The Making of Sustainable Urban Development: A Synthesis Framework

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Abstract: In a time of rapid climate change and environmental degradation, planning and building an ecologically sustainable environment have become imperative. In particular, urban settlements, as a densely populated built environment, are the center of attention. This study aims to build a clear and concise synthesis of sustainable urban development not only to serve as an essential reference for decision and policy makers, but also encourage more strategically organized sustainability efforts. The extensive similarities between environmental planning and a policy-making/decision-making/problem-solving process will be carefully examined to confirm the fundamental need to build a synthesis. Major global urban sustainability rankings/standards will be presented, discussed, and integrated to produce a holistic synthesis with ten themes and three dimensions. The study will assemble disparate information across time, space, and disciplines to guide and to facilitate sustainable urban development in which both environmental concerns and human wellbeing are addressed.

Keywords: sustainable urban development; synthesis framework; environmental planning

1. Introduction

1.1. Challenges of Climate Change and Environmental Degradation: Cities on the Front Line

The climate change we are facing now is of large scale and high speed, unprecedented and unseen in the past. It occurs across national borders and geographical boundaries and has already taken its toll on humankind. The Fourth Assessment Report (AR4) compiled by the Intergovernmental Panel on Climate Change (IPCC) makes a shocking but truthful observation: global average surface temperatures have increased by about 0.74 °C over the past one hundred years (between 1906 and 2005) and 2005 and 1998 were the two warmest years in the instrumental global surface air temperature record since 1850 [1]. In the Fifth Assessment Report (AR5) released in 2013, new atmospheric temperature measurements are used and the IPCC goes further to "show an estimated warming of 0.85 °C (1.5 °F) since 1880 with the fastest rate of warming in the Arctic" [2].

Several different scenarios of the 21st century global temperatures and greenhouse gases (GHGs) concentrations have been described in the AR5, and it has been projected that "global surface temperature increases will exceed 1.5 °C and keep rising beyond 2100 in all scenarios except the lowest-emission scenario" [2]. The speed of global warming is picking up and, without cooperative measures from around the world to limit GHGs emissions, "in the scenarios with higher rates of emissions, warming is likely to exceed 2 °C by 2100, and could even exceed 4 °C" [2]. Also noted by the IPCC is that rising sea levels are a particularly serious outcome of global warming. Worldwide sea level is expected to increase by 8–88 cm during the 21st century [3].

As temperatures increase, more floods, droughts, diseases, famines, and wars will follow, creating millions of dislocated people and destroying ecosystems. According to a team of health and climate scientists from the World Health Organization (WHO) and the University of Wisconsin at Madison, global warming and climate change will not only threaten our health in the future, but also cause more than 150,000 deaths and five million illnesses every year. This number is estimated to double by 2030 [4]. Once the 2 °C threshold of temperature increase is passed, the balance of ecosystem will be thrown off, food and water safety will be compromised, and extreme weather events will strike. Ultimately comes the extinction of all species.

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" [5]. It is stated clearly that climate change here refers only to the type originating from human causes. After decades of careful observation and examination, the scientific community has reached a consensus, concluding that climate change is indeed happening and various human activities are to take the majority of the blame.

Such a claim is supported by the United Nations Human Settlements Programme (UN-HABITAT), which has identified that, since cities are heavily populated and concentrated with human activities like manufacturing and consumption, they produce nearly 60%–70% of the total GHGs emissions. However, cities all over the world take up in total only 2% of the land [6]. It should also be noted that cities not only rank as the most prominent GHGs sources, but also "concentrate disproportional parts of the economy, resource consumption and the decision-making power in most countries" [7]. A staggeringly high proportion of "75% of the global economic production takes place in urban areas" [7]. Not surprisingly, it comes with a price: cities consume 75% of the planet's resources, generate a comparable percentage of waste, including air pollution, solid waste, and toxic effluents [8] and use 67% of the total global energy consumption [7]. From this perspective, it follows that urbanization, or to be more specific, urban development is indeed strongly associated with environmental degradation.

1.2. Reserch Rationale and Objective

Around the globe, rapid urbanization has created immense burdens on public infrastructure, such as transit systems and utility facilities. It has also produced a highly stressed and strained ecosystem. The ongoing reciprocal action between climate change and urbanization further complicates the situation and has greatly threatened the global natural environment, economic development, social stability, and human wellbeing. Combining highly concentrated population and economic assets, urban settlements are truly the places where human impacts on the environment are most extensive, persistent, and focused. Accordingly, it is well recognized that careful planning of the environment of urban settlements will be the crucial step to securing a sustainable future.

The fact that cities are the places where a large portion of economic activity and consumption take place means that human impacts on the environment will be the most intense. Contrariwise, environmental impacts on human society will be the most visible. In short, cities are fundamental to climate change management efforts. This compelling fact defines the scope of argument in this study. Namely, the focus of environmental planning presented and discussed below will be perceived from the perspective of urban settlements. We aim to address the challenge of sustainable urban development by means of offering a concise synthesis framework. It will register all concerns in environmental issues and human wellbeing. It will not only serve as a fundamental reference for decision and policy makers, but also encourage more strategically organized efforts in sustainable environmental planning.

In this study, Section 1 presents an overview of the problems of climate change and environmental degradation originating from human activities. The rest of the study is organized as follows. Section 2 begins with an investigation of the role of cities both in creating and in addressing the issues of sustainable urban development. Then comes an extensive review of a range of concepts and approaches

developed by a variety of bodies, showing their focuses and areas of overlap and divergence. Section 3 moves on to argue that environmental planning is a form of policymaking which in its turn is a type of problem-solving that requires a clear formulation of agenda, hence the need of a clear synthesis framework. The framework is finally offered by Section 4, which merges together all the approaches considered through an integrative methodology in order to give them consistency and exhaustiveness. Section 5 in conclusion indicates directions for future applications and research.

2. Overview of Urban Planning and Sustainable Urban Development

2.1. The Role of Urban Planning in Sustainable Urban Development

The world's first cities can be dated back to 3500 B.C. It is generally agreed by scholars that the Uruk Cluster in Mesopotamia is humanity's first great urban center and city [9]. It was located 150 miles south of the modern-day Baghdad and, ever since its establishment, cities have come in to existence all over the world. Early into the 21st century, cities have started to appear with greater frequency. According to statistics calculated by Global Health Observatory, a program run by the WHO, as of 2010, more than half of all people live in urban areas. It is projected that by 2030, six out of every 10 will live in cities, and by 2050, this proportion will increase to seven out of 10 [10].

Although cities cover only a trivial percentage of the land, they are densely populated and create a high volume of economic activities. It has been observed by the International Bank for Reconstruction and Development that "by enabling density—the concentration of people and economic activities in a small geographic space—cities have helped transform economies for many centuries" [11] (p. 1). Statistically, 50% of world gross domestic product (GDP) is generated on just 1.5% of the world's land, practically all of it in cities [12]. Cities are characterized by high population densities and prosperous human activities and, as stated above, around 70% of GHGs released into the atmosphere are attributed to urban residents [6]. It is hoped by focusing on the planning of cities, the most prominent GHGs sources, we might facilitate sustainability and improve human comfort and development at the same time.

Urban planning is defined as "the planning and designing of buildings, roads, and services in a town" [13]. In "urban planning," we deal with two concepts: "urban environment" and "planning." Even though the first term is frequently used, it does not mean that it has a universally-agreed-upon definition. In fact, as to what an urban area stands for or what it is comprised of, we still do not have a consensus [14]. In most countries, whether a settlement or population should be classified as rural or urban often depends on its population number, density, physical characteristics, or administrative functions [15]. The International Council for Science proposes a synthesized definition to call urban environment "the natural, built and institutional elements that determine the physical, mental and social health and wellbeing of people who live in cities and towns" [16] (p. 8). As for "planning," if used in a city or business context, it usually refers to "the establishment of goals, policies, and procedures for a social or economic unit" [17]. From the discussion above, we can see that "cities have thus been planned from the beginning, enabling new settlements, economic specialization, and cultural expression" [11].

Urbanization is most evident in the context of cities where the majority of global population resides and therefore brings about the most significant environmental impact. It can be reasonably inferred that human activity is the principal driving force of various kinds of environmental problems. With so many residents and properties in them, cities are also the most vulnerable in the face of extreme weather events or other climate-related impacts. For example, compared with rural areas, big cities will encounter a more rapid temperature increase because of the heat island effect. According to the United States Environmental Protection Agency, any city with one million people or more can be 1–3 °C warmer than surrounding areas in terms of the annual mean air temperature [18]. This shall increase or aggregate health problems. From this point of view, cities are indeed both the victimizers

and the victims. To solve this cyclical problem, cities, or urban settlements, should be carefully planned from the beginning.

2.2. Different Views and Aspects of Sustainable Urban Development

To address the challenges of climate change and environmental degradation, more holistic planning of urban development has become our immediate priority. In 1973, the United Nations Environmental Progamme (UNEP) declared 5 June of every year as the World Environment Day to promote global environmental awareness of the importance of taking prompt action to protect and to preserve the Earth. Its theme in 2005 was "Green Cities" and used the slogan "Plan for the Planet!" Starting from 1986, the UN-HABITAT nominated the first Monday of every October as the World Habitat Day. Every year, in the commemoration of this day, a specific topic on urban environment and development is celebrated, such as "Planning Our Urban Future" in 2009, "Better City, Better Life" in 2010, and "Cities and Climate Change" in 2011. They all call for cities around the world to alleviate pressure on the ecosystem and to ensure the quality and security of our living environment.

The aim of sustainable urban development has emerged and spawned numerous urban settlement theories, including the "Healthy City", "Sustainable City", "Low-Carbon City", "Transit-Oriented City", "Compact City", "Smart City", "Green City", and "Livable City". These theories may come with different concerns in different areas, but they all share one central idea and ultimate goal: achieving maximum development with minimum resource consumption and environmental impact to ensure the well-being of both humans and the Earth.

Investigating the relationship between humans and environment has always attracted considerable attention. The concept of the "Healthy City" is used in the field of public sanitation and city design; it emphasizes how policies can influence human health. It originated in the mid-19th century and its modern incarnation appeared in the Initiative on Healthy Cities and Villages advocated by the WHO in 1986 [19]. At the time, 11 cities were initially chosen to participate in the project and follow the principle of "Health for All (HTA)" [20]. The WHO points out that many factors, including society, economy, and environment, influence human health, so planning a Healthy City not only involves public health protection, but also requires efforts in political, economic, and social arenas [21]. A Healthy City will bring many benefits, such as "a clean, safe physical environment of high quality", "the meeting of basic needs for all the city's people", and "an ecosystem that is stable now and sustainable in the long term" [20].

The WHO initiated the Healthy Cities Project in 1990 and 47 countries participated in it during the first stage. At the time, the WHO drew up 53 Healthy Cities Indicators as initial references and continued to collected relevant data and statistics. After meticulous study and analysis, the 53 indicators were condensed into 32 and were classified in four categories: Health Indicators, Health Service Indicators, Environmental Indicators, and Socio-economic Indicators [22].

Since the urban environment comprises a wide range of elements and its form of planning is varied, the "Sustainable City" has become a major trend in many countries. It takes environmental impacts into consideration during the design phase of city planning and encourages residents to actively reduce their energy and water consumption and to limit their emissions of GHGs and other pollutants. In 2002, the International Environmental Technology Centre of the UNEP and the Environment Protection Authority of Victoria in Australia collaborated to hold an international expert panel in Melbourne. From it, the Melbourne Principles for Sustainable Cities were developed. The vision promoted by the principles is to "create environmentally healthy, vibrant and sustainable cities where people respect one another and nature, to the benefit of all" [23]. Rather than a fixed framework, the principles are designed to be flexible enough to be adopted by any cities and they provide a starting point for decision-makers on the journey towards sustainability, assisting government officials in understanding the implications of decisions taken at a broad strategic level [23].

The "Low-Carbon City" is sometimes referred to as the "Low-Emission City". To confront the issue of ever-increasing GHGs emissions, the UNEP and the UNFCCC have been advocating Adaption and Mitigation: the former addresses the adverse effects of climate change, responds to the impacts of existing climate change, and improves resilience against future impacts [24]; the latter refers to reduction or prevention of GHGs emissions. For example, "mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior" [25].

A Low-Carbon City uses mitigation strategies in urban planning with the aim of enlisting efforts from not only the public and private sectors but the whole community significantly to cut down emissions. In *Global Report on Human Settlements 2009—Planning Sustainable Cities: Policy Directions* published by the UN-HABITAT, it has been strongly advocated that "the key objective of the trend towards 'carbon neutral' cities is to ensure that every home, neighbourhood and business is carbon neutral. Carbon neutral cities are able to reduce their ecological footprint through energy efficiency and by replacing fossil fuels" [26] (p. 149). From this statement, we can reasonably infer that "low carbon," or the ultimate "carbon neutral", has become the goal of all sustainable urban development. Such awareness and action are essential if the world is to shift to "post-carbon cities" [27]. The World Bank launched the Low-Carbon Livable Cities Initiative in September 2013 and planned to help 300 large cities in developing countries to transition into low-carbon settlements in the next four years. Assistance will come in the form of planning and financing and necessary assistance will be promptly provided.

Along the same lines, several programs have been in place to help cities reach the goal of carbon emissions reduction or carbon neutrality. Examples include the Cities for Climate Change program by the Local Governments for Sustainability, the Clinton Foundation's C-40 Climate Change Initiative, Architecture 2030, and the UN-HABITAT's Cities for Climate Change Initiative. These programs all stress the importance of reducing energy use wherever and whenever possible, especially in the building and transportation sectors. Since transport creates the primary form of any city, it is frequently regarded as the most fundamental infrastructure for a city [28] and naturally should be the focus of any urban sustainability efforts.

One of the dominant features of modern cities is high density. Those in developing countries often have much higher density than those in developed countries. If vehicles in these confined spaces are not controlled in numbers, or have poorly-maintained fossil fuel engines, serious air pollution will surely follow. Therefore, cities have to rigorously monitor and manage such emission sources [29]. Transit-Oriented Development (TOD) has the potential to address this issue. TOD represents a neighborhood incorporating a mélange of land uses centered around a transit station [30]. Within a short walking distance from the core, usually in ten minutes, residents can easily access all kinds of daily services, such as retail stores, offices, and residential quarters. The function and importance of TODs are emphasized as follows [31] (p. 2):

> "the location, mix, and configuration of land uses in TODs are designed to encourage convenient alternatives to the auto, to provide a model of efficient land utilization, to better serve the needs of [. . .] diverse households, and to create more identifiable, livable communities".

TOD can not only reduce car use per capita by 50%, but save households about 20% of their income because they can manage with average one fewer car, or even none [32]. It also enables low carbon housing. For instance, in the United States, shifting 60% of new growth to compact/high-density patterns will reduce CO_2 emissions by as much as 85 million metric tons annually by 2030 [33]. Compared with traditional community development, TOD expands facets of economy, comfort, and environment. As identified by Belzer and Autler [34], measures of livability which relate to TOD include reduction of gasoline consumption, increased walkability and access to public transportation, decreased traffic congestion, positive health outcomes, and more convenient access to services, activities, and public spaces. Cities, or the built environment, are all too often the most prominent

GHGs sources. In other words, they are the key to success of any efforts towards emission reduction. TOD illustrates that, in urban development, environmental concerns and human interest can be balanced at the same time under the common goal of sustainability for all.

The "Compact City" also strives for TOD and plans for roads, streets, and neighborhood networks that promote walkability and are convenient for all users. It is high in density and social diversity, emphasizing the optimal provision of infrastructures in cities of small and medium size and advocating local production and consumption. In it, economic and social activities often overlap and community development is focused on the neighborhood. Therefore, energy and space efficiency can be greatly enhanced.

In *Urban Patterns for A Green Economy—Leveraging Density*, a report published by the UN-Habitat in 2012, five Ds that characterize a compact city are proposed: Density, Diversity, Design, Destination, and Distance to Transit. The five Ds show the importance of making good decisions on locations, urban structures, and street networks in order to weave an urban fabric conducive to walking, cycling, and public transit [35]. With similar ideals in mind, the Institute for Transportation and Development Policy (ITDP) released a report named *Europe's Vibrant New Low Car(bon) Communities*. It puts forth eight principles for smart urban growth, or a smart city: promote walking, prioritize bicycle networks, create dense street networks, support high-quality transit, plan for mixed land use, match density with transit capacity, create compact regions, and regulate parking and local road use [36]. In the report, the ITDP emphasizes the importance of walking, cycling, and quality public transportation and believes that the key to emission reduction is to cut back on the use of vehicles that burn fossil fuels. The belief is actually summed up in the title of the report, *Europe's Vibrant New Low Car(bon) Communities*, as the word "car" is plainly stated.

In literature on the subject on sustainable urban settlements, the notion of "greenness" has also become influential in recent years. It is frequently presented as "greening" or "green", and can be found in various city rankings, such as the European Green Capital Award (EGCA) and the Green City Index. The EGCA aims to "reward cities which are making efforts to improve the urban environment and move towards healthier and sustainable living areas" [37]. Siemens AG and the Economist Intelligence Unit (EIU) collaborate to survey cities in more than 120 countries. The focal geographical regions cover Europe, Latin America, United States, Canada, Asia, and Africa. Cities are assessed and compared in terms of environmental performance. The final evaluation results will be compiled and presented as the Green City Index, showing weaknesses and strengths of each region and each city. The Green City Index is targeted to measure and to rate the environmental performance of cities, "touching on a wide range of environmental areas, from environmental governance and water consumption to waste management and greenhouse gas emissions" [38] (p. 4).

As urban settlements represent a built environment with various man-made architectural structures, the concept of greenness is also embodied in contemporary building standards. Both homes and commercial buildings use large amounts of energy for heating, cooling, cooking, and management of waste. Attempts to rein in such energy use and its subsequent GHGs emissions from fossil fuel combustion have led to an increase of green building standards that promote better occupant comfort and lower environmental impacts at the same time. In general, a green building aims to be responsible to the environment during its entire life cycle and to increase its energy efficiency at different stages, including siting, design, construction, operation, maintenance, renovation, and demolition. It requires close cooperation among design teams, architects, engineers, and clients [39]. Compared with traditional ones, green buildings expand concerns of economy, utility, durability, and comfort [40]. Around the world, "incentives or requirements for buildings to meet green-building standards have been used in some cities as part of a move towards carbon neutrality" [26] (p. 41).

The notion of "livability" is also highly noteworthy. It is sometimes presented as "liveability" or "livable/liveable", and appears in numerous documents from both public and private sector organizations. For efforts made by public organizations, the most recent and significant one is the Better Life Initiative, which is the culmination of research results published by the Organisation for

Economic Co-operation and Development (OECD) in 2011. The OECD has put in more than a decade of work and has subsequently assembled internationally comparable measures of well-being, called the Better Life Index. The Index is one of the core products from the Initiative. It invites users to compare well-being across countries according to the following 11 topics: community, education, environment, civic engagement, health, housing, income, jobs, life satisfaction, safety and work-life balance [41]. The OECD's goal lies in "developing statistics to capture aspects of life that matter to people and that shape the quality of their lives" [41] (p. 1).

For notions deployed by private sector organizations, there are also numerous examples. By way of example, the EIU runs a global survey of livability entitled the "EIU Liveability Ranking". It states that livability "assesses which locations around the world provide the best or the worst living conditions" [42] (p. 1). Mercer, a global leading human resources consultancy, publishes "Quality-of-Living Reports" that rank cities in terms of quality factors including political/social/ economic environment, medical/health considerations, and education [43]. Monocle, a global affairs magazine, holds its annual "Quality of Life Survey", previously named "The Most Liveable Cities Index". It rates the "components and forces that make a city not simply attractive or wealthy but truly liveable" [44] and announces every year its top 25 livable cities in the world, based on "statistics collected on population, international flights, crime, sunshine, tolerance, unemployment rate, upcoming developments, electric car charging points, culture, bookshops, green space, street life, and dinner on a Sunday" [45].

Presented above are some of the most notable and most frequently-cited global livability rankings. Through them, we may get a fuller understanding of what livability is. However, livability "does not come packaged in a single accepted definition" [46] because the concept has constantly been associated with an abundance of social characteristics and physical aspects. It involves not only elements of the daily physical environment but ideals of placemaking. From this point of view, "a livable community is one that has affordable and appropriate housing, supportive community features and services, and adequate mobility options, which together facilitate personal independence and the engagement of residents in civic and social life" [47].

3. Environmental Planning as Read in Policy-Making, Decision-Making, and Problem-Solving

Innumerable countries are now faced with the same challenge: how to design and develop sustainable urban settlements. Environmental planning in this sense is much like a problem-solving process. We should also bear in mind that for any environmental planning to be sustainable, it should take into consideration the environmental, social, political, economic, governance, and ethics factors that can influence and determine the relationship between natural systems and human systems. All concerns have to be addressed in balance in order to render well-rounded decisions and polices.

If inspected in fine enough detail, policy-making is in principle strongly similar to decision-making, as interpreted since the 1950s. Harold Lasswell [48] was one of the first to view the overall process of policy-making through the lens of "phases" or "stages." He put forward the following seven "stages" of "the decision process": intelligence, promotion, prescription, invocation, application, termination, and appraisal. Since Lasswell's identification of the seven stages, there has been an abundance of variants to the number and specification of the stages [49–56]. Though the set of stages has been challenged and placed under scrutiny over the years, it remains a firm basis for subsequent study in policy science and policy analysis [57].

Stemming from the work of Lasswell are countless policy-making models. Stokey and Zeckhauser [58] propose a five-step process in which the analysts are charged to determine the underlying problem and objective to be pursued, set out possible alternatives, predict the consequences of each alternative, determine the criteria for measuring the achievement of alternatives, and to indicate the preferred choice of action. Anderson's [59] policy process model has six stages: problem identification, agenda formation, policy formulation, policy adoption, policy implementation, and policy evaluation. Quade [60] lists five elements: problem formulation, searching for alternatives,

forecasting the future environment, modeling the impacts of alternatives, and evaluating the alternatives. Hill [61] and Jann and Wegrich [57] also describe five steps: agenda setting, policy formulation, decision-making, implementation, and evaluation.

These kinds of policy-making processes have a strong resemblance to decision-making. A large number of decision-making processes or models have been proposed in literature over the years. In a simplified and generalized sense, a decision-making process can be portrayed as a problem-solving process. After analyzing 25 such decision processes, Mintzberg *et al.* [62] summarizes them into a three-phase model: (1) Identification of issues and goals; (2) Development of alternative solutions; and (3) Selection of alternative [63]. The rational decision-making model [63,64] has often been used as a reference frame when depicting decision-making processes. Though it can be a reductionist version of reality, it can still offer a close impression of the decision-making process via six steps: goal clarification, solution search, solution analysis, solution evaluation, decision, and control [64].

In Figure 1, we can clearly see the similarities among the classic policy-making process, the decision-making process, and the problem-solving process.
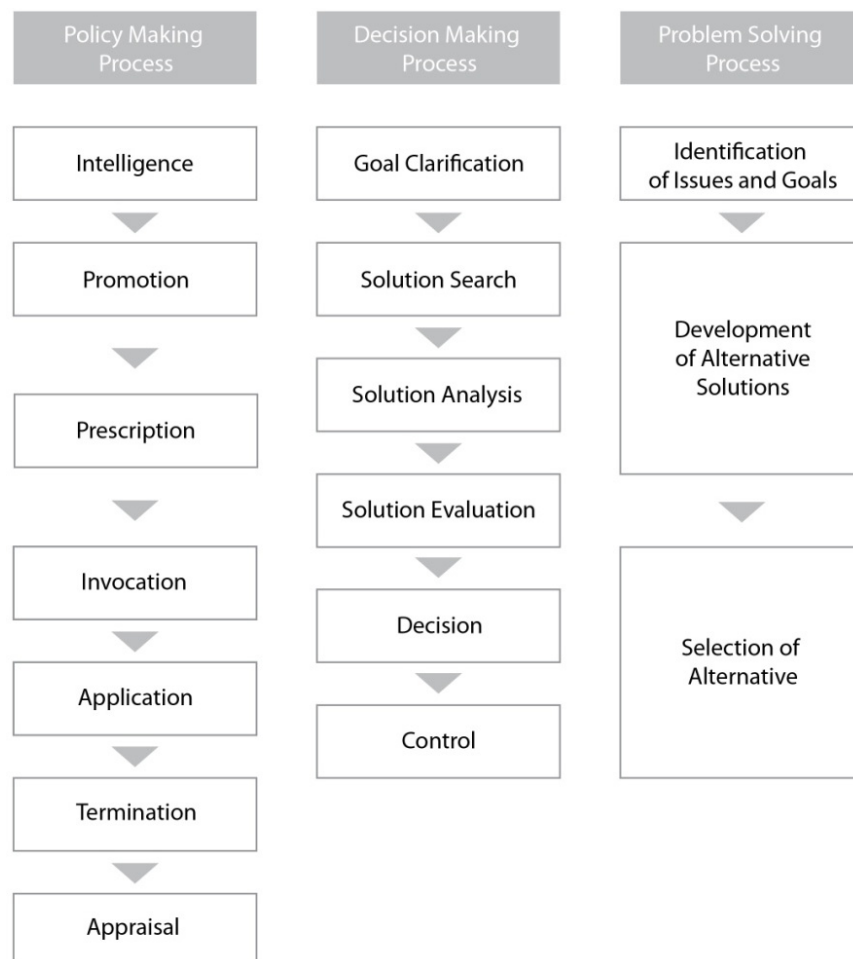

Figure 1. Comparability among policy-making, decision-making, and problem-solving processes.

Whether it is the policy-making, the decision-making, or the problem-solving process, the first and foremost step is to determine areas of concerns based on available information. Any later efforts in subsequent steps can thus be made in a more efficient and directed way. Applying such a concept in the context of sustainable urban development, we can readily infer that a synthesis framework that encompasses the complete range of human and environmental wellbeing will be the top priority (Figure 2). Since the concept of sustainable urban development is multidimensional, efforts made in

the field could be diverse, random, and not strategically organized. Such a framework should be able to provide the big picture, that is, to summarize complex issues for supporting policy makers and encouraging more focused efforts.

Figure 2. Building a synthesis framework as fundamental first step.

4. A Synthesis Framework with Dimensions and Themes

This section elaborates on how the synthesis framework is constructed and consists of four subsections:

- Subsection 4.1: Defining Sustainable Urban Development
- Subsection 4.2: Global Rankings/Standards of Urban Sustainability: Different Focal Areas
- Subsection 4.3: Global Rankings/Standards of Urban Sustainability: Sorting Indicators into Themes
- Subsection 4.4: Global Rankings/Standards of Urban Sustainability: A Synthesis Framework

It begins with Subsection 4.1, which establishes an original definition of sustainable urban development. An integrative methodology used in this study to build the synthesis framework is introduced in Subsection 4.2, and 10 representative urban sustainability rankings/standards are selected in this subsection. All indicators from the rankings/standards are collected and sorted into new themes in Subsection 4.3 Finally, Subsection 4.4 integrates the new themes into dimensions and produces a synthesis framework.

4.1. Defining Sustainable Urban Development

In the search for a sustainable development pathway, the United Nations World Commission on Environment and Development published in 1987 *Our Common Future*, also known as the *Brundtland Report*. It is considered the starting point of the global discourse on sustainability and defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [65] (p. 37). Sustainable development carries different meanings to different people, subject to their position in societies [66–68]. "It takes on meaning within different political ideologies and programmes underpinned by different kinds of knowledge, values and philosophy" [69] (p. 3). Thus far, there has been no consensus on how such development should be defined or attained.

The concept of sustainable urban development is thus ever-changing and evolving. It is sometimes defined in terms of the economic sustainability of a city, that is, its potential "to reach qualitatively a new level of socio-economic, demographic and technological output which in the long run reinforces the foundations of the urban system" [70]. This way of thinking seeks to continue economic growth and is now regarded as a relatively weaker form of sustainable development. Others may put more emphasis on the social sustainability and base the concept on a broad range of social principles of futurity, equity, and participation, especially involvement of public citizens in the land development process [71]. When viewed alongside environmental concerns, the concept also embodies environmental sustainability, meaning the pursuit of urban form that synthesizes land development and nature preservation and places the protection of natural systems into a state of vital equipoise [72]. In general, countries around the world are called to minimize environmental impact and to improve the social conditions

of individuals and the community [73]. In summary, principles of achieving sustainable urban development are generally based on environmental, economic, and social considerations [74–76].

Although current discussions appear to focus more on the environment and economy, cities are still fundamentally human habitats. In contrast to the weaker form of sustainable development, a stronger form "represents a revised form of self-reliant community development which sustains people's livelihoods using appropriate technology" [69] (p. 4). Since cities are for people [77], sustainable cities should be "places where people want to live and work, now and in the future. They meet the diverse needs of existing and future residents, are sensitive to their environment, and contribute to a high quality of life. They are safe and inclusive, well planned, built and run, and offer equality of opportunity and good services for all" [78] (p. 56). It is prescient that human health, wellbeing, safety, security and opportunity will be influenced by the way urban settlements are planned, designed, developed and managed [79]. It should also be noted that social development and economic productivity depend on citizens whose mental and physical needs are satisfied. City inhabitants' comfort hence plays a significant role in sustainable urban development.

Sustainable urban development is indeed a multilayered concept. It synthesizes land development and nature preservation. It also refers to the capacity of nature to support its activities, the vitality of a city as a complex system, and the quality of life of its inhabitants. In other words, sustainable urban development covers many fields of activity such as environmental protection, human development, and inhabitant wellbeing. However, despite all the discussions, no single or agreed meaning has been produced. Taking account of all the concerns stated above, this study proposes to define sustainable urban development as the capacity of any significant human settlements to maintain environmental quality and carrying capacity, to support socio-economic development and management, and to provide sufficient services and livelihoods to all current and future inhabitants. That is, the practicable and full realization of sustainability can only take place in the overlap, or the dynamic, among the three fundamental capacities (Figure 3).
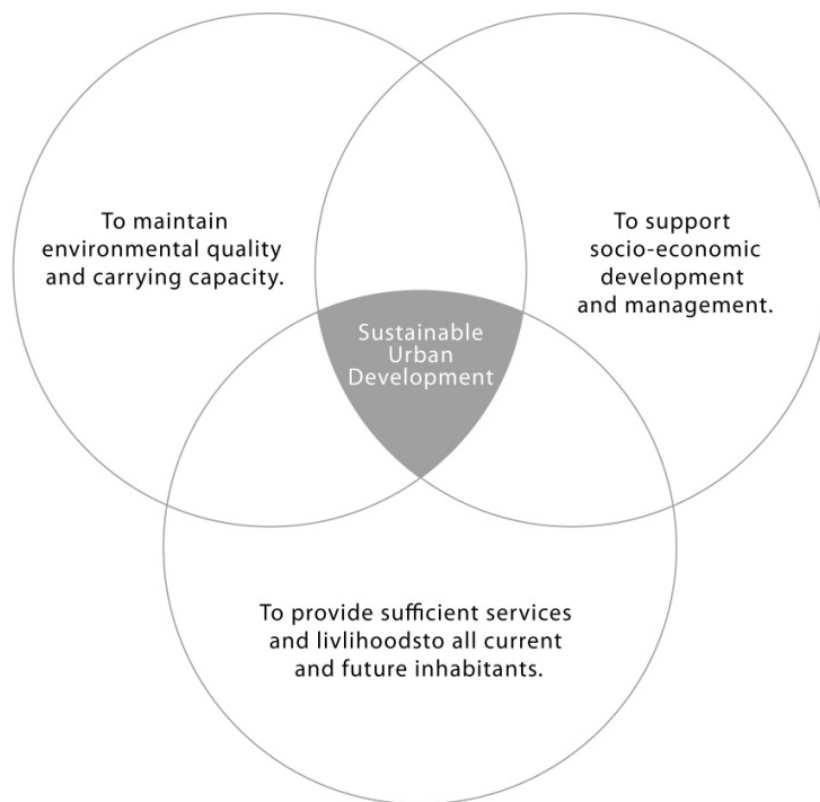

Figure 3. Sustainable urban development—defined as capability in three aspects.

4.2. Global Rankings/Standards of Urban Sustainability: Different Focal Areas

In order to facilitate an improved understanding on the state of, or changes to, urban settlements in relation to better sustainability performance, different sets of frameworks, indicators, and assessment tools have been developed [80,81]. A broad range of urban sustainability indicators has also been in use across different cities and regions, varying in accordance with their particular needs and goals [82,83]. From an initial look, these indicators or rankings/standards appear individually from different sources, leaving the impression that they are proposed as ad-hoc solutions to the emerging environmental challenges. However, each is actually sensibly put together in line with the growing trends in urban environmental planning.

For instance, in recent decades, the concept of New Urbanism, also called Smart Growth or Transit-Oriented Development, has begun to take form. It started out as a reaction against the perceived environmental, economic and social problems of earlier generations of urban planning. New Urbanism advocates "restructuring of public policy and development practices to support the following principles: neighborhoods should be diverse in use and population; communities should be designed for the pedestrian and transit as well as the car; cities and towns should be shaped by physically defined and universally accessible public spaces and community institutions; urban places should be framed by architecture and landscape design that celebrate local history, climate, ecology, and building practice" [84]. From a thoroughgoing critique of the impacts of urbanization, many have also made the case for "walkable, human-scaled neighbourhoods as the building blocks of sustainable communities and regions" [85]. Such conception are materialized into six fundamental features, including a clear neighborhood center that satisfies all residents' daily needs, the five minute walk, a street network in the form of a continuous web, narrow and versatile streets, mixed land use, and special sites for special buildings [85].

These New Urbanist features have in reality been translated into indicators, such as "shift of transport mode" in the Low Carbon Cities Framework, "local transport" in European Green Capital Award, "green transport promotion" in Green City Index, "density" in Sustainable Cities Index, "complete neighborhood/compact city" in Indicators for Sustainability, and "street life" in Quality of Life Survey. Each of these indicators serves as a parameter "which points to, provides information about, and/or describes the state of a phenomenon/environment/area" [86,87]. Indicators have the role of measuring performance. They must be clear, simple, scientifically sound, verifiable, and reproducible [88]. According to the European Evaluation Network for Rural Development [89], an indicator must be SMART: Specific, Measurable, Achievable, Relevant, and Time-related. They help make tangible an otherwise rather abstract concept, that is, in this case, urban sustainability.

"An indicator quantifies and aggregates data that can be measured and monitored to determine whether change is taking place" [90], and change can often bring cost reduction and service improvement outcomes. In Asia, the Green City Index by Siemens AG has projected potential cost savings of US$2.7 billion from various projects or clean technology deployments in the 22 Asian cities surveyed and "bulk of the estimated savings will be generated from energy consumption and energy efficiency initiatives" [91]. In Denmark, there is the Copenhagen 10-Step Program; the results are also highly positive and can be described in measurable terms. The city has: (1) reduced the number of cars in its center by eliminating parking spaces at a rate of 2–3 percent per year; (2) introduced the City Bike system, allowing anyone to borrow a bike from any one of the 110 bike stands located around the city center for a small refundable coin deposit; and (3) encouraged 34 percent of Copenhageners working in the city to bicycle to their jobs [92].

However, as much as efforts from different parties have been made in applying sustainability indicators, the results can sometimes be mixed and a number of outcomes can even fall short in terms of facilitating sustainability performance [93–95]. It has been contended that an inadequate selection of indicators [80,94] and the lack of consensus on urban sustainability indicators among different approaches [96,97] have been causing confusion and have led to, in some cases, failure to achieve favorable sustainability results. Furthermore, policymakers and city authorities today are faced with a

huge array of available urban sustainability rankings/standards and the sheer number and diversity of them can be overwhelming [98]. There are still no pertinent standards or universal methods for selecting urban sustainability indicators [99].

Among various measures currently in use, there has not been any comprehensive framework that can cover the three fundamental capacities that define sustainable urban development: (1) to maintain environmental quality and carrying capacity; (2) to support socio-economic development and management; and (3) to provide sufficient services and livelihoods to all current and future inhabitants. Hence, this study proposes an integrative methodology (Figure 4) to select urban sustainability rankings/standards with different focal areas and integrate them into a synthesis framework that can encompass a complete range of urban sustainability concerns.
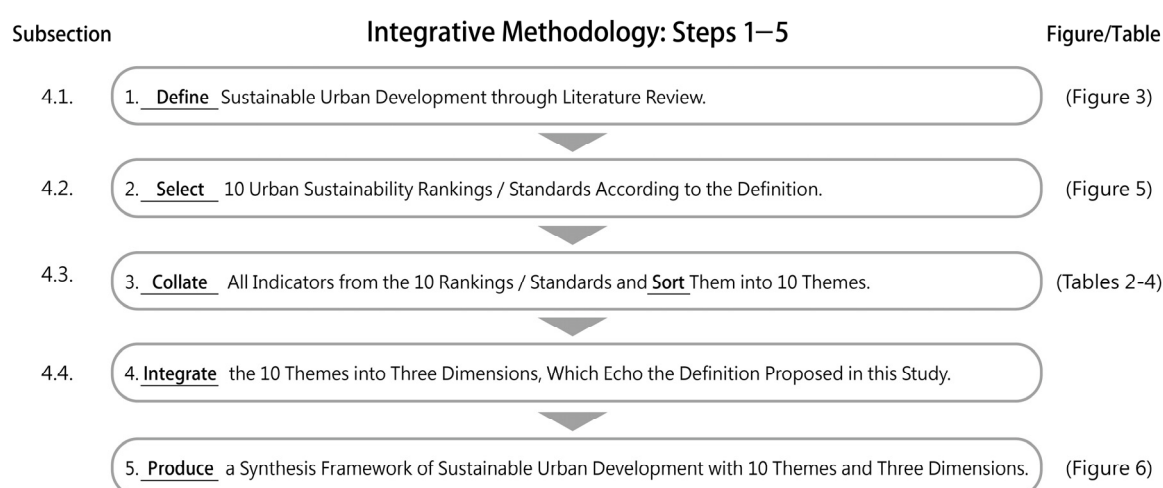

Figure 4. An integrative methodology of building a synthesis framework of sustainable urban development.

Step 1 of the five-step methodology has been carried out in Subsection 4.1. Now we proceed to Step 2, where we select representative rankings/standards that correspond to the three fundamental capacities of sustainable urban development defined in this study. There are 10 in total (Figure 5) and they are chosen to optimize the purpose of this study.

- *To maintain environmental quality and carrying capacity*: Selected are rankings/standards named with reference to "Low-Carbon" or "Green" (e.g., Low Carbon Cities Framework by the Malaysian Ministry of Energy, Green Technology and Water [100], the European Green Capital Award [101], and the Siemens AG Green City Index [38]). Their main concerns relate to the natural environment with relatively minor considerations of socio-economic issues.

- *To support socio-economic development and management*: Selected are rankings/standards labeled with "Sustainability," or "Health" (e.g., the Sustainable Cities Index of the Australian Conservation Foundation [102], Indicators for Sustainability by Sustainable Cities International [103], and the WHO Healthy Cities Indicators [22]). They usually focus on socio-economic development, public infrastructure, and human health-related statistics. Environmental or ecosystem preservation is of secondary importance.

- *To provide sufficient services and livelihoods to all current and future inhabitants*: Selected are rankings/standards titled as "Livable" or "Life/Living" (e.g., the OECD Better Life Index [104], the EIU Liveability Ranking [42], the Mercer Quality-of-Living Report [105], and the Monocle Quality of Life Survey [45]). Their emphasis on socio-economic and medical services and provision of inhabitant physical and mental wellbeing is strong. Environmental interests are limited.

Figure 5. Sustainable urban development—incorporating ten major global urban sustainability rankings/standards with different focal areas.

4.3. Global Rankings/Standards of Urban Sustainability: Sorting Indicators into Themes

Urban sustainability rankings/standards currently in use are composed of indicators that address different concerns. "Indicators are selected to provide information about the functioning of a specific system, for a specific purpose—to support decision-making and management" [90]. The common ground to be found among all these rankings/standards is that they all aim to promote sustainable urban development by aggregating diverse information into focused and applicable knowledge [106].

However, issues covered in sustainable urban development can be innumerable. For example, according to the Division for Sustainable Development of the United Nations (UN-DESA), "urban planning, transport systems, water, sanitation, waste management, disaster risk reduction, access to information, education and capacity-building are all relevant issues to sustainable urban development" [107]. In addition, in 2003, the British Office of the Deputy Prime Minister (ODPM, UK) launched a programme of action called *Sustainable Communities: Building for the future*. In it, the most important requirements of sustainable communities are set out as below [108] (p. 5):

(1) A flourishing local economy to provide jobs and wealth;
(2) Strong leadership to respond positively to change;
(3) Effective engagement and participation by local people, groups and businesses, especially in the planning, design and longterm stewardship of their community, and an active voluntary and community sector;
(4) A safe and healthy local environment with well-designed public and green space;

(5)   Sufficient size, scale and density, and the right layout to support basic amenities in the neighbourhood and minimise use of resources (including land);

(6)   Good public transport and other transport infrastructure both within the community and linking it to urban, rural and regional centres;

(7)   Buildings—both individually and collectively—that can meet different needs over time, and that minimise the use of resources;

(8)   A well-integrated mix of decent homes of different types and tenures to support a range of household sizes, ages and incomes;

(9)   Good quality local public services, including education and training opportunities, health care and community facilities, especially for leisure;

(10) A diverse, vibrant and creative local culture, encouraging pride in the community and cohesion within it;

(11) A "sense of place";

(12) The right links with the wider regional, national and international community.

As the pace of urbanization continues to accelerate, many cities are faced with "an urgent need for a transition towards a future that maximises their liveability and sustainability" [109]. The notion of urban sustainability becomes increasingly intertwined with livability, which represents "the sum of the factors that add up to a community's quality of life—including the built and natural environments, economic prosperity, social stability and equity, educational opportunity, and cultural, entertainment and recreation possibilities", as defined by the Partners for Livable Communities (PLC) [110]. In short, as put by the British Department for Communities and Local Government (DCLG), a sustainable and livable city should be an environment that is both inviting and enjoyable, where inhabitants would want to live and work now and in the future [111].

From the above discussion, it can be observed that different types of issues embody different concerns. In many cases, the concerns are unbalanced and fails to concurrently address the environmental, socio-economic, and inhabitant wellbeing aspects. Therefore, Table 1 collects issues proposed from multiple sources and summarizes them into ten major themes: (1) Environmental Quality Monitoring; (2) Natural Resource Consumption; (3) Lowering Environmental Impact and Maintaining Carrying Capacity; (4) A Sound Socio-economic Environment; (5) Adequate Infrastructure; (6) Development Strategy Considering Both Human and Natural Environment; (7) Sports, Leisure and Recreation; (8) Consumer Goods and Services; (9) Cultural Diversity and Tolerance; and (10) Sense of Wellbeing and Work-Life Balance.

In the 10 themes above, the first three are considered more environmental, the second three more socio-economic, and the last four more inhabitant wellbeing-oriented. With themes clearly laid out, we continue with Step 3 of the integrative methodology: collate all indicators from the 10 major global urban sustainability rankings/standards (Figure 5) and follow the specified theme coverage in Table 1 to re-arrange all indicators into 10 themes. Tables 2–4 show how these hundreds of indicators are sorted into themes for easy and comprehensive reference.

Table 1. Ten themes and specified theme coverage.

Proposed by	Urban Sustainability Issues	Major Theme Summarized	Theme Coverage
UN-DESA	Water	Natural Resource Consumption	Water quality/consumption, Energy intensity/performance/consumption
ODPM, UK	Requirement #5		
PLC	Natural environment		
UN-DESA	Disaster risk reduction	Environmental Quality Monitoring	Atmospheric and biological environment monitoring, Air pollution monitoring
PLC	Natural environment		
UN-DESA	Transportation systems, Waste management	Lowering Environmental Impact and Maintaining Carrying Capacity	Green transport, Green buildings, Waste, Green space planning and land use, Resource productivity improvement
ODPM, UK	Requirements #4, 5, 6, 7		
PLC	Built environment		
UN-DESA	Education	A Sound Socio-economic Environment	Social stability, Public participation, Education, Housing, Economy
ODPM, UK	Requirements #1, 2, 3, 8, 9		
PLC	Economic prosperity, Social stability and equity, Educational opportunity		
UN-DESA	Transport systems, Water, Sanitation	Adequate Infrastructure	Transportation network, Water/Energy/Telecom infrastructure, Health and medical services
ODPM, UK	Requirement #9		
UN-DESA	Urban planning, Access to information, Capacity-building	Development Strategy Considering Human and Natural Environment	City space planning, Decision-making and action management
ODPM, UK	Requirements #2, 3		
ODPM, UK	Requirement #9	Sport, Leisure and Recreation	(same as title of theme)
PLC	Entertainment and recreation possibilities		
ODPM, UK	Requirement #5	Consumer Goods and Services	(same as title of theme)
ODPM, UK	Requirements #10, 11, 12	Cultural Diversity and Tolerance	(same as title of theme)
PLC	Cultural possibilities		
DCLG, UK	An environment that is both inviting and enjoyable, where inhabitants would want to live and work now and in the future	Sense of Wellbeing and Work-Life Balance	(same as title of theme)

Table 2. Indicators sorted into environmental themes: environmental quality monitoring/natural resource consumption/lowering environmental impact and maintaining carrying capacity.

Themes / Ranking/Standard	Natural Resource Consumption	Environmental Quality Monitoring	Lowering Environmental Impact and Maintaining Carrying Capacity
Low Carbon Cities Framework		✓ Urban Greenery and Environmental Quality	✓ Waste ✓ Low Carbon Buildings ✓ Green Transport Infrastructure ✓ Clean Vehicles ✓ Urban Greenery and Environmental Quality
European Green Capital Award	✓ Water Management ✓ Waste Water Treatment ✓ Energy Performance	✓ Ambient Air Quality (PM_{10}, $PM_{2.5}$) ✓ Ambient Air Quality (NO_2) ✓ Climate Change: Mitigation and Adaptation ✓ Nature and Biodiversity	✓ Waste Production and Management ✓ Green Urban Areas Incorporating Sustainable Land Use
Green City Index	✓ Water Consumption ✓ Water System Leakages ✓ Wastewater Treatment ✓ Water Efficiency and Treatment Policies ✓ Energy Consumption ✓ Energy Intensity ✓ Energy Consumption of Residential Buildings	✓ Particulate Matter ✓ Sulfur Dioxide ✓ Nitrogen Dioxide ✓ CO_2 Emissions ✓ CO_2 Intensity ✓ CO_2 Reduction Strategy ✓ Clean Air Policies ✓ Ozone	✓ Municipal Waste Production ✓ Waste Recycling ✓ Waste Reduction and Policies ✓ Energy-efficient Buildings Standards ✓ Energy Efficient Buildings Initiatives ✓ Use of Non-car Transport ✓ Size of Non-car Transport Network ✓ Green Transport Promotion ✓ Green Land Use Policies ✓ Renewable Energy Consumption ✓ Clean and Efficient Energy Policies
Sustainable Cities Index	✓ Water	✓ Air Quality (level of particulate matter) ✓ Climate Change ✓ Ecological Footprint ✓ Biodiversity ✓ Food Production	✓ Green Building

Table 2. *Cont.*

Ranking/Standard ╲ Themes	Natural Resource Consumption	Environmental Quality Monitoring	Lowering Environmental Impact and Maintaining Carrying Capacity
Indicators for Sustainability		✓ Air quality (PM_{10}, $PM_{2.5}$) ✓ Reduce Greenhouse Gases/Energy Efficiency	✓ Waste/Reuse/Recycle ✓ Green Spaces
Healthy Cities Indicators	✓ Water quality ✓ Percentage of Water Pollutants Removed from Total Swage Produced	✓ Atmospheric Pollution (dust fallout) ✓ Atmospheric Pollution (SO_2, NO_2)	✓ Household Waste Collection Quality Index ✓ Household Waste Treatment Quality Index ✓ Relative Surface Area of Green Spaces in the City ✓ Public Access to Green Space
Better Life Index	✓ Water Quality	✓ Air Pollution (PM_{10})	
Liveability Ranking			
Quality-of-Living Report	✓ Sewage	✓ Air Pollution ✓ Climate ✓ Record of Natural Disasters	✓ Waste Disposal
Quality of Life Survey		✓ Population	✓ Electric Car Charging Points ✓ Green Space ✓ Sunshine

Table 3. Indicators sorted into socio-economic themes: a sound socio-economic environment/adequate infrastructure/development strategy considering both human and natural environment.

Ranking/Standard \ Themes	A Sound Socio-economic Environment	Adequate Infrastructure	Development Strategy Considering Human and Natural Environment
Low Carbon Cities Framework	✓ Community Services	✓ Shift of Transport Mode ✓ Traffic Management ✓ Infrastructure Provision ✓ Energy (infrastructure) ✓ Water Management (infrastructure)	✓ Site Selection ✓ Urban Form
European Green Capital Award		✓ Local Transport	✓ Eco Innovation and Sustainable Employment ✓ Integrated Environmental Management
Green City Index			✓ Green Action Plan ✓ Green Management ✓ Public Participation in Green Policy
Sustainable Cities Index	✓ Employment ✓ Household Repayments ✓ Public Participation ✓ Education	✓ Health ✓ Transport	✓ Density
Indicators for Sustainability	✓ Unemployment Rates/Jobs, Economic Growth ✓ Housing ✓ Quality Public Space ✓ Education	✓ Water quality/Availability ✓ Mobility ✓ Sanitation ✓ Health	✓ Complete Neighborhood/Compact City

Table 3. *Cont.*

Ranking/Standard Themes	A Sound Socio-economic Environment	Adequate Infrastructure	Development Strategy Considering Human and Natural Environment
Healthy Cities Indicators	✓ Living Space ✓ Percentage of Population Living in Substandard Accommodation ✓ Estimated Number of Homeless People ✓ Unemployment Rate ✓ Percentage of People Earning Less than the Mean per Capita Income ✓ Percentage of Child Care Places for Pre-school Children ✓ Percentage of All Live Births to Mothers >20; 20–34; 35+ ✓ Abortion Rate in Relation to Total Number of Live Births ✓ Percentage of Disabled Persons Employed	✓ Public Transport ✓ Public Transport Network Cover ✓ Mortality: All Causes ✓ Cause of Death ✓ Low Birth Weight ✓ Existence of a City Health Education Program ✓ Percentage of Children Fully Immunized ✓ Number of Inhabitants per Practicing Primary Health Care Practitioner ✓ Number of Inhabitants Per Nurse ✓ Percentage of Population Covered by Health Insurance ✓ Availability of Primary Health Care Services in Foreign Languages ✓ Number of Health Related Questions Examined by the City Council Every Year	✓ Derelict Industrial Sites ✓ Pedestrian Streets ✓ Cycling in City
Better Life Index	✓ Quality of Support Network ✓ Years in Education ✓ Student Skills ✓ Educational Attainment ✓ Consultation on Rule-making ✓ Voter Turnout ✓ Housing Expenditure ✓ Dwellings with Basic Facilities ✓ Rooms per Person ✓ Household Financial Wealth ✓ Household Net Adjusted Disposable Income ✓ Job Security ✓ Personal Earnings ✓ Long-term Unemployment Rate ✓ Employment Rate ✓ Homicide Rate ✓ Assault Rate	✓ Self-reported Health ✓ Life Expectancy	

Table 3. *Cont.*

Themes Ranking/Standard	A Sound Socio-economic Environment	Adequate Infrastructure	Development Strategy Considering Human and Natural Environment
Liveability Ranking	✓ Prevalence of Petty Crime ✓ Prevalence of Violent Crime ✓ Threat of Terror ✓ Threat of Military Conflict ✓ Threat of Civil Unrest/Conflict ✓ Availability of Private Education ✓ Quality of Private Education ✓ Public Education Indicators ✓ Availability of Good Quality Housing	✓ Availability of Private Healthcare ✓ Quality of Private Healthcare ✓ Availability of Public Healthcare ✓ Quality of Public Healthcare ✓ Availability of Over-the-counter Drugs ✓ General Healthcare Indicators ✓ Quality of Road Network ✓ Quality of Public Transport ✓ Quality of International Links ✓ Quality of Energy Provision ✓ Quality of Water Provision ✓ Quality of Telecommunications	
Quality-of-Living Report	✓ Political Stability ✓ Crime, Law Enforcement ✓ Currency Exchange Regulations ✓ Banking Services ✓ Standards and Availability of International Schools ✓ Rental Housing ✓ Household Appliances ✓ Furniture ✓ Maintenance Services	✓ Medical Supplies and Services ✓ Infectious Diseases ✓ Electricity (public services) ✓ Water (public services) ✓ Public Transportation ✓ Traffic Congestion	
Quality of Life Survey	✓ Crime ✓ Unemployment Rate	✓ International Flights	✓ Upcoming Developments

Table 4. Indicators sorted into inhabitant wellbeing-oriented themes: sports, leisure and recreation/consumer goods and services/cultural diversity and tolerance/sense of wellbeing and work-life balance.

Themes — Ranking/Standard	Sports, Leisure and Recreation	Consumer Goods and Services	Cultural Diversity and Tolerance	Sense of Wellbeing and Work-Life Balance
Low Carbon Cities Framework				
European Green Capital Award				
Green City Index				
Sustainable Cities Index				✓ Subjective Wellbeing
Indicators for Sustainability				
Healthy Cities Indicators	✓ Sport and Leisure			
Better Life Index				✓ Life Satisfaction ✓ Time Devoted to Leisure and Personal Care ✓ Employees Working Very Long Hours
Liveability Ranking	✓ Sporting Availability	✓ Food and Drink ✓ Consumer Goods and Services	✓ Cultural Availability ✓ Level of Corruption ✓ Social or Religious Restrictions ✓ Level of Censorship	
Quality-of-Living Report	✓ Theatres ✓ Cinemas ✓ Sports and Leisure	✓ Restaurants ✓ Availability of Food/Daily Consumption Items ✓ Cars	✓ Media Availability and Censorship ✓ Limitations on Personal Freedom	
Quality of Life Survey	✓ Street Life ✓ Bookshops	✓ Dinner on a Sunday	✓ Tolerance ✓ Culture	

4.4. Global Rankings/Standards of Urban Sustainability: A Synthesis Framework

Steps 1–3 of the integrative methodology have been completed in Subsection 4.1, Subsection 4.2 and Subsection 4.3:

- Step 1: Define sustainable urban development through literature review.
- Step 2: In line with the definition developed in this study, select 10 global rankings/standards of urban sustainability.
- Step 3: Collate all indicators from the 10 rankings/standards and sort them into 10 themes according to the specified theme coverage established in this study: (1) Natural Resource Consumption; (2) Environmental Quality Monitoring; (3) Lowering Environmental Impact and Maintaining Carrying Capacity; (4) A Sound Socio-economic Environment; (5) Adequate Infrastructure; (6) Development Strategy Considering Both Human and Natural Environment; (7) Sports, Leisure and Recreation; (8) Consumer Goods and Services; (9) Cultural Diversity and Tolerance; and (10) Sense of Wellbeing and Work-Life Balance.

Now, this subsection further proposes the following as the final two steps:

- Step 4: Integrate the 10 themes into three dimensions: (1) Environmental Quality and Carrying Capacity (Themes 1–3); (2) Environmental Management and Development Strategy (Themes 4–6); and (3) Lifestyles of Sustainability (Themes 7–10). The three dimensions correspond directly to the definition of sustainable urban development proposed in this study: to maintain environmental quality and carrying capacity, to support socio-economic development and management, and to provide sufficient services and livelihoods to all current and future residents.
- Step 5: Produce a synthesis framework of sustainable urban development (Figure 6).

Sustainable development has often been identified as composed of economic, social, and environmental goals [112]. However, "a paradigm that does not have a central focus on human health and wellbeing may fail to recognize the critical systemic relationships involved and thus the opportunities for identification of strategies that generate cobenefits" [113]. In other words, a focus primarily on environment or economy may risk excluding inhabitants' comfort or wellbeing from the benefits of sustainable development of cities. To ensure successful and sustainable urban environmental planning, an interwoven approach that addresses concerns in natural environment and resources, infrastructure and socio-economic development, and inhabitants' wellbeing should be adopted. The three aspects must receive equal attention and importance.

The framework proposed in this study addresses exactly the three aspects. It is a synthesis of existing approaches, incorporating the 10 rankings/standards advocated by international and regional organizations. It overcomes the heterogeneity of a myriad of indicators currently offered and addresses a certain confusion surrounding the topic of sustainable urban development. Careful reference to all the three dimensions and the 10 themes of the framework will enable environmental planning that exemplifies a balanced intersection among various sustainability goals. Indicators from multiple urban sustainability approaches are collated and sorted into specific themes for ease of quick reference and possible selection. More indicators can be added or removed in accordance with emerging needs or gained experience and that allows policy and decision makers to customize their best practices in individual cases. For any existing environmental planning policies or programs, the synthesis framework with all its components can also serve as a checklist to assess the policy strengths and weaknesses.

Figure 6. Sustainable urban development—a synthesis framework with three dimensions and ten themes.

5. Conclusions

Since many countries are moving into a fast-growing and transforming stage, there is global dialogue and consensus that urbanization will continue to bring about compelling global and local changes. To adapt and respond to changes, the study has hence collected major global urban sustainability rankings/standards and provided a newly devised synthesis framework of sustainable urban development with 10 themes and three dimensions. In summary, it has:

- enabled the idea of sustainability in various urban settlement theories to be explored through a review of current notions in literature;
- approached the multifaceted concept of sustainable urban development from the perspectives of policy-making, decision-making, and problem-solving processes to establish the essentiality of developing a synthesis framework;
- re-organized and integrated major global urban sustainability rankings/standards into newly and clearly defined dimensions and themes under a concise framework to help identify a more holistic approach to realizing the goal of livable, ecological, and sustainable cities; and
- devised a synthesis framework that is globally encompassing and adaptive for any cities to use in their policy-and-decision-making processes towards a sustainable future.

This project contributes to the ongoing discussion of urban sustainability. To facilitate truly sustainable urban development, we first inspected the evolution of views on human–environment relations in urban settlements theories to examine the interconnectedness between human societies and ecosystems. An original definition of sustainable urban development is offered, bringing a

clearer understanding of this multidimensional phenomenon. We then examined the high degree of similarities between environmental planning and a decision process (including policy-making, decision-making, and problem-solving) to confirm the need to build a synthesis framework. Through the procedures explained earlier, we have established a synthesis framework based on integration of current approaches and concepts. The framework has managed to put some order in a broad and partly inconsistent literature. As underlying guidance, it will provide the conceptual and practical scaffolding for creating new policies and encourage more strategically organized efforts in sustainable environmental planning.

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