Application of urban ecological concepts towards healthy and humane cities

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Abstract. Recognizing the era of demographic trends, it is important to anticipate population growth between 2000-2030, according to the United Nations about 2 billion people will be concentrated in urban areas. The 21st century will be a century of urbanization that covers around 1-6% of the earth's surface, but they have enormous ecological 'footprints' and complex, strong, and indirect effects on ecosystems. At present, more than 50% of the world's population lives in urban areas, and it is estimated that 70% of the world's population will live in cities and towns by 2050. An urban ecological approach is becoming increasingly important in dealing with large numbers of the world's population, urban health problems arising from urbanization and globalization in developed and developing countries. This research is a descriptive study with a Systematic Literature Review (SLR). This research focuses on urban areas that store various types of nature such as semi-natural habitats to abandoned areas, green open spaces, and other biotopes that are highly influenced by humans with collections of related species. The results show that it is necessary to understand, integrate, and apply ecological models and processes to urban biodiversity for populations and their importance in the face of large-scale population increases and developing cities, so that there is a balance between urban areas and environmental sustainability in order to achieve a better standard of living and harmony with the environment for urban communities.

1. Introduction
Recognizing the trend of the demographic era is important to anticipate population growth between 2000-2030, according to the United Nations about 2 billion people will be concentrated in urban areas [1]. The 21st-century will be a century of urbanization that will cover about 1-6% of the earth's surface. a small part, but have enormous 'ecological impressions' and future complex effects on ecosystems. Currently, more than 50% of the world's population lives in cities, and it is estimated that 70% of the world's population will live in cities by 2050. 23 of the 25 largest urban agglomerations on the planet are in Africa, Asia, and Latin America, not in Europe or North America [2]. These large cities are considered as 'hotspots' of global change [3].

Urban areas store various types of nature such as semi-natural habitats to abandoned areas, green open spaces, and other biotopes that are heavily influenced by humans with collections of related species. Therefore, it is necessary to understand, integrate, and apply ecological models and processes in the management of urban biodiversity for the population and their essential values in facing the dynamics of urbanization and population increase and massively developing cities.
The thing that needs to be considered in ecology is urban first, looking at the various types of nature that exist in the city. Second, knowledge of ecological models and processes of urban biodiversity is required, as is an understanding of the comparative invasive species from many urban areas. Third, based on ecological knowledge, it is necessary to develop management schemes that maintain and conserve urban biodiversity. This method must also pay attention to environmental protection, for example in urban national parks or green open spaces. Finally, since an ecological perspective alone does not provide complex information about how humans affect urban ecosystems, interdisciplinary research involves both natural and social sciences must be integrated holistically to apply ecological concepts to urban planning processes to achieve ecologically sustainable characteristics of cities, healthy, and humane.

2. Research methods
This research is a descriptive study with a Systematic Literature Review (SLR) method that identifies, assesses, and interprets all findings on a research topic, to answer a pre-determined research question [4]. The author describes this paper by collecting, compiling, and interpreting existing data than analyzing the data, and examining more clearly the various factors related to the conditions, situations, and phenomena being investigated.

3. Results and discussion
3.1. The concept of urban ecology
To understand the concept of "urban ecology", "urban" refers to the high density of people, their place of residence, and other building constructions. The meaning of the word "ecology" has evolved over the last few decades [5]. The definition of ecology is often viewed from different perspectives. Ecology can be defined as a science which is a 'natural economy' (ecosystem services offered and the number of organisms), while the definition of ecology as nature is a resource for humans [6]. The 'ecological' and 'urban' paradigms have several meanings and perspectives. The integration of various approaches to urban ecological research shows that ecology is a broad scientific discipline as the subject of ecological research in urban management [7]. The study of urban ecology is a field of applied science that aims for explicit application in planning and management of urban green areas [8].

Furthermore, the term 'Urban Ecology' is defined in two aspects. First, in the natural science of urban ecology, it discusses biological patterns and related environmental processes in urban areas, as sub-disciplines of biology and ecology. In this sense, urban ecology seeks to analyze the relationship between plant populations, animals, and their communities and their relationship to environmental factors including human influence. But the second definition is complementary which implies an anthropocentric perspective. Anthropocentric implies urban ecology as multidisciplinary approach to improving the standard of living of human populations in urban areas that refers to the ecological function of habitats or urban ecosystems for humans by taking into account social, planning, and scientific aspects [9].

In principle, urban ecology also discusses the study of ecosystems which includes humans who live in cities and urbanization. It is this ecosystem services situation that is closely related to urban development patterns [10]. Meanwhile, according to Mcdonell, urban ecology is a classic ecology that focuses on the main questions of ecology in urban areas such as how ecological patterns and processes in urban areas are combined with the environment and how urbanization and the influence of ecological development of organisms in urban areas [11]. Urban ecology is an integrated interdisciplinary study for society to achieve the Sustainable Development Goals (SDGs). The study of urban ecology is the foundation of many disciplines including public health, sociology, urban planning, landscape architecture, geography, anthropology, engineering, economics, climatology, and ecology. Since the concept of urban ecology encompasses an interdisciplinary science, and focuses on how humans interact with urban natural systems, 'urban ecology' has been used in a variety of methods to describe the study of human patterns in cities, nature in cities, and the combined relevance of humans and nature.
Figure 1. Basic components of the urban ecosystem; this concept is focused on the spheres of the earth system which are important for cities. The processes between different spheres and the impacts of the anthroposphere (six selected examples) are of special interest [12].

So how do we define the discipline of urban ecology today? The urban ecologist seeks to define the boundaries of the urban discipline. Ecology is the study of the way humans and ecological systems develop together in urbanized areas. This suggests that urban ecology emerged from the integration of several disciplines as a result of a common interest in understanding the ecological structure and function of cities [13]. Experts describe urban ecology as "an integrated interdisciplinary field that aims to understand how human and ecological processes can coexist with efforts to educate urban communities on sustainable urban environments in human-dominated systems.

Urban ecology is viewed from three things: (1) the ecology and evolution of living organisms that live in urban boundaries; (2) the biological, economic, political and cultural ecology of humans in urban areas; (3) cities resulting from human relations and natural processes combined. This perspective sees humans and nature as forces that shape mutually measurable patterns and processes in urban planning and development [12].

Urban ecology studies the dynamics of interactions of organisms, the structures they are built on, and the physical environment. The urban population is so complex that the interaction of city residents with nature becomes difficult, urban areas store various types of nature such as semi-natural habitats to abandoned areas, green open spaces, and other biotopes that are very useful by humans with related species collections. Due to the habits and paradigms of urban residents spending most of their time indoors so that environmental sustainability is often ignored and unknown, it is very urgent why it is necessary to integrate the concept of urban ecology as a whole because of human welfare, work efficiency and health as well as the integrity of natural elements close to everyday life in the city. Human activities have become a point of attention as an important part of influencing urban areas, and the integration of the geo-biosphere- and anthroposphere approaches is needed. Figure 2. is an example of an integrated practice that can be developed at ecological points in cities.
Urban ecology provides a more distinct look from urban or industrial areas. The significance of the number of urban people has increased since 2007 when for the first time the majority of the population lived in cities rather than rural areas. Thus, it is a common assumption that increased land use and degradation with construction and settlement creates additional problems. Urbanization can be understood as a process of spatial concentration supported by economic agglomeration and the wealth of socio-cultural facilities that it offers city. However, like both sides of the coin, cities inevitably face risks and disadvantages from agglomeration, such as congestion, air quality problems, scarce housing availability, etc. as a result, the decentralization process almost always coincided with urban growth. Then what is the right solution to overcome the various problems that arise with the increasing number of urban people in the world?

Finally, urban ecology must be relevant and participate in the integration of ecological studies with urban policies, because efforts to improve the quality of living conditions in cities cannot be separated from the awareness and active participation of the wider community and individuals to achieve the goals of Sustainable Development Goals (SDGs). The challenges for policies led by urban ecology are threefold: first, the ecological integrity of cities must be restored, which means re-creating the green matrix proportionately in urban areas, to bring plants and animals back to urban dwellings; second, production and consumption systems must be redesigned to address the global problem of unsustainable 'metabolism'; third, urban residents must be revived, not only in making ecologically acceptable transitions but also in pursuit of social and ecological justice [15].

3.2. Healthy city planning concept

The spatial planning activity is an effort to improve people's welfare and ensure a sustainable environment by taking into account the comparative advantage in an area and reducing the development gap by reducing areas that are poor, slum, and underdeveloped. Urban and regional spatial planning is determining, planning, and ensuring how to use space proportionally so that the existing area can meet aspects of economic, social, and environmental activities in urban areas.
Understanding the meaning that urban planning must be able to guarantee prosperity and a sustainable living environment, this theoretical orientation provides a basis for how public health and urban planning intersect because the physical and social environment plays a major role in intrinsically related community health. In other words, urban planning serves as a form of primary prevention and a contributor to health outcomes. This explains how a holistic, multi-disciplinary approach to building cities is key.

The World Health Organization (WHO) defines health as an urban city that continues to create and improve the physical and social environment, as well as develop human resources to collaborate with all functions of life and reach their maximum potential [16]. The idea of healthy cities is a participatory process framework for health problems arising from urbanization. The goal of environmental health is a healthy environment, whose conditions are protective and conducive to human health. Between humans and the environment, there must be an ecological balance to ensure prosperity and survival. This is the problem of all humans, not only physical health but also mental health and optimal social relationships with a certain environmental context. Furthermore, a healthy city aims to create an environment that supports health in order to create a good quality of life, which is marked by the availability of basic sanitation and hygiene needs, and the availability of access to health services.

In 1986, 11 goals were formulated based on historical and contemporary reviews of urban development and urban health that are in line with the United Nations and WHO value systems [17]. There are eleven criteria for environmental conditions that must be strived for as a healthy city, including:

- a clean, safe and high quality physical environment (including quality housing);
- the current system is stable and sustainable in the long term;
- mutually supportive, strong and non-exploitation communities;
- high levels of public influence and participation in decisions that affect a person's health, life and well-being;
- fulfillment of basic needs (water, food, shelter, security, employment, income) for all urban communities;
- access to a variety of experiences and resources with the possibility of multiple contacts, interactions and communications;
- a vital, innovative and diverse urban economy;
- promote cultural and biological heritage relationships both individually and in groups;
- optimal level of public health with hospital care services accessible to all;
- high health status (high positive health status and low or almost no serious illness);
- Compatible city shapes with increased top parameters and behavior.

The idea of ecocity can be achieved through finishing patterns, space-saving and energy-efficient, combined with transportation patterns, energy flows, air cycles, and habitat structures that are in line with overall sustainability goals. Eco-city, combined with attractively designed public spaces, integrating green areas and cultural heritage to create a beautiful environment, should be an attractive place to live and work. Sustainable and viable structures contribute to the health, safety and well-being of communities. The success of the idea of healthy cities lies in the assessment of health effects and equity in many interdisciplinary fields of urban life science [18].

Then why is the urban ecological study approach important to discuss in this paper? As already stated that urban ecology is an ecological urban planning concept that aims to ensure the welfare of urban communities, so the urban planning aspect also has implications for public health. The eco-city approach is currently becoming a trend of urgency in both developed and developing countries in dealing with a large number of urban health problems that arise from urbanization and globalization. A healthy city pays close attention to the physical, mental and social conditions of the community and aims to make its society just and inclusive. Any city can be a healthy city this starts with a commitment to put people and health on the priority urban development agenda which requires a multidisciplinary approach that includes urban planning, development economics, social science, and public health [19].
The idea of "making cities inclusive, safe, resilient, and sustainable" is one of the Goals of Sustainable Development (SDGs). Municipalities and local governments can act on urban health issues responsively to making significant impacts at the national and global levels because public health is a social and political problem. Urban planning has a direct and continuous impact on the quality of health. Environmental health challenges in cities where work and business and investment are carried out will always be at the highest level. Can benefit human health where populations can meet their needs for hygiene, employment, and nutrition. At the same time, the urban environment can also harm health, either directly or indirectly. An immediate risk occurs when people are not adequately protected from health problems caused by disease, for example in a polluted environment, ecosystem disturbances, degradation of urban and rural resources, low quality of green open space in cities, poor transportation systems and adequate waste management. Irregular and poor quality management of environmental resources can contribute to climate, geology, and global oceans with adverse climate, economic and health changes. This process is well illustrated by the worldwide climate change that is being experienced today. Therefore the practice of urban planning can be considered as a major determinant of environmental health.

Unfortunately, this is often not the case as urban planning practices tend to be fragmented, and planning for various urban purposes generally does not have an integrated approach. Planning development ordinances enter from day-to-day governance as a direct change from sectoral approaches to these activities, and functional and disciplinary specialists. As a result, there has been criticism of cross-sectoral collaboration due to established values specialists and sectoral institutions and professional institutions.

3.3. Creating a humane city and a sustainable city
Then to realize urban planning using an urban ecological approach that aims to humanize humans cannot be separated from the concept of a sustainable city. A sustainable city has a broad meaning, but often the understanding from the perspective of context and substance leads to the existence of a city that pays attention to the environment. Although this context and substance are in the scope that places the environment as an important aspect, it also requires a variety of approaches involving other comprehensive aspects. In other words, related fields are not only related to the environment, but together also link other fields, for example, planning and design, technology, economy, society, culture, and politics.

A sustainable city is closer to the vision of the city to aspire to, sustainable development is the development that can meet the needs of the present generation without sacrificing and harming the next generation to meet their needs. In other words, sustainable development uses resources wisely, so that these resources do not run out and can be enjoyed by future generations. A sustainable city is a city structured in a way that makes it possible for all urban residents to meet their own needs and to improve their welfare without destroying nature or other people's living conditions, present or future. Dominski develops the three stages required to move towards urban sustainability which implies an ecological goal known as the "3 Rs": Reduce, Reuse, and Recycle.

Realizing a humane and sustainable city, the main pillars of sustainability have been formulated, namely the economic, social, and environmental dimensions. Implementing 'sustainable urban' requires an interaction between the three: the economic environment, eco-physical, and social. These interactions produce several positive and negative externalities. In Figure 3. Describes how the effects of externalities are generated from interactions between the three dimensions of making a city that is sustainable as a complex idea.
The interaction scheme above illustrates that the sustainability of energy generated is as important as economic and environmental factors. Therefore, the government needs to pay more attention to energy maintenance and the use of renewable energy to provide funds for the provision of facilities and the environment, as shown in Figure 3. If the calculation of the external influence is greater than the calculation of the negative external effect, then the city will become a sustainable city [24].

3.4. Implementation of the concept of urban ecology in a healthy and humane city arrangement

Three big questions need to be addressed to incorporate the ecological knowledge outlined above into urban planning for a healthy and humane city. First, we need to know what types of nature exist in urban areas. In many cities in developing countries as well as cities in developed countries, basic ecological knowledge like this is still scarce. Methods of interaction of various habitat types and related species in a mapping. Biotope mapping provides information about physical properties (location and size) and about biotic references (species composition in cities). Biotope mapping can be presented as a database and a map that forms a useful basis for urban spatial planning [8].

Second, knowledge of urban ecosystems includes processes that affect urban nature compared to rural areas will assist in planning in good urban planning work. The significance of human-induced disturbance, and its consequence on succession, needs further research [7], [25]. Besides, invasive ecological disturbance by one species, and its interactions with native species is more prevalent in urban environments. It is better implemented so that the harmful effects of exotic species on native biota can be reduced.
Third, based on ecological knowledge, ecosystem-specific schemas need to be designed for urban traits. For example, an ecosystem-specific approach designed to maintain high species diversity and habitat richness in an area \[^6\]. It is based on two urban natural features of high alpha (micro-habitat level) diversity and high inter-ecosystem diversity approach (beta). The diversity of site-specific management procedures used will result in a diverse and rich urban green.

These concepts and theoretical orientations provide the basis for a basic understanding of how public health and urban planning intersect. This suggests that urban planning serves as a major deterrent and contributor to health outcomes. Also, it explains how a holistic approach to building cities is key.

3.5. Ecological city development requirements

The requirements for realizing ecological urban development are as follows.

- **ecological guarantee**: covering a proportionate green space area, achieving non-carbon transportation systems, and zero emissions in the atmosphere. Clean and safe air, provision of clean water, healthy and nutritious food, energy-saving management, waste management towards “zero waste”, healthy housing and workplaces, city government services, disaster protection for everyone.

- **ecological sanitation**: must meet the aspects of efficient, cost-effective, environmentally friendly ways to process and recycle the products of human metabolism, waste, and dirty water.

- **ecological industrial metabolism**: where the preservation of resources and protection of the environment includes industrial transition, emphasizing reuse of materials used, sustainable production, renewable energy, efficient transportation, and the need for human relations.

- **ecological landscape**: which includes the unit that regulates built structures, open green spaces, links such as roads and bridges, natural components such as rivers, hills, maximizing urban accessibility for all city residents while conserving energy and resources. The conditions and characteristics of urban planning land are optimized as a place for people to live and have a culture. The planned area is planned to become a city that has an environmentally friendly concept, preserves areas that have high ecological value, as well as efforts to reduce the problem of vehicle accidents, air pollution, declining water quality, heat effects, and global warming are happening.

- **ecological awareness**: is the scientific study of the relationships that living organisms have with each other and with their mutually influencing natural environment. Understanding ecological awareness includes helping people understand that their place is part of nature, cultural identity, a responsible attitude towards the environment, and helping them to change their consumption habits and increase their ability to contribute to maintaining the city’s ecosystem with high quality.

3.6. Implementation of the concept of urban ecology (eco-city) in the world

The implementation of the urban ecology concept towards a healthy and humane city is generally defined as a healthy and sustainable city, an environmentally friendly city without carbon. The idea of “green cities” coined by Richard List in 1987 in his book entitled Ecocity Berkeley: Building Cities to a healthy future that aims to reduce carbon dioxide or Greenhouse Gas (GHG) emissions to zero, and produce clean and renewable energy (Kolte et al. 2013) Urban ecology concept-based urban planning contributes to improving the quality of life. In Table 1 Programs designed for urban planning are to create a healthy and humane city based on the concept of urban ecology which covers various disciplines.
Table 1. Examples of countries and cities in the world that have and will implement sustainable cities

| City       | State     | Program                                                                                     |
|------------|-----------|---------------------------------------------------------------------------------------------|
| Moreland   | Australia | Carbon neutral program "Zero Carbon Moreland"                                                |
| Calgary    | Kanada    | Qualification at an excellent level in sewage services, sewage systems, relatively low air pollution, and water drinkability and availability. |
| Kalundborg | Denmark   | Models for industrial ecology.                                                               |
| Oxford Residences | Estonia | Achieving carbon negative and considering economic, financial development, social factors towards the surrounding environment, energy, government policies, local people, education, in reality, more than any other system development. |
| Freiburg   | Jerman    | Green city programs, all houses produce more energy than they consume, and car-free (motorized-free area-ed). |
| Songdo IBD | Korea     | Central Park, seawater irrigation, bicycle path, a subway line, rainwater catchment system, pneumatic garbage collection system about 75% of the waste generated by urban development will be recycled. |
| Masdar     | United Arab Emirates (UAE) | Explore renewable energies, avoid dependence on fossil fuels, and create carbon-free eco-cities. |

4. Conclusion

The necessary to understand, integrate and apply ecological models and processes to urban biodiversity for populations and their importance in the face of large-scale population increases and developing cities, so that there is a balance between urban areas and environmental sustainability in order to achieve a better standard of living and harmony with the environment for urban communities. Finally, the implementation of the urban ecology concept that involves various scientific disciplines is needed for good urban planning in realizing a healthy (ecological) and humane city.

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