GREEN INFRASTRUCTURE IN JAKARTA, BASIC UNDERSTANDING AND IMPLEMENTATION EFFORTS IN INDONESIAN CITIES

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ABSTRACT

Public awareness of the importance of conserving natural resources and ecosystems can accelerate the implementation of green infrastructure (GI) in Indonesia. One of the Indonesian government's efforts to apply the principles of GI in urban areas in a structured and massive manner is through the Green City Development Program (P2KH) Ministry of Public Works and Public Housing (PUPR). The approach taken is Green Planning and Design, Green Open Space, Green Energy, Green Water, Green Waste, Green Building, Green Transportation, Green Community. The city that is the case study for discussion is Jakarta. Jakarta Smart City, Green Buildings, Urban Agriculture, and Child Friendly Integrated Public Space (RPTRA) are programs that successfully implemented. The implementation GI program easily accepted if based on the community.

INTRODUCTION

In various countries, especially the United States and European Union countries (EU, 2013), the concept of Green Infrastructure has been internalized in the urban planning process, contained in the development documents along with the accompanying regulations. Green infrastructure has become an urban development solution. This fact makes it essential to understand the basic concepts of Green Infrastructure and explore its application in Indonesia. It becomes a driver for mainstreaming green infrastructure development in Indonesia. When the term green infrastructure comes to the fore, most of us answered incorrectly. We just start by understanding the supports, the facilities, and buildings needed to create an efficient work area. As infrastructure, it is often, commonly referred to a building or construction made of concrete or metal such as roads, bridges, buildings, or piping systems (often referred to as grey infrastructure).

In comparison, Green Infrastructure (GI) is interpreted as a combination of buildings, positions, connectivity and types of green spaces which together facilitate the availability of a variety of benefits (Forest Research, 2010).

Besides, there are various definitions of GI found in diverse literature. The Environmental Protection Agency (EPA), USA (2016), Green Infrastructure is a concept, effort, or approach to maintain a sustainable environment through structuring green open space and maintaining natural processes that occur in nature such as rainwater cycles, soil conditions, etc. The concept of green infrastructure is to shape the environment with a natural process that is maintained; covering rainwater management, water quality management, to flood mitigation. Focus of implementing green infrastructure is to support community development by improving environmental conditions and maintaining green open space. On the other hand, the European Environment Agency (EAA) states that GI is based on

the principle that 'protecting and enhancing nature and natural processes that consciously integrated into spatial planning and territorial development' (Widyaputra, 2016).

Green infrastructure is an infrastructure that pays attention to the concept of conservation that has functions and benefits for human life. The fundamental aspect of the GI development concept is to prioritize the principles of multi-function, sustainability and resource saving, which consists of various features of the natural environment. In addition, community involvement in planning, management and monitoring is a must. In general, there are two things that differentiate between green infrastructure (GI) and gray infrastructure. First, GI is related to or imitates ecosystems in nature whereas gray infrastructure is the result of engineering or human thinking that does not take inspiration or follow natural ecology. Second, GI is multifunctional, meaning that it can provide more than one type of service to the community (Benedict & McMahon, 2006). For example, a city park as the lungs of the city as well as a reservoir for rainwater. In contrast to gray infrastructure, which generally only has one specific function, such as a bridge that functions as a link from one place to another. Although the two types of infrastructure are different, gray infrastructure can be part of the GI. Both of these can be seen in buildings that have green roofs or green walls.

METHODS

Various types of green infrastructure have been implemented in the world, ranging from hardware to software. Ranging from parks, open spaces, playing fields, forests, is included road trees, individual gardens, canals, water bodies, to more recent forms, such as:

a. Bioswale: A beautiful natural rainwater seepage system with plants, flowers and shrubs.
b. Green Roof: Roof vegetation that provides ecological value, reduces rainwater runoff, and improves building performance.
c. Green wall: A vertical structure designed to absorb air pollution and function as a noise barrier and add beauty.
d. Dry pond: Ponds that hold water after rain and allow sediment to settle before disposal.
e. Permeable pavement: Surface pavement that allows water to absorb into the soil.
f. Perforated pipe: An underground pipe with small holes that allow rainwater to enter and exit to the ground.
g. Rain harvesting: Use of tanks to collect rainwater and increase water supply.
h. Ecosystem Planning: Planning the development of new areas that consider the natural conditions surrounding and drainage channels.

RESULTS AND DISCUSSION
a. Benefits of GI and Ecosystem Services

Affordable green space is able to increase physical activity (exercise) so that the physical health of the local community also improves. Additionally, it can impact mental health and cognitive function. Lastly, green space can also help social connectivity, cohesiveness and community cohesive development. However, the direct economic benefits from the existence of green open space are relatively difficult to measure, however the economic benefits can be seen from the low health costs. Improving air quality, physical activity, water management, adding carbon, and tourism can improve public health. Increased property and territorial value, economic

activity, and job creation are part of the economic benefits for citizens.

The benefits of green infrastructure on the environment such as reducing air pollution, reducing the risk of flooding as part of a sustainable urban drainage system are relatively easily measured. It includes an improvement in the perception of the aesthetics of urban areas, a reduction in temperature due to the impact of the urban heat island phenomenon (the accumulation of heat in specific locations in cities due to lack of trees), and climate change. But sometimes the difficulty of obtaining land in urban areas is an obstacle to the realization of green space. In reality, people still neglected land utility as green space. Improving environmental conditions, increasing the quality of locations, and increasing the value of the property and regional investment due to changing land use neglected to green space can be very useful (Sinnett et al., 2016). However, changing land use requires resources and funds for long-term management.

(SUDS), swamps, and water reservoirs also provide hydrological benefits through Water Flow Fund increase of soil Green infrastructure can provide hydrological benefits in 2 (two) ways, namely reducing flooding and improving air quality. Green infrastructure can providehydrological benefits in two keys areas: flood alleviation and water quality. Tress, especially located along the river and floodplain, can contribute to flood alleviation by delaying the downstream passage of flood flows, reducing the volume of runoff, and promoting rainfall infiltration into the soil, thereby reducing the runoff. Flood alleviation using trees only significant during lower intensity rainfall events over longer time periods as tree store more water. Green roofs, Sustainable Urban Drainage Systems

(SUDS), wetlands and retention/detention basins also offer hydrological benefits through reduced runoff, increased storage and improved water quality.

The ecological benefits of green infrastructure are a priority for habitats. Various types of animals utilize green infrastructure, ranging from neglected large-scale locations to small-scale islands such as road islands. An active green infrastructure network provides opportunities for animals to move and occupy new areas. Although this transfer sometimes poses challenges for local animals, even carrying diseases, it also provides opportunities for animals to climate change. In addition, there is a term called ecosystem services which are the benefits provided by ecosystems that contribute to making human life possible and worth living; there is a wide range of goos and services that green infrastructure, can provide. These can be classified as supporting, provisioning, cultural, and regulating services. (Forest Research, 2010).

b. **Green City Development (P2KH)**

The Indonesian government effort to apply the GI principles in urban areas in a structured and massive manner is through the Green City Development Program (P2KH) Ministry of Public Works and Public Housing (PUPR). P2KH is a form of implementation of City/Regency Spatial Planning (RTRW) by involving the active participation of stakeholders at the local level to improve the quality of urban space. P2KH is held to respond to the issue of climate change and reduce carbon gas emissions on a national scale and as a concrete action to realize the mandate of UUPR (Spatial Planning Law) Number 26 of 2007 concerning Spatial Planning related to the target of achieving 30 percent of Green Open

Space (RTH) in urban (PUPR, 2017; Jakarta.go.id, 2012). Through P2KH, the Ministry of PUPR encourages eight green city attributes;

a. Green Planning and Design, namely increasing the City/Regency Government's ability to realize environmentally friendly city planning and design.

b. Green Open Space increases the capacity of City / Regency Governments to achieve the availability of green space.

c. Green Energy increases the role of the City / Regency Government in realizing the utilization of energy that is efficient and environmentally friendly.

d. Green Water increases the capacity of the City/ Regency Government in the usage of water resources.

e. Green Waste increases he size of the City / Regency Government in realizing environmentally friendly waste management, one of which is implementing 3 R (reduce, reuse, recycle).

f. Green Building increases the capacity of City / Regency Governments in developing energy-efficient buildings.

g. Green Transportation increases the size of City / Regency Governments in realizing the application of sustainable transportation/mass transportation systems.

h. Green Community expands he capacity of the City/Regency Government to recognize the increasing role of the community as a green community.

The concept of GI internalized in P2KH is a tool in the development of P2KH. ased on the P2KH Implementation Guidance prepared by the Ministry of PUPR, GI is one of the construction models for the design of the P2KH policy. The policy aims at (i) utilizing infrastructure systems that have been provided by nature and (ii) creating infrastructure engineering that respects the harmonious cycle with life through engineering drainage, clean water, roads, sanitation, solid waste in a sustainable manner. It contributes to creating public space green to improve the quality of human ecology in urban areas. Besides, the Ministry of PUPR has also established a strategy for implementing GI to support the P2KH program, namely:

a. Internalize the concepts, components, and benefits of GI in the Ministry of PUPR, provincial governments, and district/city governments.

b. Mapping and defining the remaining natural infrastructure in Indonesian cities

c. Urban-scale GI planning, both logical infrastructure plans and revitalization plans for built infrastructure.

d. Regional-scale GI planning.

c. Efforts to Implement Green Infrastructure in Jakarta

1. Jakarta Smart City
Jakarta Smart City is an effort optimizing the use of information and communication technology to maximize public services, provide solutions to solve problems, and support sustainable development. There are six pillars of concepts becoming the main focus of Jakarta Smart City, namely: (i) Smart Governance; (ii) Smart Economy; (iii) Smart People; (iv) Smart Mobility; (v) Smart Environment; (vi) Smart Living.
From the six concepts, the pillar that is in line with the improvement and utilization of GI in Jakarta is the fifth pillars namely the smart environment. Jakarta smart city defines this pillar as the city focusing on creating a healthy environment through sustainable management of natural resources to make Jakarta a livable city and to encourage green building

programs and environmentally friendly development.

2. Green Building
Green building practices efficiency in the use of resources such as electricity, water, and materials while reducing the negative impact on human health and the surrounding environment. To support the implementation of green buildings, the Provincial Government of DKI Jakarta has issued Governor Regulation No.38 of 2012 concerning Green Buildings. It serves as a reference for the implementing apparatus and building owners in meeting the requirements of green building construction. ew buildings must meet green building requirements.

Besides, the Green Building Big Building Design launched as a commitment of various relevant stakeholders in achieving agreed targets. The Great Design has a 30: 30 Target, which means that in 2030 all-new buildings meet the efficiency of electricity, water and reduce greenhouse gas emissions by 30 percent each from the initial conditions. The old building itself targeted at only 70 percent which an meet the target. The formulation of this Grand Design uses a collaborative approach involving various stakeholders through the Green Building Forum, which until now has been actively overseeing the implementation of the Green Building road map.
The Green Area in Daan Mogot has also launched the Grand Mosque Hasyim Asy'ari as a landmark. This Green Zone has been intended as a model for the construction of the Green Building in Jakarta. In the 17-hectare location, it has been planned to build 7 (seven) towers with a height of 26 floors intended for low-income people with a low-cost apartment plan. The area is with hospitals, schools, firefighters, lakes that function as waste processors. The whole area uses a green building scheme, including street lighting, including urban agriculture.

3. Urban Agriculture
Urban Agriculture (PP) is defined as activities that produce, process, and market food and fuel to meet the daily needs of consumers in the city and utilize land and water, uses and reuses natural resources and urban waste, to produce various foods and livestock (UNDP, 1996). DKI Jakarta Provincial Government intends to make PP as a food supply solution in the city of Jakarta. At the same time, it contributes to solve the problem of air pollution and hot weather, unstable food prices, the threat of flooding, and the lack of green cover. DKI Jakarta Provincial Government (2017), in collaboration with NGOs, business entities, universities, and communities, has successfully compiled and launched the Great Design of Urban Agriculture in 2018-2030. This large design is expected to be a guideline for the implementation, planning, and formulation of policies related to urban agriculture, including activities carried out by the community or collaboration between the government and the community (GIO, 2017).

The Grand Design of Urban Agriculture even expressly stipulated through Governor Regulation Number 14 of 2018 concerning the Implementation of Urban Agriculture. It is in article 77 states clearly that the implementation of urban agriculture refers to the Grand Design of Urban Agriculture. Urban agricultural activities have flourished in various forms ranging from green alley activities that utilize alley corridors and home yards as a location for planting, office yards, low-cost housing, including roofs and tall buildings.

4. Child-Friendly Integrated Public Space (RPTRA)

Besides RTH, Jakarta also developed GI through the construction of a Child-Friendly Integrated Public Space (RPTRA). the RPTRA not only has the primary function for supporting children's needs and rights and making Jakarta a child-friendly city, the RPTRA but also functions as a green open space and a place for absorbing groundwater (Governor Regulation Number 196 of 2015 concerning RPTRA Management Guidelines).

CONCLUSION

Green infrastructure development has become a necessity for cities in Indonesia. For this reason, the green infrastructure concept needs to be internalized in the development documents of the central and local governments to ensure its sustainability. In line with this, community involvement in the development of green infrastructure will increase the effectiveness of its use.

Ther are Various types of green infrastructure need special attention so that they can be properly utilized by the community. Provincial governments need policies by ministries, such as PUPR. It internalizes GI concepts, components, and benefits by mapping and defining existing natural infrastructure. This implementation is easily accepted by the community, such as the Child Friendly Integrated Public Space (RPTRA). Further studies on the application of GI that discuss the life cycle of GI benefits for cities and communities will be interesting.

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Appendix

Table 1. Types of Green Infrastructure Ecosystem Services
(based on the Millennium Ecosystem Assessment)

Type of Ecosystem Service	Shape
Provisioning	**Providing products for humans**
Wood / bio fuel	Wood products (raw and recycled wood) as electricity generation fuel, and domestic fuel wood
Regulating	**Improve or change aspects of the environment, strengthen safety and quality of life in the urban environment**
Pollution Mitigation	Capturing atmospheric pollutants through tree hoods
Ground Protection	Plants, especially grasses and trees, protect against erosion and landslides.
Flood and water protection	Trees, especially when it rains, delay and reduce flooding. Due to the minimal use of fertilizers, sustainable management of forests also offers the benefits of improving water quality.
Carbon Absorption	Plants, especially trees, will capture carbon through photosynthesis, and soil carbon will increase.
Climate change mitigation	Tree hoods can help reduce the impact of climate change on open space, thereby protecting the soil, animals and humans from extreme temperatures and sunlight.
Culture	**Provides opportunities for recreation, rest, relaxation, and soul strengthening**
Social cohesion and individual strength	Green space is important for individual enlightenment, a place to meet, do activities and integrate, especially if the community is involved in planning and managing green infrastructure.

Type of Ecosystem Service	Shape
Health, recreation, comfort	Green space is open to the public for outdoor recreation activities, which are beneficial for health and fitness
Support	**Support other types of ecosystem services.**
Soil formation, food cycle, water recycling, oxygen production	Green space is beneficial for soil formation and other biogeochemical processes that are essential for life
Biodiversity (BISE, 2013)	Green space can provide habitat for a variety of plants and animals

Source: Forest Research (2010)