development of digital tools for outreach, communication, and consultations.

The framework we have proposed is consistent with other recent publications focused on integration and transformative change for advancing urban sustainability. In a recent World Bank report [13], the need for integrated urban action was at the center of the proposed "Action-Oriented Framework for Healthy Cities", which highlighted coordinating institutions and sustainable financing as key factors for an enabling environment to promote public health. Asaad et al. noted that sustainability assessment tools can help cities in the Global South tackle their challenges through case study-based frameworks and tools [76]. The "Integrated-assessment tool" for future cities by Alnusairat et al. [77] focuses on linking health and resilience with the psychological impact of urban development.

Another rapidly evolving research topic post-COVID-19 is around urban resilience, from mostly focusing on climate and nature disasters to increasing emphasis on how recovery processes can reduce vulnerability and risk exposure by addressing urban poverty and inequality as key determinants [7]. It is now widely recognized that resilience thinking must be applied to the whole system and all societal groups to build stronger cities [78]. Research during and after COVID-19 has increasingly linked resilience with sustainable development, urban quality of life, and more focus on "healthy cities" [79]. The devastating impacts of COVID-19 drew the attention of city planners and policymakers to the need for

pandemic resilience [80], which must ensure integrated approaches to social, environmental, economic, and institutional systems, as well as health systems [81].

Further on the theme of inclusion, a recent "Transformative urban recovery" framework has emphasized how social movements contributed to a major COVID-19 reconstruction program with increased support to informal settlements [82], and a study from the United Kingdom argued that governments need to work more closely with cities to achieve an "Inclusive Renewal Deal" [83]. Several global reports also highlight inclusion, poverty, and inequality among the most important urban issues to address in the post-COVID city [7,19], and private sector networks like the World Business Council for Sustainable Development (WBCSD) and the World Economic Forum (WEF) point out Equity and Equality amongst the key imperatives to address in cities [84]. The need for a "just transition" can be seen from the perspective of the UN Sustainable development Goals (SDGs), where progress on "people-related" SDG targets (SDGs 1–5) is as poor or worse than progress on "planet-related" SDG targets (SDGs 6, 12, 13, 14 and 15) [85].

Responses to the COVID-19 pandemic have led researchers to highlight a new wave of urban innovation, where cities have relied on innovation in a wider sense—going beyond technology to changes in people's behavior and culture that allowed cities to approach new ways of doing things [86]. The urgency of the pandemic is believed to have made city leaders more aware of their growing responsibilities to provide essential services, clean air, healthy diets, adequate housing, and food security [87]. This broader perspective corresponds well to the observations made in this paper.

Amongst the enablers discussed in our framework, data and digital tools have lately received much attention, with studies pointing out how the pandemic accelerated digital technologies as a key enabler to address complex urban challenges while also supporting a green recovery [13,19,88]. Many have emphasized new risks with the current digitalization trend in urban governance, calling for increased digital inclusion which requires reliable internet access, affordable devices, and digital skills training to benefit all groups in cities to avoid generating new socio-economic inequalities [84]. These are important aspects that this paper does not go into depth on.

As seen immediately following COVID-19, research has also shown that city governance mechanisms with clear roles and effective coordination can be particularly decisive in their ability to bounce back to the normal state, depending on local governance actors' ability to handle shocks [7,89]. The relationships between cities, municipalities, and their rural surroundings have proven increasingly important to enhance their resilience post-COVID-19 [19], calling for a more regional or metropolitan approach to urban planning in line with the experiences presented in this paper.

Regarding the need for financial leverage, this is widely recognized as an important gap to fill and many studies are pointing out the need for diversified sources of funding [13,19,31]. The findings in this paper equally highlight the need to look at different sources but also put emphasis on the importance of coherent policies and multi-level coordination to not only mobilize more finance but also spend the limited resources in a more efficient way.

To summarize, while the themes in the framework proposed in this paper have been discussed in other research on urban systems, the Healthy Planet Healthy People concept and its application in cities has not yet received much attention. The COVID-19 pandemic triggered new thinking around many of the themes discussed above, in particular, health and resilience, which is what our framework aims to capture. Hence, it is building on rather well-known factors but applying them in the cityscape and linking them with their implications for the health of people and the planet in a way that can contribute to sustainable urban transformation in the post-COVID-19 era.

6. Conclusions

In this paper, we have demonstrated how the integrated approach can help cities to be better prepared for systemic shocks and new challenges emerging from urban development.

As cities around the world continue to experience a population increase, this approach will become more and more important for planning and investing in healthy and resilient cities. Furthermore, development partners and international financing entities such as the GEF can play an important role in supporting the establishment of platforms for innovation and learning to promote integration.

City responses during the pandemic reinforced the value of programmatic approaches, which enabled cities to learn from each other, keep connected, and remain motivated to work toward sustainability. For example, the GEF-SCP continued to operate virtually and enabled cities to stay connected and learn through webinars, discussions, and training [23]. The value of a programmatic approach also applies to other channels as cities join various networks and platforms to exchange knowledge through peer-to-peer learning. Such an approach also helps to ensure that the whole (i.e., the program, network, or platform) is greater than its parts (i.e., its projects or cities) in promoting collective action for urban transformation. After all, even if each city is unique and its challenges very context-specific, many cities across the world face similar challenges and can benefit from best practices—as well as mistakes—that other cities have been through. Especially during COVID-19, where the severity of the crisis demanded immediate responses and adaptation, speeding up these learning processes was key to successful responses for many cities.

Despite the difficulties that cities faced during the pandemic, the results presented in this paper aim to shed light on positive changes that can lead to long-lasting effects in cities. We believe that the approaches highlighted in our framework—integration, inclusion, and innovation—will become cornerstones of sustainable cities as the world heads towards an even more urbanized future.

The GEF program on sustainable cities offers opportunities for research and understanding of approaches to urban transformation, guided by a Healthy Planet Healthy People concept. As a financial mechanism for multilateral environmental agreements, the GEF aspires to remain enlightened by scholarly works and assessments as it supports sustainable urban transformation for achieving global environmental benefits. We hope that this paper will catalyze such work to continuously inspire action by cities and national governments, especially in the global south.

As part of future research on the theme of integrated urban planning and the impacts of COVID-19, more in-depth discussions with urban planners and policymakers at various governance levels can provide additional findings on specific outcomes, as well as more information on the practical challenges and constraints that they face. Contextual factors, for example, the political and geographical landscape, can be explored further to bring additional insight into differences between countries, governance models, and the degree of decentralization in cities. Lastly, assessing the quantitative impacts of integrated urban planning solutions, such as the solutions presented in this paper, can contribute to more understanding of its benefits at both the local and the global levels.

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