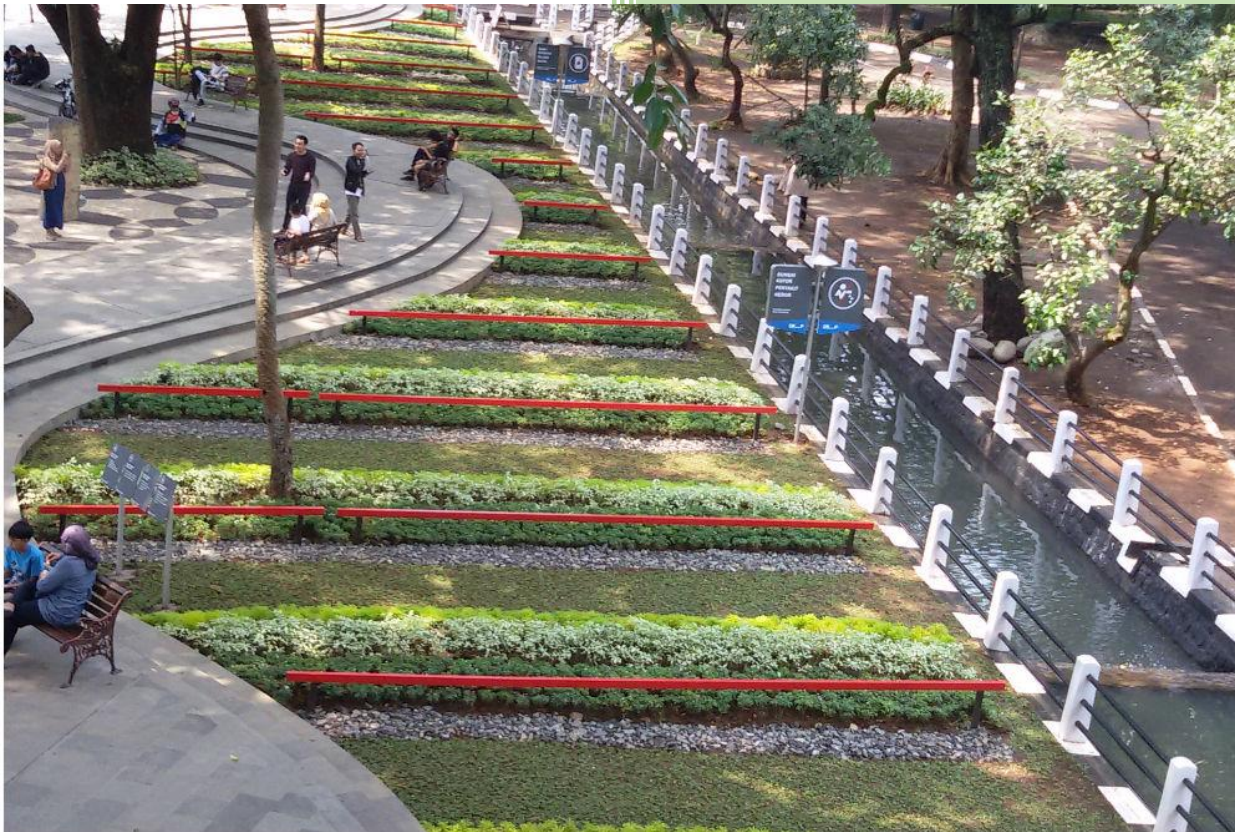


Master Thesis Report

Urban Climate Adaptation in Indonesia



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“And the God of all grace, who called you to his eternal glory in Christ, after you have suffered a little while, will himself restore you and make you strong, firm and steadfast.” (1 Peter 5:10) (NIV)

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Nanda Ratna Astuti, 2018

Abstract

Within the large area and high population, the urban area has its own urban microclimate conditions which highly influenced by the urban design and structure. Urban planning and design hold the key role to create a liveable urban environment and addressed the climate adaptation within. Among the megacities in the world, Jakarta Metropolitan Area the capital city of Indonesia, now ranked as the second largest megacity with approximately 31,5 million inhabitants. The rapid rate of urbanization also happened in ther Indonesian cities. It comes with many consequences, especially for the environment and peri-urban area. Urban climate adaptation now become emerging issue for urban practitioners and also local and national government. This study wants to explore the current state of urban climate adaptation in Indonesia with focus on specific research in green infrastucture implementation as climate adaptation. Therefore there will be two parts, the general research of urban climate adaptation in national level and the specific part of finding barriers of green infrastructure implementation in two big cities (Bandung and Yogyakarta).

Key words: urban climate, climate adaptation, climate change, green infrastructure, implementation

1. Introduction

Since 2014, urban dwellers filled up more than half of the world population (United Nations, 2014). This number will keep growing every year with projection by 2025 around 5 billion dwellers of urban area (Cohen, 2006; Mills et al., 2010). Moreover, the urbanization rate in Asia is getting higher. Among the megacities in the world, there are twenty-three cities located in Asia, with Jakarta Metropolitan Area (Indonesia) now ranked as the second largest megacity with approximately 31,5 million inhabitants. The rapid rate of urbanization comes with many consequences, especially for the environment and peri-urban area. With the high population density and concentrated economic activities, there are increasing issues for the environment to cope with urbanization and providing high quality of living.

Within the large area and high population, the urban area has its own urban microclimate conditions which highly influenced by the urban design and structure. One of the most known effect of urbanization regarding the urban climate is the higher temperature in the city compared with peri-urban or its surrounding area. This phenomenon is called Urban Heat Island (UHI). The urban structure and anthropogenic activity released a large amount of heat which the complexity can absorb and reflect back the solar radiations (Rizwan et al., 2008). In addition to that, the changing in global climate can also affected the urban climate and intensify the UHI's effect.

The area with sufficient green vegetation has cooler temperature than less-green area. Many studies and practices shows that green space contributes to shape urban climate and better living environment for human well-being. In 2011 Ministry of Public Works launched the Green City Development Program (in Bahasa Indonesia: Program Pengembangan Kota Hijau or P2KH). Its main objectives are to create green and sustainable environments through the implementation of green open space in the city, based on Government Laws number 26/2007 about Spatial Planning. The green infrastructure program (P2KH) designated to be adaptation program for cities to cope with changing in global climate, including UHI, through creating green and sustainable built environment.

In Green City Development program (P2KH), there are five main strategies to achieve that objective: 1. Strengthening institutional management; 2. Green planning and design; 3. Build green infrastructure; 4. Build green open space; and 5. Establishing green community and movement. This program is revised in 2015 with planned goals in 2019 there is 18 cities, 12 metropolitan areas and 744 municipalities implemented the P2KH program. The expected outputs of this program are: 1) masterplan of a green city which includes: existing green infrastructures in the cities and planning for new green city parks. 2) Build the green open space: emphasizing in expanding the percentage of green space. 3) Supervision and facilitation on green infrastructure implementation. 4) Create green community forum as the active participation of citizen and 5) Green community mapping. The current state in 2016, 165 cities and municipalities are being the part of the program (P2KH, 2016).

The planning phase of this program proceeds quite well, but when it comes to the implementation, it did not happen thoroughly (Ernawi, 2016). There is different progress in implementing green infrastructure program in each city. Even though the plan has been ready, the implementation process encounters some obstacle which depends on the situation in each city. In several cities, it is going quite well, but in other cities, not many green infrastructures have built. For instance, the city Bandung and Surabaya have extensively built parks and green space in past recent years. On the other hand, the city like Makassar and Banjarmasin finds it is difficult to expand their number of green space and green infrastructure (Luwukpost, 2016; BLHD Makassar, 2014). Newspaper and local news suggest that the problems are related to the limited amount of land and lack of coordination between the municipality and other stakeholders such as the consultant, contractors, and citizen community. From this, there is

an indication of potential barriers in implementing green infrastructure for climate adaptation. Therefore, this study wants to identify the barriers to implementing green infrastructure as climate adaptation measures in Indonesia.

1.1 Problem Statement

Urban planning and design hold the key role to create a liveable urban environment and addressed the climate adaptation within. The city design can shape the microclimate, for instance the green area which can create cooling effects to reduce the heat stress in the city (Lenzholzer, 2015). The use of climate information can be useful for urban design development and build an effective climate change policy (Mills et al., 2010).

The complexity of urban structure which consists of buildings, roads, green areas, water bodies and human activities such as traffic and industries have a major impact on local temperature and climate, which clearly differs from the climate in rural areas (Lenzholzer, 2015). These conditions lead to a phenomenon called Urban Heat Island (UHI). Due to UHI effect, the urban area will have higher temperature compares to suburban or rural areas (Figure 1). The UHI effect occurs depending on urban fabric, building density, green quantities and the energy produced in a city.

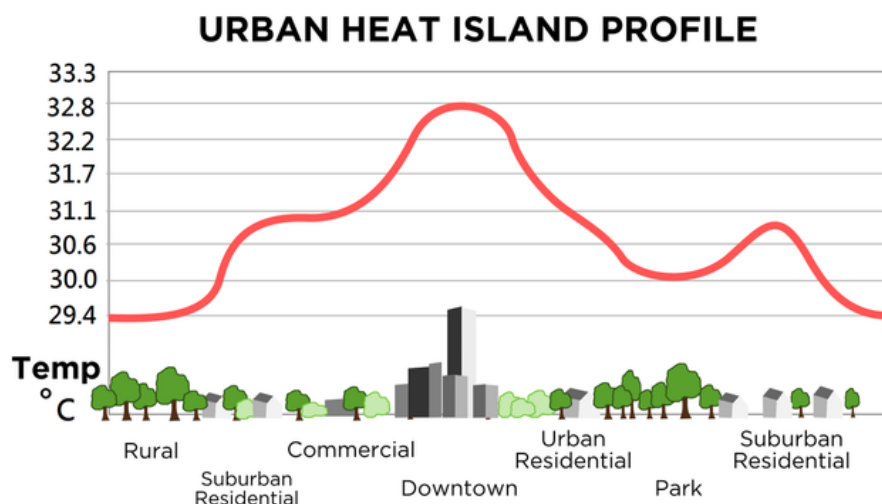


Figure 1 Urban Heat Island Profile (Retrieved from <http://geographylaunchpad.weebly.com/urban-microclimates.html/>)

In the past years, the trend has been showing that cities are aiming to adapt the impacts and aftermath of climate change in global scale and urban climate in smaller scale. Climate adaptation become necessity to keep urban milieu liveable to its citizens. Due to various climate conditions and different development state, countries and regions develop different climate adaptation measurements. At the moment, there is limited research that identify current state of urban climate adaptation in different countries, which limits the understanding of current state of climate adaptation globally (Park, 2015; Scheltema, 2017). Therefore, there is a knowledge gap that must be fulfilled with a specific urban climate adaptation research in various countries. The general objective of this research is to fill that gap of knowledge.

According to relevant literature, in climate change mitigation, one of the most prominent method is by growing more green vegetation (Rizwan et al., 2008) but how about adaptation measure? Many previous studies stated that green infrastructure, in general, has many benefits in creating a comfortable urban environment. The study from Byrne and Yang (2009) gathered the fact that urban green space has 'natural services' from reduces heat and mitigates disaster to reducing stress and contributes to healthy living activities. Therefore, green infrastructure and green space are quickly appointed as the solution to urban climate-related problems. Green infrastructure became preference response for adaptation because it appears to be easy to implement, relatively cheap, appealing to the public and politically safe (Bowler, Buyung-ali, Knight & Pulin, 2010 as cited in Matthews et al., 2015; Byrne and Yang, 2009). These major findings advise that spatial planners should pay more attention to utilizing green infrastructure in the urban area.

According to Matthews et al. (2015) there are three key challenges for spatial planning concerning green infrastructure, specifically in conceptualizing green infrastructure; perpetuating green infrastructure within planning; and adopting green infrastructure for climate adaptation. The first challenge is defining shared understanding on the concept of green infrastructure. This is inevitable because various interpretations and understandings about from environmental, social, political and economic perspectives; with lack of accordance between the stakeholders (Wright, 2011; Matthews et al., 2015).

The second is issue on perpetuating green infrastructure within planning is "how spatial planners can utilize green infrastructure as a new and innovative form of planning, not just rebranding existing initiatives as somehow being 'green'" (Matthews et al., 2015 p.158). As the research from Ahern (2007) said that innovative spatial planning can accommodates "abiotic, biotic, and cultural" functions through green infrastructure and also contributes to sustainability. Finally, the last challenge to adopt green infrastructure as climate adaptation lies in managing uncertainties from climate change, anthropogenic activities and policy problems (Matthews et al., 2015)

From challenges mentioned above, the situation for implementing green infrastructure is a lot more complex and incoherent in reality (Matthews et al., 2015). Meanwhile, as mentioned before, the development process of green infrastructure in Indonesia might be hampered by several problems which lead to ineffective and inefficient implementation. The research form Matthews (et al., 2015) can be used as a framework for assessing implementation of green infrastructure as climate adaptation in several cities in Indonesia. Therefore, the specific research objective is to find what possible barriers in implementing green infrastructure for climate adaptation in Indonesia.

1.2. Research Objective

There are two main objectives in this thesis research. First is to analyse the current state of urban climate adaptation in planning and design process in Indonesia. This study will explore the awareness level of climate adaptation, communication strategy in climate adaptation process, then the policy instruments were used and the concrete implementation of climate adaptation in Indonesian cities. The research questions for this part is developed by previous researchers as a part of worldwide study on urban climate adaptation. The similar studies in this topic already conducted in other countries, inter alia Kenya, the Netherlands, Belgium, Bulgaria, China and South Korea.

The second part of the research focusing on of the climate adaptation measures namely green infrastructure. The use of green infrastructure in cities has been a research object for many years. The multifunctionality of green infrastructure has many benefits to human life and for urban environment. This study aims to identify potential barriers to implement green infrastructure for urban climate adaptation specifically in Indonesian cities.

1.3. Research Questions

For the general part of the research, current state of urban climate adaptation, the research questions were developed by previous researchers Qiu (2016) and van der Schans (2017).

What is the current state of urban climate adaptation in Indonesia within urban planning and design processes?

1. Awareness and communication

- What is the sense of urgency to adapt the urban environment to climate change amongst citizens, politicians, planners, designers and urban climate experts?
- How aware are the people involved in planning and design processes of urban climate phenomena and urban climate adaptation measures?

2. Planning and design process for implementation

- Which urban climate adaptation strategies are used in the planning and design process and how successful are these strategies?
- Which concrete urban climate adaptation interventions are used in urban climate adaptation strategies?

3. Question for green infrastructure implementation

- What are the barriers for implementing green infrastructure as a strategy for climate adaptation in Indonesia?

1. How do key stakeholders conceptualize green infrastructure?
2. How is the concept of green infrastructure utilized in planning regulation and plans?
3. What kind of uncertainties are considered and how do these influence the process of planning?

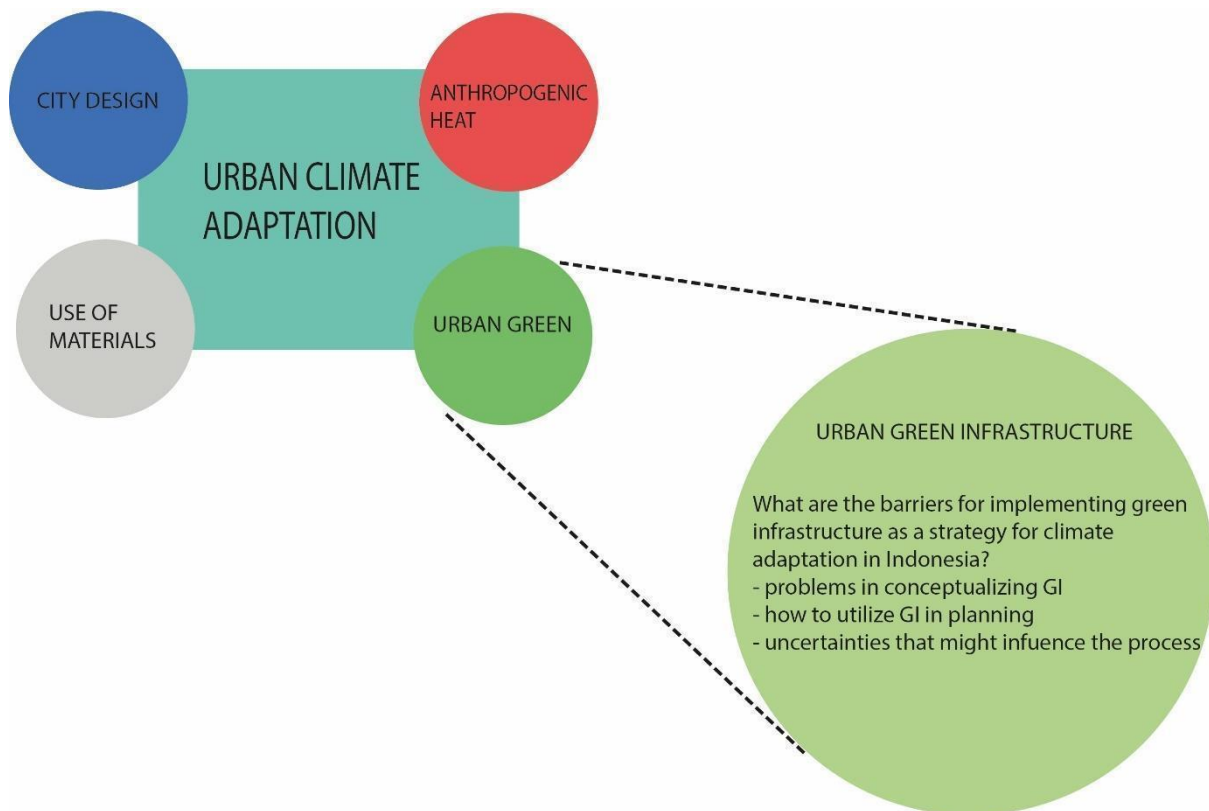


Figure 2 Specific Research Diagram

1.4 Thesis Outline

Chapter 2 consist of theoretical framework about the topic related to urban climate research. The first subchapter will explain about urban climate phenomena, the second one is about urban climate adaptation measures and the last one is about green infrastructure as climate adaptation.

Chapter 3 described the methodology of data collection and data analysis.

Chapter 4 consists of the results and discussions for the general research about current state of urban climate adaptation in Indonesia

Chapter 5 contains the results and discussion about the specific research in barriers of implementing green infrastructure for climate adaptation.

Chapter 6 consists the thesis conclusion which answer the research questions and provides recommendations for further research regarding the topic.

The annexes consist the complete interview results for general research and specific research part.

2. Theoretical Framework

To elaborate deeper in the context of urban climate adaptation, first the term 'climate adaptation' itself needs to be define. The United Nations Framework Convention on Climate Change (UNFCCC) (OECD, 2006 p.5) defines climate adaptation as "actions taken to help communities and ecosystems cope with changing climate condition". According to the UN Development Programme (UNDP, 2005 as quoted in OECD, 2006 p.5), climate adaptation is a "process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented". Adaptation requires a multidisciplinary approach and covers multiple policy domains. This chapter will explain related theories that are used in this study, including urban climate phenomena, urban climate adaptation measurements and green infrastructure as a means of climate adaptation.

2.1 Urban Climate Phenomena

The rapid changes in industrial and urban growth have the potential to improve quality of human life. However, at the same time, it causes many problems for human health and well-being, for instance air pollution, industrial waste and global warming. Cities are among the most vulnerable areas to changing climate which has been seen to have a more enhanced effect in urban environments (World Bank, 2011). In this research, there are two urban climate phenomena that will be studied, urban heat island (UHI) and wind dynamics. Local wind speeds and solar radiation are the only microclimatic parameters that depend greatly on urban form, which is comprised of different factors such as on-site location, building forms, and the geometry and orientation of open spaces (Reiter, 2010). Therefore, urban planners and designers can play on the interaction between these climatic parameters and the urban form to create comfortable urban climates.

2.1.1 Urban Heat Island

Climate conditions in cities differ from broader climate conditions. The specific microclimate of cities is the result of the complexity of urban morphology and structure, lack of vegetation (which has a cooling effect) and various human activities (Smith and Levermore, 2008). The growing population, densification of built-up area and increasing number of motorized vehicles contributes to the higher temperatures found on the micro scale. The phenomena of increased temperatures in city centre is known as Urban Heat Island (UHI). UHI is an urban climate phenomenon where the urban area has higher temperature compared with peri-urban and adjacent rural areas (Rizwan et al., 2008; Bowler et al., 2010; Sharifi and Lehmann, 2015). The areas with heat island effect can reach to 12°C higher than the surroundings (Oke, 1981 as cited in Eliasson, 2000).

Urbanisation changes the way the environment absorbs and reflects solar radiation, as well as the "surface energy balance" (Bowler et al., 2010). Moreover, the heat from sunlight, in urban areas there are also anthropogenic heat sources (Figure 3). This includes automobiles, power plants, air conditioners and another source related to human activity. Most anthropogenically-sourced heat comes into the environment "instantly and directly" (Rizwan et al., 2008 p.121). Direct heat comes from solar radiations, and the rest of the heat consumed by the built structures which heat the urban environment indirectly.

Throughout each day, urban structures constantly absorb and store heat energy comes from the solar radiation. Later in the evening, the heat energy that has been stored is released into the environment. The amounts of heat released by urban structures is determined by "controllable factors" or the manmade structures. A study from Rizwan et al. (2008) say that in cities where the sky factor is decreased, the ability to release heat by long-wave radiation is low. This results in a significant amount

of heat trapped in the building structures (Figure 3). These conditions are compounded with the use of materials which have low albedo, a coefficient that shows the capacity of a material surface to reflect solar radiation, that often occurs in the cities and streets configurations.

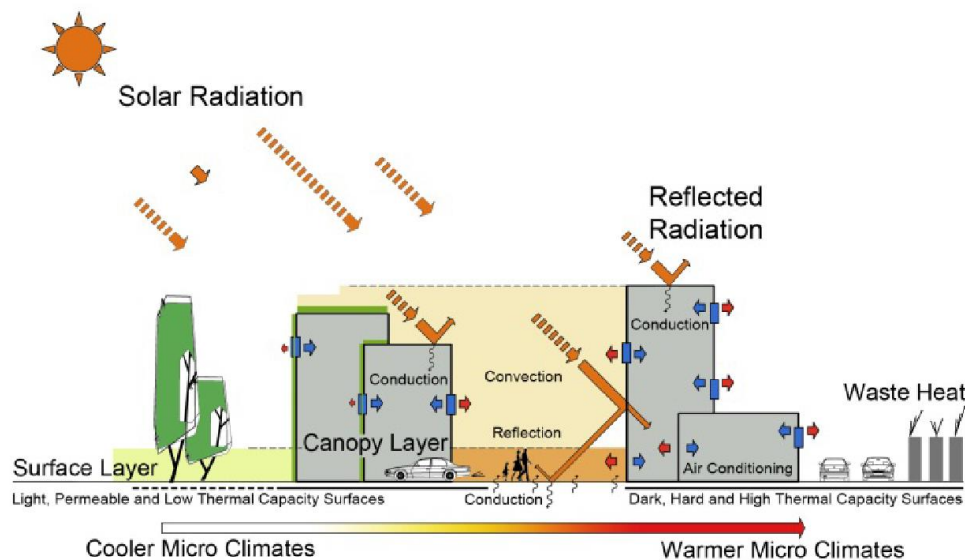


Figure 3 Urban Structure, Landscape, Land-cover and Metabolism Contribute to the Urban Heat Island Effect in Cities (Sharifi and Lehmann, 2015)

The occurrence of the UHI effect is generated by controllable variables and uncontrollable variables (Rizwan et al., 2008). The controllable variables include “urban design and structure-related variables”, namely sky view factor, building materials and green areas, and “population-related variables” such as anthropogenic heat and air pollutants (Rizwan et al., 2008 p.121). The uncontrollable variables refer to climatic and weather conditions such as anticyclone conditions, cloud cover and seasons.

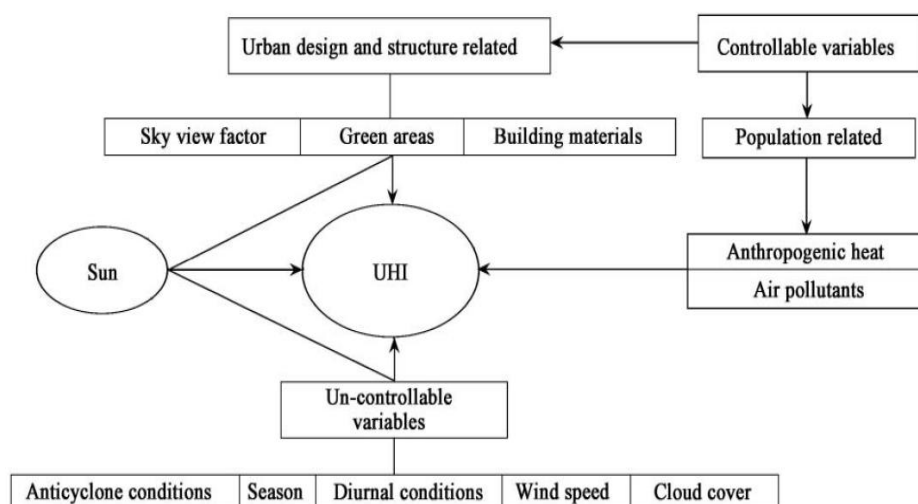


Figure 4 Generation of Urban Heat Island (Rizwan et al., 2008)

According to Smith and Levermore (2008), the urbanisation trends in developing countries is different from developed countries. For Asian cities, the study from Hung et al. (2005) shows different reported intensities of UHIs, for instance 8°C for Tokyo on July nights, 4.5°C for Seoul on August nights and of 5°C for Bangkok on February nights. In the future, it is possible that urban heat island intensity will increase, depending on the change in urbanization trends and climate change. Diverse and comprehensive studies need to be conducted in the future to better understand how climate change influences urban climate and urban heat island.

2.1.2 Wind Dynamics

Besides the temperature, wind dynamics have a significant influence on urban microclimate. However, urban planners oftentimes ignored the wind dynamics as microclimatic parameter (Reiter, 2010). For outdoor spaces in the city like open plazas or pedestrian areas, wind speed has an important role in determining outdoor thermal comfort. Wind interacts with built features to alter the climate at the micro level. Sometimes in an area filled with skyscrapers, the wind reaches speeds that can be too hard to navigate or even dangerous for the pedestrian. Thus, the building design should calculate its effect on the environment outside the building rather than just focus on creating comfortable indoor environment (Blocken and Carmeliet, 2003).

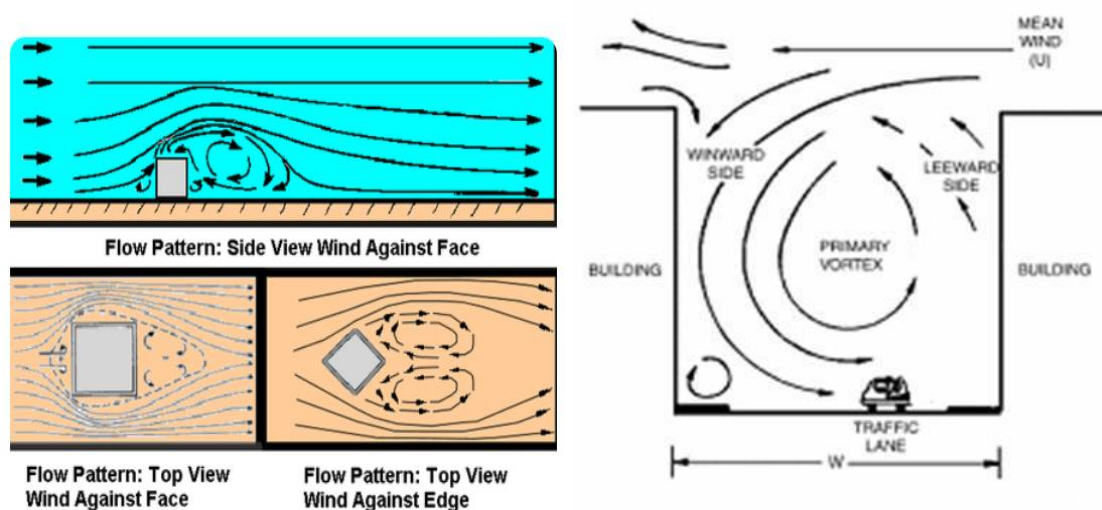


Figure 5 Urban Winds Flow Pattern (Retrieved from <http://thebritishgeographer.weebly.com/urban-climates.html> and <http://www.chemlabs.bristol.ac.uk/outreach/resources/Box4.html>)

Cities modify meteorological conditions including decreased wind speeds due to the presence of buildings (Koerniawan, 2016). Based on many studies and practices, around tall buildings the wind influences the outdoor temperature. The wind flows from one place to another because there is a difference in the air pressure. When there is higher pressure difference, the wind speed will increase, for instance in the area around tall buildings. The building height orientation influences the wind flow pattern and speed (Figure 5). The windward side of a building is the side where the wind hits the building's surface, resulting in an increased wind pressure. The leeward side is the side where the air pressure is lower because the wind comes as a "rebound" from the other side (Figure 6). In this theory, an ample wind velocity can dissolve the urban heat island effect, however it requires different wind speed for every city. For instance, a research in Seoul indicates that the required wind speed is

approximately 6 m/s whilst another study conducted in Lisbon shows that the required wind speed is 8 m/s (van der Schans, 2017).

Wind dynamics can cause difficulty or discomfort for certain human activities. For an activity that requires less movement like sitting, a lower wind speed is required (van der Schans, 2017). The ideal wind speed is around 2-3 m/s for stationary activities, and it increases to 5-7 m/s for more dynamic activities such as walking. Generally, if the wind speed is higher than 20 m/s it can be dangerous (van der Schans, 2017). Therefore, these different activities should be considered when planning and designing a particular urban area.

2.2 Urban Climate Adaptation Measurements

As seen on previous research by Rizwan et al. (2008) there are controllable variables and uncontrollable variables which affect the generation of UHIs. In this research project, which has been developed previously by Qiu (2016) and van der Schans (2017), there are four measurements that offer possibilities for adaptation to urban climate phenomena: city design/structure, vegetation, use of materials and anthropogenic heat.

2.2.1 City Design and Structure

Urban design and structure have an important influence on urban heat island and wind patterns. A study from Oke (1973) shows that the intensity of urban heat effect relates to the size of the city in terms of population. It is hard to impact the population size; therefore, the city structure has to be designed carefully to help shape a comfortable urban climate.

The picture below illustrates different scales of climatic conditions in the urban area. Mesoscale includes the city, peri-urban area and the adjacent rural areas. Local scale includes the neighbourhood area and microscale covers smaller area that neighbourhood, for instance a street or housing block. Based on this, climate adaptation strategies can be based on intervention in urban design and structure. For instance, land use planning, orientation of buildings and streets, planting vegetation or using different materials (Qiu, 2016).

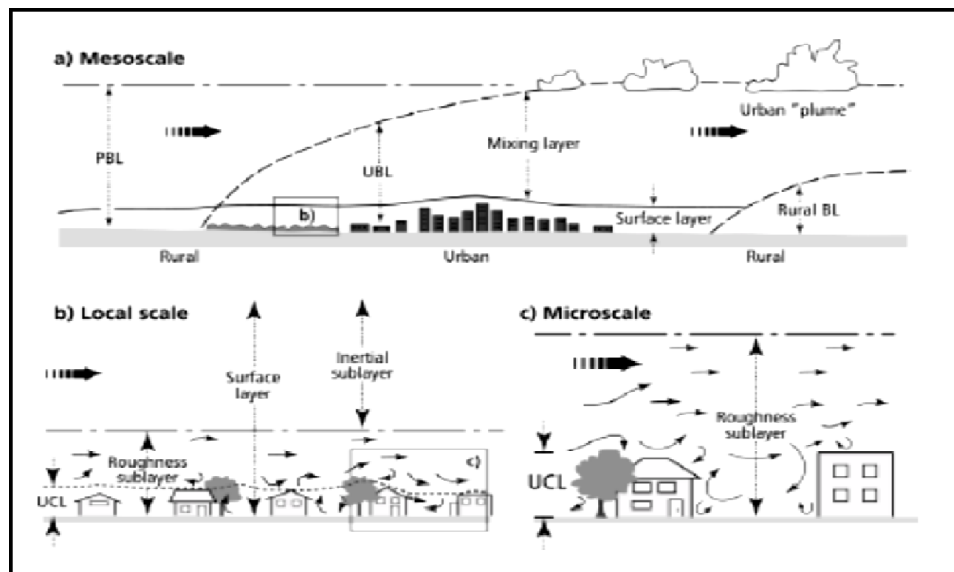


Figure 6 Climate Scale Division according to Space and Vertical Layers in the City (Shepherd, 2005 as cited in Koerniawan, 2016)

2.2.2 Urban Green and Vegetation

The greening of cities advances their climate-resilience and liveability (Mathey et al., 2011). Previous research shows that the trees and vegetation placed in the city have the ability of impacting the urban climate phenomena mentioned in this research: urban heat island and wind dynamics (Park, 2015; Qiu, 2016; van der Schans, 2017). This can happen in various ways. Green vegetation is widely used in mitigation measurements because of significant energy savings and lowering temperature (Rizwan et al., 2008). Research from Byrne and Young (2009) explores the range of nature's benefit from urban green space in combating global warming. These includes regulating ambient temperature, filtering dust, carbon sequestration, diluting storm-water, flood mitigation, decreased energy usage in buildings, slowing the speed of wind and biodiversity preservation (Byrne and Young, 2009).

The shadow created from groups of trees or vegetation can help reduce the temperature for building and built-up surroundings (Mathey et al., 2011). Green vegetation can help create cooler temperatures through evapotranspiration. It also absorbs CO₂ and releases O₂ which makes fresher air to breathe (Figure 7 and 8).

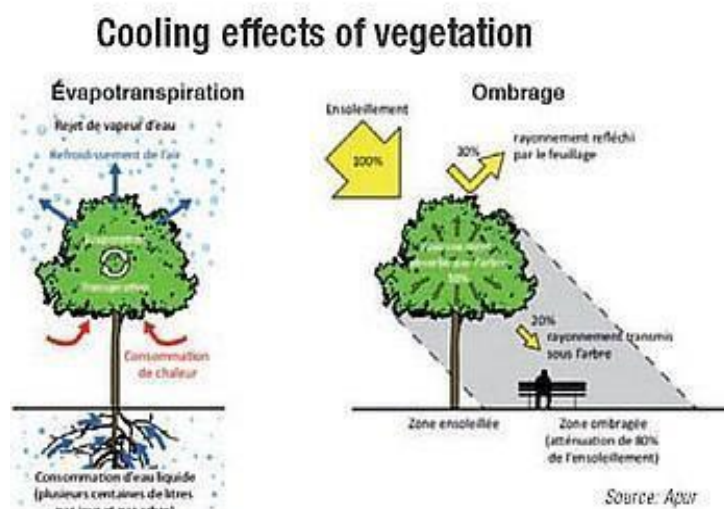


Figure 7 Cooling Effects of Green Vegetation (Retrieved from <http://www.worldurbancampaign.org/iau-revegetation-strategies-helping-urban-areas-combat-effects-heat-waves>)

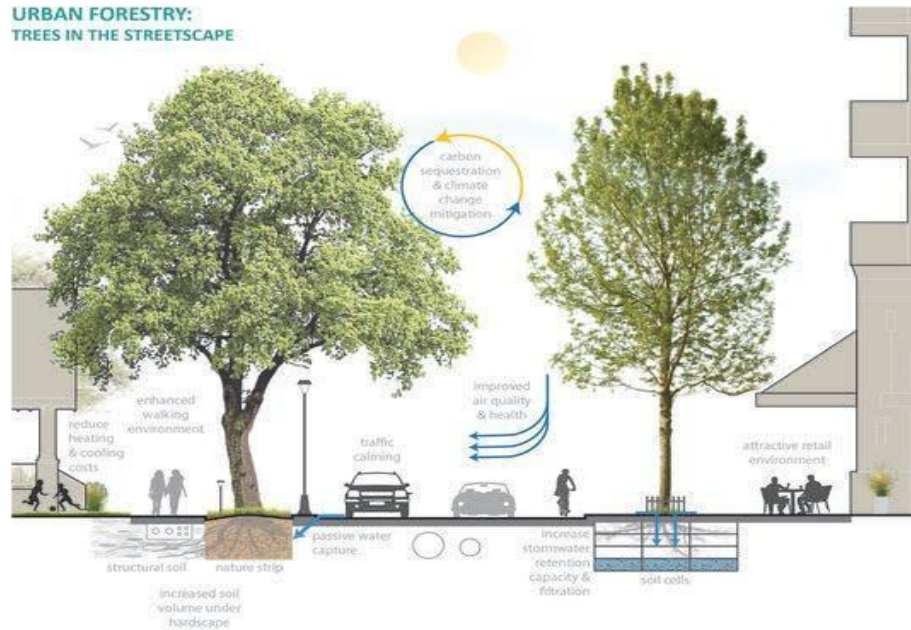


Figure 8 Example of Green Infrastructure Implementation in Urban Area (Retrieved from <http://www.diamondheadconsulting.com/p35-campbell-river-urban-forest-management-strategy/>)

Similar to the addition of trees and vegetation, the construction of green roofs (Figure 9) influences temperature in several ways. It provides shading in the outer side of the building envelope and provides better overall insulation. For the summertime, green roofs and green walls keep the building cool from the direct heat of the sun. It cools down the building temperature which decreases the need for air-conditioner and decreases the total amount of building energy consumption (Mathey et al., 2011). The green roof also helps decrease heat loss in the winter time through extra insulation on the roof. This saved energy saving results in lower greenhouse gas emissions (BCIT, 2017). Hence, the reduction in energy consumption for cooling and heating will result in cost savings.

Green Roof Comparison

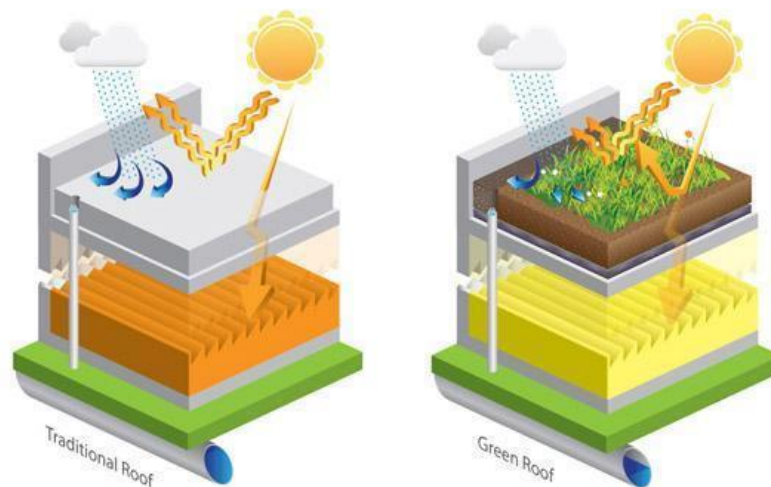


Figure 9 Comparison between Traditional Roof and Green Roof (Retrieved from <http://lagoscleanbeach.wix.com/site1/apps/blog/green-white-green-roofs>)

Similar to urban design and structures, plants and vegetation can influence wind dynamics. High wind speeds oriented toward the city square can be lowered with trees and vegetation that are placed strategically “windbreakers”. The building height ratio and the width of space in between determines wind speed. It is better to add several rows of trees to reduce the width difference, and allow wind to pass through the open space rather than creating high barriers (Qiu, 2016). Placing vegetation and trees in the neighbourhood scale or microscale will be more effective to intervene in the wind flows. In addition, trees can block winds as well as provide porous screens, and they are useful for streets where there is “canalization effect” (Qiu, 2016).

2.2.3 Use of Materials

The Urban heat island is mainly affected by the components and structures of buildings. The heat energy that can be released into the environment from the urban structure, depends on the particular building material and sky view factor (Rizwan et al., 2010). Each material has a different albedo range. Albedo is a coefficient that shows the ability of a material to reflect sunlight, ranging from 0 (the darkest material) to 1 (the whitest material) (Figure 10). A higher albedo is better because the heat will be released and not trapped in the urban canopy layer.

There are several kinds of materials that enhance the heat island effect. Most of the dark materials such as asphalt, concrete pavements and dark roofing are included in this category. These kinds of materials have a low albedo as they do not reflect shortwave radiation very well. Just as the most common materials used for streets and pavements is concrete or asphalt, dark roofing is also very common. The light colour tile or green roof can be an alternative to the dark roofs which would cool down the temperature and increase insulation. The way solar energy is reflected, emitted and absorbed can also influence the heat island effect. These processes can be broken down into the solar reflectance rate, thermal emissive rate and heat capacity of the urban property materials (Qiu, 2016).

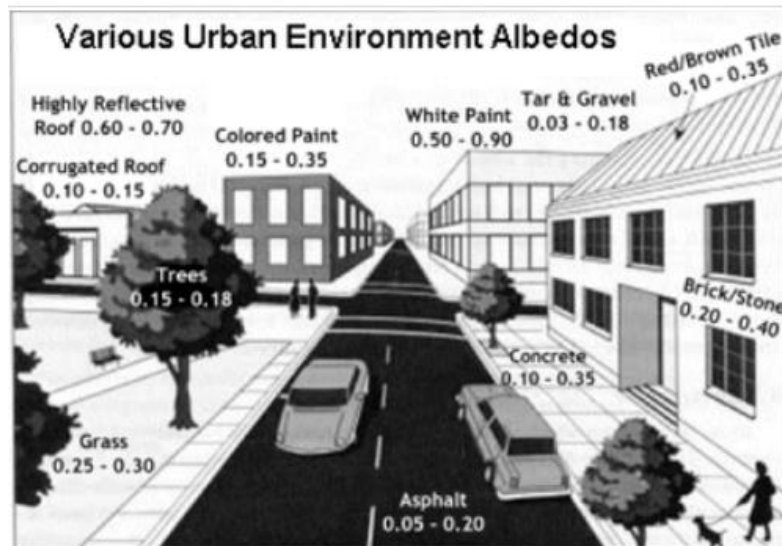


Figure 10 Various Urban Environment Albedos (Retrieved from <http://thebritishgeographer.weebly.com/urban-climates.html>)

2.2.4 Anthropogenic Heat

The anthropogenic activity is human activity that can be a source of heat generation. Anthropogenic heat is the heat generated by manmade sources such as automobiles, air-conditioners, and industrial facilities. There are three major sources of anthropogenic heat: metabolic emission (such as industrial activity), vehicular emission (from transportation activity and automobiles) and building emission (such as heating device and air-conditioners) (van der Schans, 2017). The heat generated dissolves into the urban environment directly and contributes to generates urban heat island effect (Rizwan et al., 2008).

The significance of anthropogenic heat varies depending on the area, their energy consumption scheme, as well as seasonal or even weekly trends (Rizwan, et al., 2008). Anthropogenic heat is produced mainly from infrastructures and human activities, and increases with the number of energy-consumptive buildings, industrial activities and transportation activities (Figure 11). Technological innovations such as energy-efficient air-conditioners and household appliances can help to reduce anthropogenic heat generation. Improved public transportation can reduce the number of automobile users. In Indonesian cities, where the climate is hot and humid, accessibility and use of energy-efficient cooling systems must be a priority, as the extensive use of air-conditioners contributes to high levels of anthropogenic heat. Similarly, the number of private vehicle users is also quite high, which makes it important to develop the public transportation system to lower the impact of automobiles on anthropogenic heat generation. These considerations are especially important in mega-cities like Jakarta, where the urban heat island effect is strong.

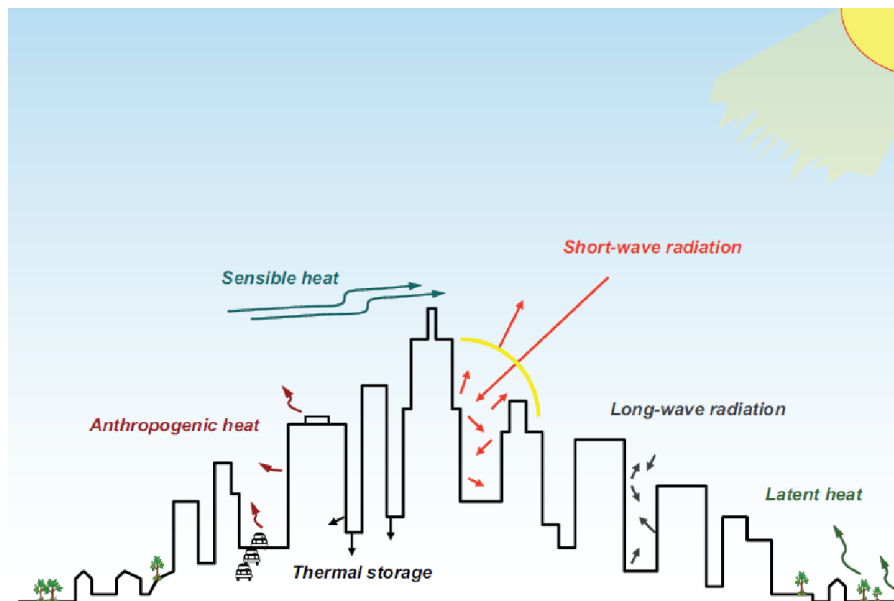


Figure 11 Urban Surface Heat Sources (Retrieved from <http://thebritishgeographer.weebly.com/urban-climates.html>)

2.3 Green Infrastructure Implementation for Climate Adaptation

Measuring the level of climate adaptation in urban area can be done in several ways. One is by evaluating the amount of urban green vegetation, which is known to have many benefits for human life. It is believed that green infrastructure also can counter the negative effects of climate change, including reducing urban heat phenomena (Derkzen et al., 2016; Byrne and Young, 2009).

In this study, the term “green infrastructure” is used instead of green vegetation to support the broader ideas of nature’s biophysical features that benefit human life, including the maintenance of a better urban climate. Moreover, green infrastructure has been a subject for research regarding its function to cooling urban centres.

Definition of Green Infrastructure

The concept of green infrastructure has been known among researchers and practitioners for quite some time. The principles behind green infrastructure extend beyond simply planting some green vegetation in an urbanized area. There is an evolving discussion regarding the role and presence of green infrastructure. Here are some definitions of green infrastructure developed in previous research

Table 1 Various Definition of Green Infrastructure

Source	Definition	Key points
Derkzen et al., 2017 (p. 107)	Green infrastructure is the “infrastructure of green spaces, water and built systems, e.g. forests, wetlands, parks, green roofs and walls that	infrastructure, green space, ecosystem, human

	together can contribute to ecosystem resilience and human benefits through ecosystem services.”	benefits
Matthews et al., 2015 (p. 156)	“Green infrastructure typically refers to an interconnected network of multifunctional green-spaces that are strategically planned and managed to provide a range of ecological, social, and economic benefits.”	interconnected network, green space, benefits
Benedict and McMahon, 2006 (p.1)	“Green infrastructure is an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water and provides a wide array of benefits to people and wildlife. Used in this context, green infrastructure is ecological framework for environmental, social and economic health or in short, our natural life-support system.”	interconnected network, natural spaces, benefits
Tzoulas et al., 2007 (p. 169)	“Green infrastructure can be considered to comprise of all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas, at all spatial scales.”	networks, multifunctional, ecological system
Naumann et al., 2011 (p. 1)	“Green infrastructure is the network of natural and semi-natural areas, features and green spaces in rural and urban, and terrestrial, freshwater, coastal and marine areas, which together enhance ecosystem health and resilience, contribute to biodiversity conservation and benefit human populations through the maintenance and enhancement of ecosystem services.”	network, natural and semi-natural areas, benefit
Ahern, 2007 (p. 267)	“Green infrastructure is an emerging planning and design concept that is principally structured by a hybrid hydrological or drainage network, complementing and linking relict green areas with built infrastructure that provides ecological functions.”	structured network, green areas, ecological functions
Byrne et al. 2015 (p. 133)	Green infrastructures are highly modified or engineered ‘intentional landscapes’, not those which are characterized by vegetated natural remnant or left-over spaces occupied by spontaneous vegetation	modified or engineered, intentional landscape
Merk et al. 2012 (p. 12)	green infrastructure (i.e. infrastructure developed to serve an environmentally	infrastructure, environmental

	beneficial function, such as environmental protection) and —greenable infrastructure (i.e. existing infrastructure, like building or transportation, that can be improved to reduce its environmental impact	benefit
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According to the definitions above, there are three important points that are embedded in the green infrastructure concept: connected network, nature or green area and benefits for humans and the ecosystem. Green infrastructure includes the following spatial configurations: green spaces, forests, water bodies, wetlands, parks, green roofs, green walls and all natural, semi-natural, natural or artificial ecological systems. Green area is not the same as green infrastructure but being a part of it, as green infrastructure also includes other types of greenery, also semi-natural and artificial ecological systems.

The study from Mathey et al. (2011) shows that the effects of urban climate phenomena such as heat island, high temperatures, wind discomfort and other effects related to climate change might also lead to the degradation of biodiversity in cities and urbanized areas. The role of green infrastructure become essential as a partial solution for such problems, especially in creating cooling effects for dense and hot cities, maintaining air humidity and improving air circulation (Mathey et al., 2011). Green infrastructure also contributes to carbon sequestration which means that it has mitigation and also adaptation functions (Wende et al. 2010 as cited in Mathey et al., 2011). The important aspect of green infrastructure that contributes to climate adaptation are biophysical capability and ecological functions that give benefits to human and the environment.

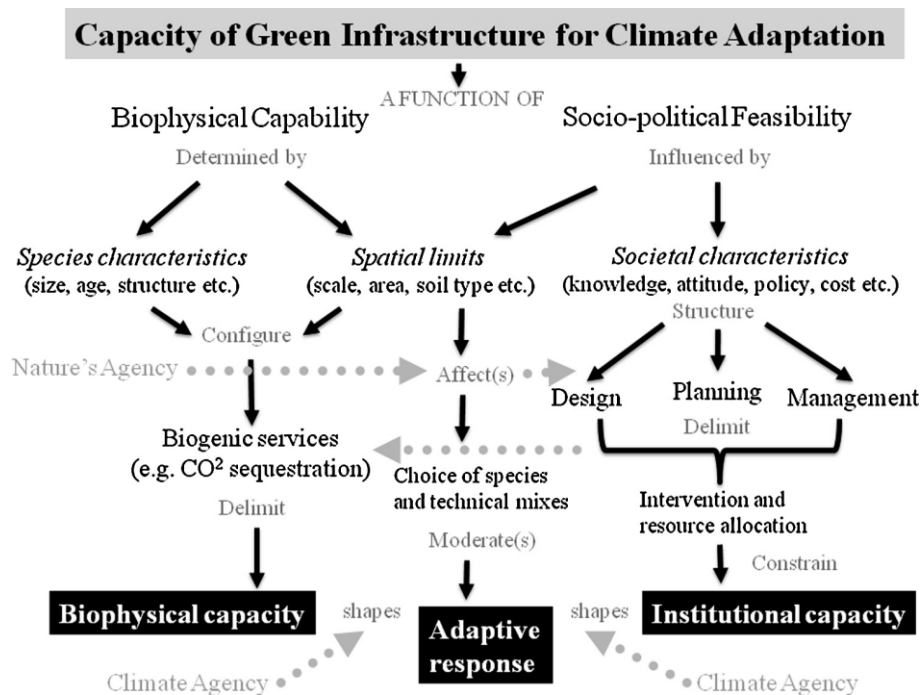


Figure 12 Capacity of Green Infrastructure for Climate Adaptation (Matthews et al., 2015)

Utilization of green infrastructure for climate adaptation is quite a new idea (Byrne & Yang, 2009; Byrne et al., 2015) even though the capacities and benefits of green infrastructure have been for the subject of many studies. As we know, urban areas have particular biophysical features compared with

suburban and rural areas. The ecological functions of natural areas such as water catchment, evaporative cooling and water filtration are now rarely found in urban areas because urbanization has replaced porous natural surfaces with hard-built infrastructure (Gill et al., 2007). However, these “missing functions” of natural areas can largely be fulfilled by providing urban green infrastructure.

Many studies previously focused only on the biophysical capabilities of green infrastructure and paid less attention to socio-political capabilities (Matthews et al., 2015; Byrne et al., 2015). Socio-political factors mentioned here include: governance concerns, management issues, urban morphology restrictions and public involvement challenges (Matthews et al., 2015). Research from Matthews et al. (2015) tries to combine both biophysical features and socio-political factors of green infrastructure for climate adaptation measures (Figure 12). For spatial planners, green infrastructure is favourable because of its usefulness and especially its “no regrets” measures for climate adaptation (Byrne et al. 2015). This is in line with a study from Matthews et al. (2015) who also found that green infrastructure arises to be an attractive solution for climate change because it is considerably quick to implement, not expensive, appealing to the public and “politically benign”. The study from Byrne et al. (2015) underlined the lack of attention from citizens towards the implementation of urban green as climate adaptation measures. The study also shows that in different region (European compares to Asian cities) there are different attitudes and levels of acceptability from the citizens concerning the implementation of urban green for climate adaptation.

2.4 Barriers and Challenges to Adaptation

In the general practice of adaptation, there are some measures that have already been implemented by practitioners. However, the adaptation phase implementation is quite slow overall, mostly because some of the promising methods are “politically unpalatable” (Byrne & Yang, 2009; Matthews et al., 2015 p. 155). Furthermore, many other adaptation measures might be considered unfavourable because they are out of budget, disturb the privacy of property owners, require major alteration in current planning systems or limit the future development in property sectors (Bulkeley, 2013 as cited in Matthews et al., 2015).

While the acclaimed benefits of green infrastructure in urban areas has been recognized since the 1980s, there is an insufficient sense of urgency in integrating urban climate and green infrastructure issues into spatial planning (Mathey et al., 2011). However, it has begun to gain some attention more recently (Mathey et al., 2011). Green infrastructure has gained acceptance in the era where more attention has been given to urban infrastructure planning. Green infrastructure is considered a no-regrets adaptation measure and as politically benign (Byrne and Yang, 2009). Therefore, green infrastructure implementation is quickly appointed as a preferable response for climate adaptation (Matthews et al., 2015) even though it needs further evaluation (Byrne and Yang, 2009).

According to Mathey et al. (2011) there are several barriers which currently green infrastructure implementation from progressing quickly. One of these barriers is a limitation on detailed knowledge focused on the climate effects of particular vegetation structures, and how they affect the broader system of urban green infrastructure. Also, the finding that conservation and green space planning abides by various conflicting political and planning requirements (Mathey et al., 2011) is similar to the challenges encountered by spatial planners regarding green infrastructure implementation defined by Matthews et al. (2015). In the context of spatial planning, there are three challenges encountered when green infrastructure is implemented as climate adaptation (Matthews et al., 2015):

- 1) Different perspectives in conceptualizing green infrastructure,
- 2) Problems with utilizing green infrastructure with planning regulations and processes, and

3) Managing risks and uncertainties related to implementation of green infrastructure

2.3.1 Green Infrastructure Conceptualization

The first challenge is diverse conceptions of green infrastructure from different stakeholders. There are several key stakeholders in spatial planning regarding the implementation of climate adaptation. General research shows that there are four groups of stakeholders that relate to climate adaptation: citizens, politicians or government institutions, urban planners/designers and urban climate experts.

The concept of green infrastructure is divided and gradually developed between environmental theory and socio-economic policy (Wright, 2011). Similarly, Matthews et al. (2015) tries to remedy the confusion among these concepts by distinguishing between green infrastructure as a “form of capital” and green infrastructure as a “risk buffer”. The capital-based concept emphasizes the role of green infrastructure as a provider of public goods. Public goods here mean the services or benefits from green or natural features such as contributions to human well-being and public health, its recreational function and possibility to fulfil social and economic needs (Matthews et al., 2015). The risk-based perspective sees green infrastructure as a remedy to help reduce the negative impacts of climate change heat stroke or flooding (Matthews et al., 2015). In other words, by acting as a “risk buffer”, green infrastructure is indirectly supplying public goods (Matthews et al., 2015 p.157).

Benedict and McMahon (2006) suggest that it is important to differentiate green space and green infrastructure. Green space is understood as natural features that are convenient. Green infrastructure is something that is indispensable: it protects and restores the natural life-support systems (Benedict and McMahon, 2006). Describing “green infrastructure as a necessity” emphasizes the important benefits gained from green elements and from the protection of these planning interventions from any other political interest or agenda (Matthews et al., 2015 p.157).

According to Matthews et al. (2015), there are changes occurring in how green infrastructure is conceptualized, emphasizing to see it as necessity not amenity (Benedict and McMahon, 2006), from an ecological to an economical focus and the overall greater emphasis in policy discourse and economic benefits. There are potential enablers for spatial planners, through these conceptual shifts, to appeal the multiple benefits of green infrastructure and improving the attractiveness from policy perspective (Matthews et al., 2015).

Wright (2011) says that the concept of green infrastructure is ambiguous and contested, because it has been given definitions but not yet explicitly defined due to the different perspectives (environmental, political, social and economic) attached to it. Moreover, there is a lack of shared understanding on how it should be defined, which leads to definitional ambiguity for spatial planners and potentially delays the uptake of green infrastructure as a climate adaptation measure (Matthews et al., 2015). These conditions lead to first the research sub-question of this study:

1. How do key stakeholders conceptualize green infrastructure?

2.3.2 Utilization of Green Infrastructure for Climate Adaptation in planning regulation

The second challenge relates to the utilization and perpetuation of green infrastructure in spatial planning. Oftentimes, planning and managing green infrastructure is seen as a “rationalist exercise” like any other type of built infrastructure (Matthews et al., 2015 p.157). These rational and stable conditions result from the well-known practical scale and scope of green infrastructure, like

conservation and recreation functions. This stable and sometimes stagnant situation can lead to “path dependence” (Matthews et al. 2015), which can be overcome so long as urban planners and designers continue innovating to prevent further negative impacts of urbanization and global climate change. Through innovation in green infrastructure, spatial planning can better accommodate abiotic, biotic and cultural functions which also contribute to sustainability (Ahern, 2007).

The innovation process should be focused on coping over path dependence. Path dependence is described here “situations where institutions become adapted to certain issues and activities over time, and consequently become reluctant to respond to the emergence of new imperatives” (Matthews et al., 2015 p. 158). The positive side of path dependence is the maintenance of paths that were previously successful, which involved the leading institutions and therefore help the development to grow on track (Sydow, Lerch, & Staber, 2010 as cited in Matthews et al., 2015). This positive benefit could also become a barrier to the adoption of the idea of green infrastructure, which is considered new in some contexts. Because the nature of path dependence includes the fastening of the institution into sectoral or particular systems of thinking and decision making, it makes it difficult to act when a new problem like climate change occurs (Matthews et al., 2015). Within the fixed pattern of such an institutional system, the negotiation cost is reduced, but so too is the possibility for institutional innovation hindered and the capacity to pursue more current and crucial objectives weakened (Matthews et al., 2015).

Spatial planning processes are “vulnerable to path dependence” (Matthews et al., 2015 p. 158) and most likely will confront the shift in important focal points, including the necessity to take response on climate change by doing climate adaptation (Matthews, 2013). Therefore, the main challenge for spatial planners is finding the way to make use of green infrastructure as an innovative and contemporary method of planning, not just putting a new brand on existing conditions or taking “green” ideas for granted (Matthews et al., 2015). Innovation is also important because the role of planners is to help tackle the adverse effects of climate change in cities which caused a debate in policy and planning regime (Heazle et al., 2013 as cited in Matthews et al., 2015). These conditions lead to the second research sub-question:

2. How is the concept of green infrastructure utilized in planning regulation and plans?

2.3.3 Managing Uncertainties of Planning Green Infrastructure for Climate Adaptation

Third challenge lies in manage the risks and uncertainties that may occur, mainly resulted from climate change itself and anthropogenic activities generally. Predicting the possible outcomes of climate change comes with a low level of precision, which creates new challenges for spatial planners and policymakers (Matthews et al., 2015). The unexplainable, less predictable and “cross scale nature” of climate change makes it less favourable in the rational perspective of conventional governance. In addition, climate change effects are spreading cross governance boundaries and are occurring in many layers from the local to the global (Steele et al., 2013 as cited in Matthews et al., 2015). Shifting perspectives into “green infrastructure as necessity” reduces the possibility of implementation influenced by climate change and human collective action.

Anthropogenic activities can produce ‘waste heat’ because of energy use from activities like heating, air conditioning or traffic (Tsilini et al., 2014). The anthropogenic side of climate change creates probabilities in the shifts of climate system, and an unidentifiable probability of future disastrous impacts such as hurricanes, heat waves and flooding. Climate change is seen as the unwanted consequences of modernity, unlike other natural weather conditions. It is mostly invisible, displaced over time and space, and only approved by scientific knowledge (Matthews et al., 2015).

In addition to these two challenges, there is also the challenge of “embedded policy discourse” and planning approaches related to the risk-based approach of green infrastructure. The complex and highly uncertain nature of climate change and related responses to cope with it (including adaptation through green infrastructure) means planning systems must confront the ‘wicked’ policy problem. This ‘wicked’ problem relates to socio-political contexts and institutional responses.

The institutional capacity of planning regimes might be extended to multiple scales. The process of planning and managing green infrastructure will generate new governmental and socio-economic considerations (Matthews et al., 2015). Hence, the planning sector probably needs to connect with various different sectors. It also must be prepared to keep up and frequently respond to the changing circumstances by updating their “risk assessments and action plans” (Matthews et al., 2015 p.159). The change in circumstances will almost certainly occur because climate change lies within the “risk-based concept” of green infrastructure (Matthews et al., 2015 p. 159). This means that the main function of green infrastructure is to overcome the negative impacts of undesirable economic expansion, instead of promoting it. In addition, climate change adaptation emphasizes system resilience, meaning there is an alteration process going on, but the system is withstanding the same function and structure (Matthews et al., 2015). These conditions lead to the third research sub-question:

3. What kind of uncertainties are considered and how do these influence the planning process?

3. Methodology and Case Study Selection

3.1 Type of Research

The research of urban climate adaptation is a global study conducted in several countries and this thesis is a part of it. The broader study aims to find state of the art mechanisms of urban climate adaptation. I have chosen case studies from Indonesia because of my familiarity with the language and culture. Furthermore, urban climate adaptation has not yet been studied in tropical climates or in the South-East Asia region. I also consider this study as a contribution to the development of my country. To explore the current state of urban climate adaptation in Indonesia, there are two cities selected as case studies, Bandung and Yogyakarta respectively, in addition to an examination of the current national state.

Indonesia is situated in South-east Asia, as an archipelago between the Indian and Pacific oceans and between the Asian and Australian continents. It has five major islands, and in total more than 16,000. Indonesia has a majority tropical climate, with a Koppen-Geiger climate classification *Af* or “tropical rainforest climate” with average rainfall of at least 60 mm/month all year long. There are small areas in eastern Indonesia that are classified as *Aw* climates (tropical wet and dry or savannah climate) with fewer than 60 mm rainfall in the driest month. The country lies along the equator, the average temperature is 28°C for coastal areas, 26°C in inland and mountain areas and 23°C in the higher mountain regions. The humidity is quite high and ranges between 70 to 90 percent. Indonesia has two seasons, rainy season and dry season with rainfall as the main variable of climate in Indonesia, influenced by monsoons. The rainy season occurs from October to April and the dry season from May to September.

Because the climate conditions in Indonesia is generally uniform in all parts of the country, the selection for case study cities is based on the progress of green infrastructure implementation. For this specific research, case studies Yogyakarta where the green infrastructure implementation is going well, and Bandung, where the implementation is not going well. For the general research, the current state for urban climate adaptation is assessed at the national level and includes two case study cities from specific research. Based on P2KH progress report in 2013 Yogyakarta has the largest green space area (18,03%) from the target of 20%. Meanwhile, Bandung has only 6,1% public green area even though the government has several greening programs.

3.2 Data Collection

For selecting the interviewees, I asked some friends and colleagues in the field of urban planning and architecture for some names of people who are familiar with this research topic. For the “expert” interviewees, I asked some people at the universities and browsed the related research topic to find the proper person. For the “government” interviewee I gathered the information from websites and documents about Green City Program (P2KH) to know which government institutions are related to this program. Some of the expert and other interviewees also recommended the right institution to be interviewed. Unfortunately, there is one local government institution that cannot be reached by direct meeting because of a permit issue. For the “urban planners and designers” component, I reached out to urban practitioners who are also doing some research in universities, NGOs or donor organizations. This category includes architects, urban planners and people with environmental or climate backgrounds.

There are several names and institutions I tried to contact but who rejected the offer to participate because they said they did not know about the topic or the topic is not related with their work. There are also some people and institutions which did not reply at all. There are 12 interviews in total, with 7 interviewees consulted for both parts which means 10 interviewees for the general research and 9 interviewees for specific research.

Most of the interviews were conducted in person. First, I informed participants about my research, confirmed their willingness to be interviewed, made an appointment for a meeting and sent them the interview questions. Therefore, they have further information about this study and could be more prepared for the interview. The interviews were held in Indonesia between February and March 2017, except for the last two interviewees (9A and 10A) for the general part. I contacted them via mobile phone first and explained about the research context and interview questions in general, then they asked me to send the full list of questions via email. Within a few days, they replied and for some parts which unclear for them, I explained through a phone call and messaging application. I asked their permission to record the interviews, which were used later for transcription.

(later in the results and interview transcripts, the interviewees will be coded as (number)A, for example: 1A, 2A,...10A. The "A" means they are interviewed for the general research component, to distinguish from the specific research component). The symbol typed after the position indicates the same person interviewed for both parts.

Table 2 Interviewees for General Research Part

No	Position	Organization	Methods	City
1.	Environmentalism / applied geographer	University of Indonesia	direct meeting interview	Jakarta
2.	Architect and research assistant (∞)	Bandung Institute of Technology	direct meeting interview	Bandung
3.	Urban climate expert and lecturer (Δ)	Bandung Institute of Technology	direct meeting interview	Bandung
4.	Architect and urban climate researcher (○)	University of Education Indonesia	direct meeting interview	Bandung
5.	Local government institution (◇)	Dinas Tata Ruang (Spatial Planning Agency)	direct meeting interview	Yogyakarta
6.	Urban planner and lecturer	Gadjah Mada University	direct meeting interview	Yogyakarta
7.	Architect and lecturer (□)	Gadjah Mada University	direct meeting interview	Yogyakarta
8.	Urban climate researcher (⬢)	Gadjah Mada University	direct meeting interview	Yogyakarta

9.	Urban Planner	Consultant at World Bank Indonesia	via phone and email	Jakarta
10.	Environmental and climate researcher (v)	Greenpeace Indonesia	via phone and email	Jakarta

(later in the results and interview transcripts, the interviewees will be coded as (number)B, for example: 1B, 2B,...10B. The “B” means they are interviewed for the specific research component, to distinguish from the general research component)

Table 3 Interviewees for Specific Research Part

No	Position	City/Organization	Methods	city
1.	Green city program secretariat - P2KH	Ministry of Public Works	direct meeting interview	Jakarta
2.	Architect and research assistant (∞)	Bandung Institute of Technology	direct meeting interview	Bandung
3.	Urban climate expert and lecturer (Δ)	Bandung Institute of Technology	direct meeting interview	Bandung
4.	Architect and urban climate researcher (o)	University of Education Indonesia	direct meeting interview	Bandung
5.	Local government Institution	Parks and Green Space Agency Bandung	website and documents	Bandung
6.	Local government institution (\diamond)	Spatial Planning Agency Yogyakarta	direct meeting interview	Yogyakarta
7.	Architect and lecturer (\square)	Gadjah Mada University	direct meeting interview	Yogyakarta
8.	Urban climate researcher (\triangle)	Gadjah Mada University	direct meeting interview	Yogyakarta
9.	Environmental and climate researcher (v)	Greenpeace Indonesia	via phone and email	Jakarta

3.3 Structure of In-depth Interviews

The theoretical framework in used in chapter 2 to form an in-depth interview structure consists of two parts: the general research and specific research questions. For the general research part, the set of interview questions is formulated by a previous student/researcher and has been used in previous studies in several countries (The Netherlands, Belgium, China, South Korea, Bulgaria and Kenya). There are two types of question in the general component, the closed question and open question. Closed questions are in the “sense of urgency and awareness” section to obtain more specific answers and administer precise assessments. In the specific research section, all of the questions are open-ended which gives more room for interviewees to elaborate on their answers.

For the specific research component, the questions focused on urban green infrastructure as a means of climate adaptation. They inquire about the general meaning of green infrastructure for different stakeholders, the implementation program in spatial planning, barriers to implementing green infrastructure for climate adaptation and managing uncertainties for the future.

Interview questions for general research: current state of urban climate adaptation

Sense of urgency and awareness

1. What is the sense of urgency to adapt the urban environment in the future, amongst citizens, government and urban planners and designers?
2. In case the sense of urgency is low, what is needed to make those groups feel a greater sense of urgency about adapting the urban environment?
3. How aware are citizens, government and urban planners and designers of the following two urban climate phenomena: urban heat island and wind discomfort?
4. In case awareness is low, what is needed to increase the awareness among those groups of the two urban climate phenomena mentioned in question 3?
5. How aware are the groups of the following four urban climate adaptation measures?
 - city design
 - urban vegetation
 - use of materials
 - anthropogenic heat
6. In case awareness is low, what is needed to increase the awareness among those groups of the four urban climate adaptation measures mentioned in the question above?

Communication

7. Which roles do citizens, government, planners and designers and urban climate experts have in the process of planning, designing and implementing urban climate adaptation measures?
8. What are the relationships between these four groups in the communication strategies?
9. What is the role of communication to support the planning, design and implementation of adaptation measures?
10. Are there formal guidelines or policies that drive the use of communication in the planning, design and implementation of adaptation measures?
11. What are the strengths and weaknesses of the communication process?
12. Is there a need to improve the communication process?

Instruments

13. Are there legally binding instruments (e.g. zoning plans) used to implement urban climate adaptation measures? If yes, please explain how they work?
14. What are the strengths and weaknesses of the legally binding instruments used?
15. Are there certain opportunities missed when using the legally binding instruments (e.g. coupling with other instruments)?
16. Are there other policy instruments used to implement urban climate adaptation measures? If yes, please explain how they work?
17. What are the strengths and weaknesses of the other policy instruments used?
18. Are there certain opportunities missed when using other policy instruments (e.g. coupling with other policies)?

Implementation

19. Which concrete urban climate adaptation measures/ interventions are currently being implemented or have been implemented in your city?
20. What are the strengths and weaknesses of these urban climate measures/ interventions?
21. Are there conflicts between aesthetics and these urban climate adaptation measures?
22. Are there conflicts between urban functions and these urban climate adaptation measures?
23. Are there certain opportunities (e.g. coupling with other interventions / 'no regret' measures) missed when implementing these mentioned urban climate adaptation measures?
24. What evidence is there that would indicate what the citizens are feeling/thinking?

Interview questions for specific research: green infrastructure for climate adaptation

- ❖ Conceptualization of green infrastructure by key stakeholders
- 1. What comes to your mind when hear "green infrastructure"?
- 2. In your opinion, what are elements that define green infrastructure?
- 3. What parts of your city do you think can be considered green infrastructure?
- 4. How did the quantity of green infrastructure in your city/region change during the past 5 years? Please explain (and if there is maps or statistic data, please provide)
- 5. How did the quality of green infrastructure in your city/region change during the past 5 years? Please explain
- 6. How much emphasis does your city/region/institution put on the following tasks
 - a. Conserving green space and natural areas (1 2 3 4 5)
 - b. Restoration of green space and natural areas (1 2 3 4 5)
 - c. Creating new green space or green infrastructure (1 2 3 4 5)

❖ Green infrastructure utilization in planning

7. To what extent green infrastructure has been included in planning regulation?
8. Are there formal guidelines or policies that drive the use of green infrastructure in planning?
9. What are the challenges or barriers for green infrastructure implementation in your city/region? Please explain and give examples
10. What is going well with the green infrastructure implementation in your city/region? Please explain and give examples
11. What processes of innovation have been involved in planning green infrastructure as climate adaptation in this city/region? (including: abiotic, biotic and cultural function of GI)
12. How to improve utilization of green infrastructure for climate adaptation?

❖ Managing Uncertainties

13. What kind of uncertainties do you think might arise in the future regarding urban green and climate adaptation issues? How to overcome these uncertainties?
14. Will these uncertainties influence the planning and implementation process? If yes how?
 - a. Uncertainties in climate change or anthropogenic issue
 - b. Wicked socio-political or institutional context

3.4 Data Analysis

In Chapter 2, the literature study in relevant topics was conducted to shape theoretical framework regarding urban climate adaptation and green infrastructure. The literature study also helped to shape the interviews structure and questions. Here are the keywords for literature study in this research:

Part 1: urban climate, urban heat island (UHI), urban climate adaptation, climate adaptation, climate change

Part 2: green infrastructure, urban green infrastructure, green vegetation, green space, green infrastructure implementation, barriers in green implementation

The interviews were recorded and transcribed. For the analysis, interview transcripts were collected based on each research question. All the transcripts and related documents were analysed by the researcher. Related documents included the city's spatial planning documents, zoning regulations and green implementation programs (P2KH documents). Next, the important and related information processed to be written for the results and discussion chapter. For the closed questions, the data are represented in excel tables and graphs for better presentation. The answers from interviewees were first analysed per city, to find particular urban climate adaptation and green infrastructure implementation characteristics. Secondly, the analysis tried to identify the state of the art of urban climate adaptation in the national level and the implementation of green infrastructure in two cities, Bandung and Yogyakarta. The third step was to compare the results in Indonesia with previous studies in other countries to seek the differences and/or similarities.

Table 4 Research Questions and Methods to Gather Information

Research questions	Methods	Output
- What is the sense of urgency to adapt the urban environment to climate change amongst citizens, politicians, planners, designers and urban climate experts?	1. Interview 2. document study	general part “awareness” questions 1-6
- How aware are the people involved in planning and design processes of urban climate phenomena and urban climate adaptation measures?	1. Interview 2. document study	general part “communications” questions 7-12
- Which urban climate adaptation strategies are used in the planning and design process and how successful are these strategies?	1. Interview 2. document study	general part “instruments” questions 13-18
- Which concrete urban climate adaptation interventions are used in urban climate adaptation strategies?	1. interview 2. document study	general part “implementation” questions 19-24
- How do key stakeholders conceptualize green infrastructure?	1. Interview 2. literature study	specific part “Conceptualization of green infrastructure by key stakeholders” question 1-6
- How is the concept of green infrastructure utilized in planning regulation and plans?	1. Interview 2. document study	specific part “Green infrastructure utilization in planning” question 7-12
- What kind of uncertainties are considered and how do these influence the process of planning?	1. Interview	specific part “Managing Uncertainties” question 13-14

4. Results and Discussion: Current State of Urban Climate Adaptation in Indonesia

For the first part of the research, there are 10 interviewees, who comes from different backgrounds and institutions. Each of the 10 interviewees are giving their perspectives/opinion about the following four groups of stakeholders: Citizens, Government, Urban planners/designers and Urban climate experts. Therefore, the bar charts in total will shows 40 results for close-ended questions. All interviewees for this part were interviewed directly. For the full transcript interviews, please see Annex1.

4.1 Interview results: Awareness and Basic Knowledge

This part of the interview explores the awareness and basic knowledge about climate adaptation. This includes the awareness to the tow urban climate phenomena, namely urban heat island (UHI) and wind dynamics. Also, the awareness to the four urban climate adaptation measures that selected for this study, there are city design, urban green vegetation, use of materials and anthropogenic heat. These points were explored using close-ended questions and the responses are represented in graphic charts. Open-ended questions were asked to follow up on how to raise awareness in the following topics.

Sense of Urgency and Basic Knowledge

Interview question 1: What is the sense of urgency and awareness to adapt the urban environment to climate change amongst the following groups in your city?

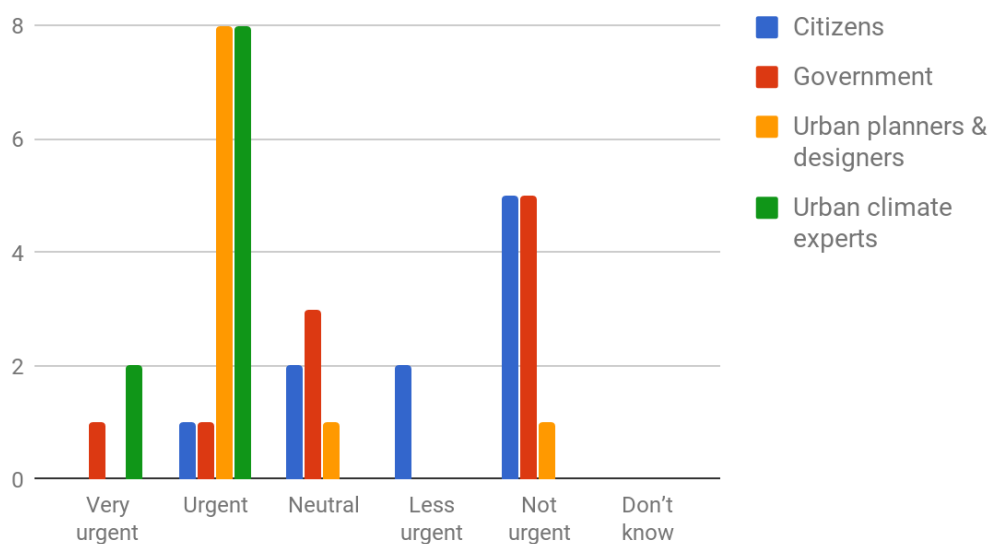


Figure 13 Sense of Urgency and awareness to Adapt to Climate Change

Figure 13 above illustrates the result from ten interviewees. The majority stated that the groups with the highest sense of urgency and awareness to adapt to climate change are urban planners and designers and urban climate experts. Meanwhile if the interviewees said “neutral” it indicates that the individual has never heard of the issue, or that they know about the issue but do not really understand its importance. Because Indonesian cities have hot and humid climate all year long (no seasons), it is unclear if its sufficient to ask the citizens only about the hot temperatures in the city. The hot temperature in the city might be from the heat island or it could be just the normal weather. Therefore, to know more about heat islands we need quantitative measurements such as a digital thermal map.

The most interesting group is citizens, because of the various types of responses they had regarding awareness and sense of urgency. According to some of the interviewees in Bandung and Yogyakarta (4A, 6A, 7A) it is hard to identify the level of awareness for citizens because of the diversity in the society. The awareness level of an individual depends on their background which includes level of education and economic status. There is a wide variety of citizens in Indonesia, from the upper class and highly educated, middle-class worker to less-educated and low-income citizens. The mid-upper-class society with a high level of education is known to have better knowledge about climate issues, or at least to have heard about this topic previously. The less educated or lower-class society mostly did not know about this issue or had never heard about it before. Therefore, the response of citizen awareness is varied, from neutral, less urgent and not urgent but mostly they had low awareness about the issue and low sense of urgency to adapt.

The politicians and government institutions are also considered to be lacking awareness regarding adapting to climate change. Some of the interviewees (1A, 3A, 7A) said that the government knows about this issue, but does not really understand what it means and how to address it and implement it into their programs. Similar to the citizens, the government and politicians only have basic knowledge about climate change from news or seminars without further information regarding what action to take. Some of the interviewees (2A, 3A, 7A) added that the environmental and climate change issues are not yet a priority in Indonesian cities. Urban planning and development in Indonesia still focuses on hard infrastructure to boost up economic value and accommodate urban growth.

Discussion

The awareness and sense of urgency to adapt are important factors to be able to achieve better urban climate adaptation process. Within the condition of various responds about awareness and knowledge about climate change in Indonesia, it is essential to spread the basic knowledge about climate change itself. According to EEA (2012) the knowledge and understanding of climate change problem is fundamental and persistent to promote climate adaptation. It will be very difficult to spread climate adaptation activities without sufficient awareness and understanding about climate change issue.

The situation in Indonesia is similar with findings from study in Bulgaria by Arabadzhieva (2016) which shows politicians and citizens group has lower awareness and sense of urgency to adapt because they are not involved much in scientific research about climate issues. Since the information and knowledge regarding this issue mostly not available or not pertinent for non-scientist community. Therefore, Indonesia’s government institution need to take action to raise awareness about climate change issue especially amongst politicians and citizens.

Measure to increase the sense of urgency

Interview question 2. In case the sense of urgency is low, what is needed to make those groups feel a greater sense of urgency about adapting the urban environment?

To raise the sense of urgency for climate adaptation, there are various methods suggested by all interviewees for each group. There is a different approach for each group. As seen from the previous graph, there are two groups with the lowest sense of urgency to adapt: citizens and politicians/government. Most of all interviewees, 9 out of 10 (2A, 3A, 4A, 5A, 6A, 7A, 8A, 9A, 10A) agreed there is an urgency to raise the citizens' awareness about climate adaptation. Citizens can be reached through knowledge sharing or campaigns which involve small daily actions. In addition, the campaign must be developed using simple language. One of the interviewee (4A) said about her previous research about UHI in Bandung "if you ask people in the streets randomly about the term urban heat island, they won't understand, those technical terms are only for researchers or experts".

Education and/or knowledge sharing can be encouraged through social campaigns, module distribution, training, and similar activities at the community level regarding the cause and adverse effects of climate change and specifically about the urban climate. The introduction of technical approaches applicable to prevent and adapt with the impacts can also raise awareness. Campaigns that involve daily activities can more easily raise the level of knowledge and sense of urgency about urban climate.

Secondly, for politicians and government institutions, the majority of interviewees (1A, 3A, 4A, 6A, 8A, 9A, 10A) suggested that they should be given a training, workshop or short course about this topic to increase their knowledge about climate change issues in general and urban climate issues specifically. This activity is also meant to emphasize that they have the most important position regarding the adaptation program implementation.

Urban planners and designers are considered to have a higher awareness and sense of urgency to adapt compared to other groups. They are considered to have the basic knowledge about urban environment and climate change in general. Therefore, they can try to infuse climate adaptation urgency into urban planning and urban design strategy. The urban climate experts can try to spread the knowledge by educating and communicating the climate issues to all elements of society. This can be done by organizing seminars, campaigns or workshops in cooperation with local governments, NGOs or citizens or by initiatives that are related to the issues.

Discussion

The policy and planning in Indonesia does not yet put climate adaptation and any other environmental-related issue as a priority. This result is similar to studies about urban climate adaptation in Kenya (Scheltema, 2017) and Bulgaria (Arabadzheva, 2016) where the citizens and government/politicians are the groups with less sense of urgency and understandings about climate change or climate adaptation topic. Therefore, to improve the awareness and sense of urgency of climate adaptation in Indonesia most interviewees suggested that information and knowledge sharing through seminars, trainings or using popular media are needed. Also, the practical workshops or programs that involve daily activity is easier to understand for many citizen groups. This is in line with findings from a climate

change study by BBC ClimateAsia (2013) who said that Indonesian people have higher awareness and put more attention to climate change effects if it is related to their daily activity or impacts their health and livelihood.

Awareness of Two Urban Climate Phenomena

Interview question 3: How aware are the groups of the following two urban climate phenomena: urban heat island and wind discomfort?

The awareness of urban climate phenomena was examined using two closed questions, one for urban heat island (UHI) and the other for wind discomfort. The results are written in the tables below

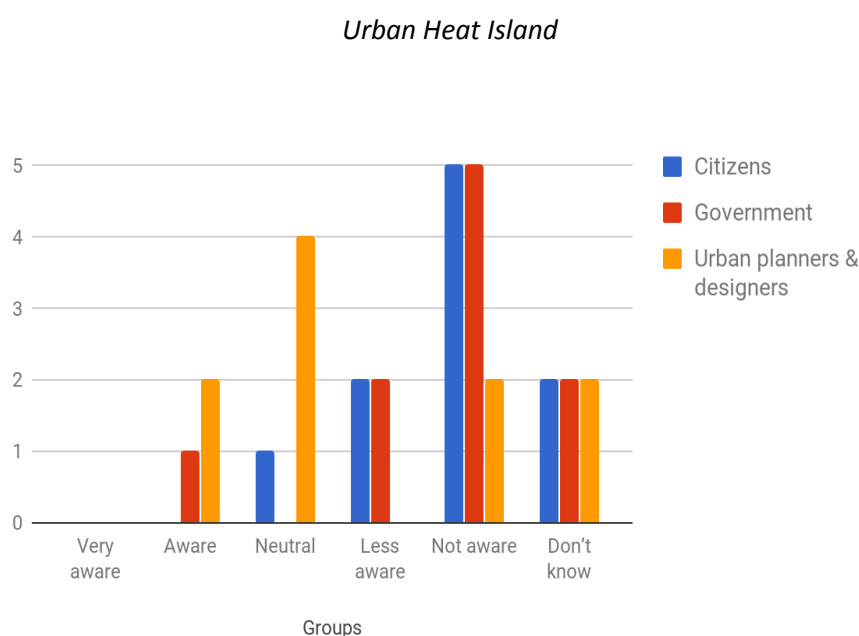


Figure 14 Awareness of Urban Heat Island

The interviewees' levels of awareness of urban heat island in Indonesian cities shown in Figure 14 above. The number of "not aware" and "don't know" answers is higher than any other answers. The answer of "don't know" indicates that the interviewees are not familiar with the UHI topic or did not want to give a statement about their level of awareness. According to the graph above, the citizens and government groups tend to be lower in awareness about UHI phenomena. According to one of the interviewees (4A) it is because the natural climate in Indonesian cities is hot and humid all year long. The difference in temperature during the rainy season and dry season is not very noticeable. Therefore, it is hard for the society in general to identify the UHI effect. Interviewee 4A said, "with a tropical climate like ours, people always feel the hot temperature, even if we don't know for sure the source of the heat." There is a part of society that knows about urban heat island, but the number is still very low compared to the number of people who are not aware.

Urban planners and designers have different perspectives about the awareness of UHI effect. This is in part due to their background of a university education, where the topic of urban climate has been included or not. One of the interviewees who was an architect and assistant lecturer (2A) said "the teaching focus in the school of architecture and planning is different in each university. Some of them

do not even include the issues about urban climate or climate change at all". Hence, urban planners or designers could have different opinions regarding this issue.

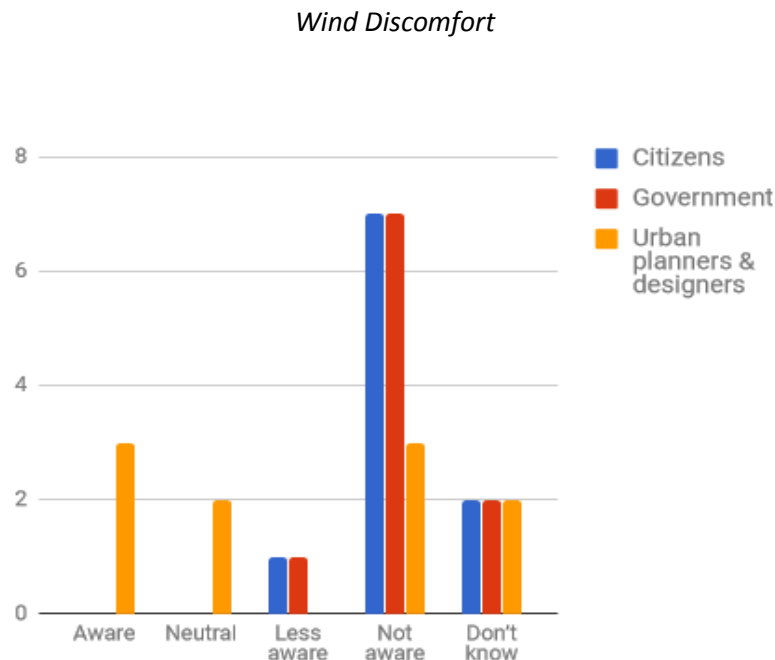


Figure 15 Awareness of Wind Discomfort

Figure 15 above shows the awareness of wind discomfort. Urban planners and designers are shown as the group with the highest level of awareness, mostly because architects have knowledge about wind dynamics for building design. Most of the interviewees thought that wind discomfort is not recognizable or considered not important. Two of the interviewees (3A and 4A) describe how, because of the tropical climate and lower altitude of the cities, the wind velocity is quite low, and people are not familiar with gusts of wind. The urban climate expert (3A) said based on his previous research, even in coastal cities like Jakarta, the wind speeds are very low because the building configuration tends to block the wind from the sea. "The buildings and city structure in Jakarta is not designed properly to allows the winds to come through, which makes it a less-ventilated city ". There are two of the interviewees that are not familiar with wind dynamics, and therefore they said "don't know" with both of the urban climate phenomena. In general, the interviewees tend to recognize the UHI phenomenon more than the wind discomfort effect.

Discussion

The scientific terms such as urban heat island, urban climate or climate change will be difficult to understand for people without a related educational background. The awareness of citizens is also influenced by the tropical climate in Indonesia, which makes it harder to identify urban climate phenomena. For UHI effects, the urban climate expert said it is difficult to recognize without thermal mapping (quantitative analysis) because the average temperature in Indonesian cities is normally quite high. The average temperature is 28°C in coastal area and 26°C in the inland area, also high humidity circa 75% throughout the year (Koerniawan and Gao, 2014). The same thing happened with wind dynamics, which is hardly recognized because of the low velocity. The equatorial latitude of Indonesia means that the only season are the rainy and dry season, neither of which generates many winds. The

city design and urban structure in Indonesian cities does not generate sufficient wind velocity because the built environment is not designed comprehensively according to microclimate measures.

If the side effects of climate change already affect their daily life, or are related to daily activities, people will have higher awareness and start to understand that there is urgency to do the adaptation measures. The awareness they had is still very basic, by just hearing about climate change in some news article or through seminars without further action to cope with it. This condition is similar with the situation in Kenya (Scheltema, 2017) where the study shows “there is a gap between basic awareness and in-depth understanding about climate change”. This situation is different from situation in South Korea, based on similar study by Park (2015) where the citizens have high awareness on climate change or climate adaptation issues in the Netherlands (van der Schans, 2017) where the citizens have a neutral level of awareness and considered not to need to raise the awareness anymore.

Increase the Awareness of Urban Climate Phenomena

Interview question 4: In case awareness is low, what is needed to increase the awareness among those groups of the two urban climate phenomena mentioned in question 3?

For citizens, most of the interviewees said that knowledge sharing through education, socialization or small campaigns can be effective to increase the awareness about urban climate issues. Two of the interviewees (4A and 6A) said for the citizens, we need to use simpler terms (not scientific or technical terms like UHI or thermal comfort, etc) so it will be easier for the citizens to understand the phenomena. One of the interviewees (10A) said that popular media such as TV and social-media can be used for spreading the knowledge and information about urban climate phenomena, because they are more accessible to the public.

To raise awareness among politicians and government institutions, most of the interviewees agree that training and education are important to make the government officials and civil servants aware of this issue. Two of the interviewees (2A and 5A) said that the Mayor (or other political leaders) should be the first person to develop the awareness. Interviewee 2A said that “if the mayor is already aware of the issue, then the information can be spread easier”. In addition, another interviewee (5A) said “if the (political) leader has the awareness, then it will be more easily understood by the civil servants”.

For the urban planners and designers group, the majority of the interviewees (2A, 3A, 4A, 6A, 7A, 8A, 9A) said that urban planners or architects are considered to have the knowledge about the urban climate phenomena. However, it depends on what specific university they were trained by. Two of the interviewees (2A and 7A) who are architects, said that not every university teaches its architecture/urban planning students about urban climate issues. It is critical that this population should be able to access the most current knowledge about urban climate, climate change and climate adaptation, which should be included in the teaching curriculum at each university that has an architecture and urban planning program.

Discussion

The government institutions and political leaders need to put more attention to climate-related issues because people look up very much to their leaders. If the leaders have higher awareness it will be easier to implement programs and spread the awareness to the citizens. Currently in Indonesia, climate change, environmental and climate-related topics have very low priority from political actors. This similar situation also happens in Kenya (Scheltema, 2017) where the politicians focus on other topics that are consider more important, and therefore the citizens also give less attention to climate adaptation. This is in line with study from Biesbroek et al. (2009) which state that developing countries still struggling with social issues like poverty, hunger, health and basic-needs resources to be their utmost priority rather than take action for climate change. Therefore, climate change needs to shift from political and scientific focus to more “transdisciplinary and sustainable development perspective” (Biesbroek et al., 2009 p.231) to give broader awareness and room for spreading the knowledge.

On the other hand, urban planners and designers should be given more trainings or seminars about how spatial planning can contribute to urban climate adaptation and how they can infuse the implementation of adaptation measures through their expertise. Not all urban planners and designers in Indonesia have sufficient knowledge about climate-related issues because it is not being taught by their university. Therefore, there is also urgency to put climate-related topics into university curricula for urban planning and architecture programs.

The Four Urban Climate Adaptation Measures

Interview question 5: How aware are the groups of the following four urban climate adaptation measures?

City design (e.g. street orientation, adapting to wind and solar orientation of building and streets, type of land use in the surrounding areas)

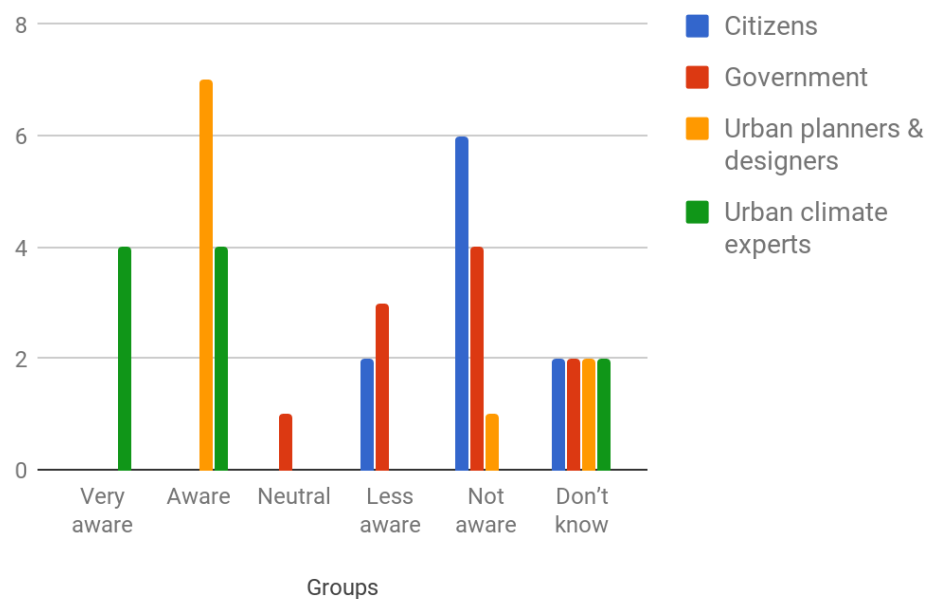


Figure 16 Awareness of City Design

The graphic above shows the awareness level of city design. The majority of the interviewees, eight out of ten, said that urban climate experts have the highest level of awareness for city design as a climate adaptation measure. It is obvious because this group is considered to have the most knowledge and expertise in urban climate. The exception is two interviewees who stated, “don’t know” about the level of awareness for each group, because they are not sure how to answer or chose not to answer this question. Seven out of ten interviewees thought that urban planners and designers has awareness about this topic. One of the interviewees (3A) stated that the growth of urban areas in Indonesia happened so fast and was carelessly planned so that “the urbanization and built infrastructure in Indonesian cities are rapidly growing, and urban sprawl is inevitable”. Originally, Indonesian cities like Batavia (Jakarta), Bandung and Yogyakarta were built by Dutch colonists. But these city patterns did not consider the eventual urban expansion that would occur. The interviewees in Bandung (4A) and Yogyakarta (7A) agreed that the massive urban development in their cities is very much business-oriented and did not consider the environmental effects caused by the intense built areas, “urban planners and designers have that awareness, but we are powerless. The decision-makers (governor or city mayor) can decide to build anything in the city which can boost the regional income”.

Both government employees and citizens are considered neutral or less aware about city design as urban climate adaptation measures. For government workers or politicians, four of ten interviewees stated that this group is not aware, three said they are less aware, one said they are neutral and two did not know. Citizens are considered to have the lowest level of awareness among the other groups. Six out of ten interviewees said they are not aware, two of them said they are less aware and two of the interviewees did not know.

Discussion: City Design

In Indonesian cities, such as Jakarta, Bandung and Yogyakarta, the urbanization and growth of the city emphasizes its function as the centre of development, cultural civilization and economic capital. Regarding to the environmental issues such as climate adaptation, it still lags far behind other metropolitan cities. The current development trends result in questions on sustainability of the environment (Steinberg, 2007). The city design and building layout is less prioritized and did not create a better urban climate. This is in line with study from Firman et al. (2010) which state that Jakarta is lacking in land use control and infrastructure maintenance. This condition is resulted from lack of climate knowledge among the urban planners and others involved in the planning process (Eliasson, 2000).

City design is an essential measure for a city to having a better urban climate. The city of Stuttgart has been a good example for a city to manage their UHI effects through a well-designed urban area (EEA, 2012). The city has “climate analysis map” for the Stuttgart region which designed to protect natural features and creating “ventilation-corridors” to lower the temperature and air pollution. This successful implementation of urban climate adaptation can be achieved by cooperation between urban practitioners and climate experts and also willingness from the government to take action in climate adaptation. In Indonesia this action is very much needed, regarding the current situation of city’s development and to cope with the effects of climate change.

Urban vegetation (e.g. green roofs, urban forestry, parks, strategically placed trees and shrubs, vegetated walls, vegetated rails and roads)

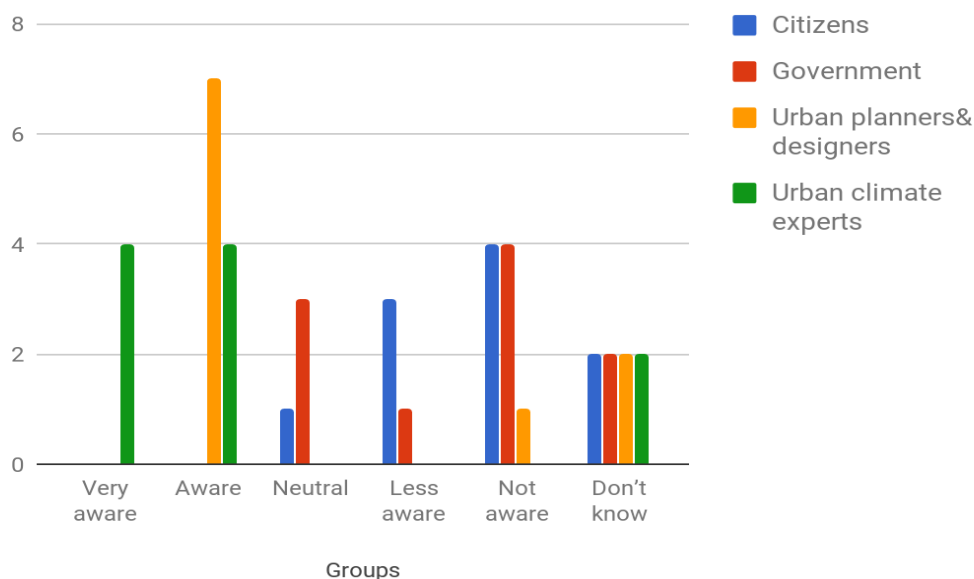


Figure 17 Awareness of Urban Green Vegetation

Figure 17 above illustrates the awareness level from four groups in Indonesia regarding urban green vegetation as an urban climate adaptation measure. Urban climate experts have the highest level of awareness, with four interviewees who said they are very aware, four who said they are aware and two people who do not know the level of awareness. Urban planners and designers also had a relatively high level of awareness. Five out of ten interviewees said that this group is aware of the potential uses of green vegetation as climate adaptation measure, one person said they are not aware and two people said do not know. One interviewee who is an urban climate expert said, “In Indonesia architects, more so than the planners are more aware of the issues regarding microclimates or green infrastructure.” This idea is supported by an academic lecturer that said their architectural student’s research that focuses on urban climate issues.

For the citizens, the interviewees thought that they have low awareness regarding the use of green vegetation for climate adaptation. Three interviewees said the citizens are less aware and four people said the citizens are not aware. For governments and politicians, three interviewees said neutral. This suggests that the government has addressed some greening issues which show they are aware of the benefits of green vegetation, but the implementation of greening programs is still minimal. Moreover, the urban climate expert in Bandung added “The greening program is more for aesthetics and street decoration, and is not seriously built for greater ecological purposes such as better microclimate or

reducing storm water”. The rest of the interviewees thought that government officials are less aware (one person) and four people said that the government officials are not aware. Two people did not know the answer to this level of awareness.

Discussion: Urban Green Vegetation

The use of urban green and vegetation is renowned to help reducing the heat in built and urban areas. Green vegetation can help create cooler temperatures through evapotranspiration. It also absorbs CO₂ and releases O₂ which makes fresher air to breathe. Many cities in different countries has proof of the benefits of urban greenery for better urban climate and lowering the temperature. European cities started to invest and built more green infrastructure which integrated with spatial planning to provide multiple benefits for the citizens and environment (EEA, 2012). One of the good example is in Manchester, UK. The city successfully manages the amount of green areas and other green infrastructure to maintain the temperature and to cope with other climate change impacts (EEA, 2012).

In Indonesia, there is possibilities to improve the use of urban green vegetation for urban climate adaptation as they do in European cities. For instance, in Bandung, the local government starts to build more parks and green space although the main purpose is not for climate adaptation. Therefore, urban planners/designers and climate experts have to approach government institutions, to give insight about the importance and benefits of green vegetation for urban climate adaptation.

Use of materials (e.g. low albedo and longer cooling time-lag materials)

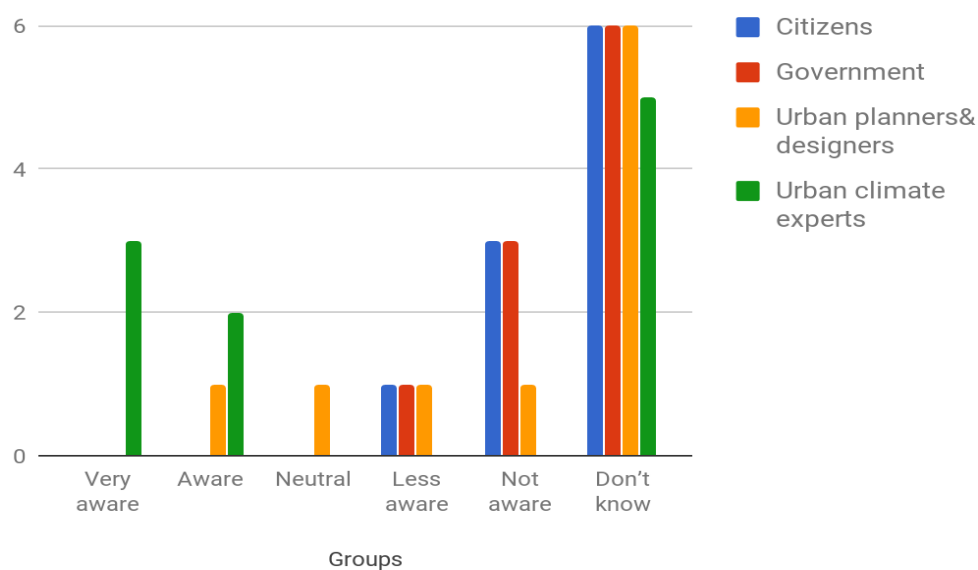


Figure 18 Awareness of Materials Used

Figure 18 above shows the level of awareness regarding the use of materials as a potential urban climate adaptation measure. For this question, six interviewees gave the answer “don’t know” for three groups: citizens, government and urban planners and designers. There are also five people who said, “don’t know” for urban climate experts. These responses reflect the interviewees’ insufficient knowledge about materials use and albedo index in relation to urban climate adaptation measures. The urban climate expert is considered to be the group with the highest awareness level. For urban planners and designers, the results are quite varied, from aware, neutral, less aware and not aware. This reflects the fact that urban planners have inadequate knowledge about building materials

compared to the architects. Government officials and citizens are considered to have a low awareness level about the use of materials. One of the interviewees (2A) said “Citizens are not aware of the type of materials they use for building their houses, as long as it looks good and fits their budget. In one neighbourhood you can see people with stainless steel for their fences”. The same thing happened for an infrastructure project funded by the government. “Even in an open green space like parks, they had hard structure (concrete block or asphalt) covering up to 50%” said one of the interviewee who is an architect.

Discussion: Use of Materials

Refer to the theory, the use of materials is important for the buildings and built areas to be more adaptive to the urban climate. Unfortunately, in Indonesia there is lack of awareness about materials been used for the buildings or for open spaces. The spatial planning law and regulations also do not mention about the use of materials for urban areas. Although urban planners and designers are quite aware about the use of materials in the buildings, the citizens are less aware about it at mostly built their house based on materials that affordable by price and widely available in the market. These findings are similar with condition in Bulgaria (Arabadzhieva, 2016) and Kenya (Scheltema, 2017) where there is a less awareness about of material used for better urban climate.

Anthropogenic heat (e.g. less air conditioners, lower car use)

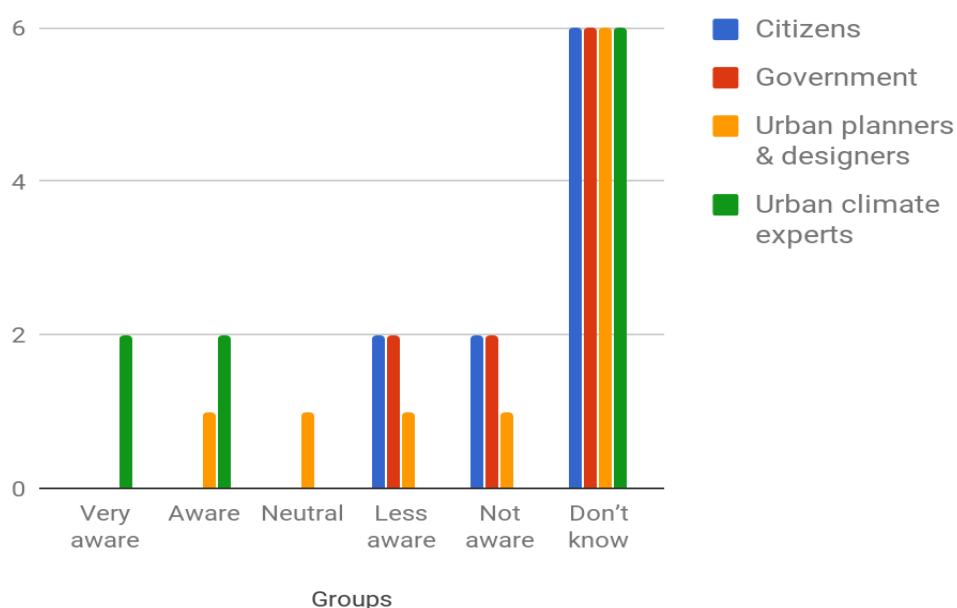


Figure 19 Awareness of Anthropogenic Heat

Figure 20 above illustrates the awareness level of anthropogenic heat in Indonesia. Once again, the urban climate expert is the group with the highest level of awareness. There are two people who said they very aware and two people said aware. Interestingly, six out of ten interviewees chose to say “don’t know” about this issue. This is because they are not familiar with the concept of anthropogenic heat and are not sure how to imagine the level of awareness of the other groups regarding these measures. A significant number of interviewees, six out of ten, did not give an answer or said they don’t know about this issue. Besides that, the urban planners and designers are considered to have sufficient knowledge about anthropogenic heat, but still they are not taking action about this issue.

Both citizens and government groups are considered to have a low level of awareness. One of the urban climate researchers (8A) said that in general, citizens are not aware of anthropogenic heat: “Nowadays if they feel the temperature in their house is too hot, they will buy air conditioners, rather than planting more trees or opening the windows”. One of the interviewees who is an architect (2A) also said “The building designs in Indonesia are now air-conditioner oriented. Newer building has smaller window and ventilation unlike the older buildings. This happens for residential houses, schools and office or governmental buildings.”

Two other interviewees (5A and 6A) added that the lifestyle of Indonesian people is car and motorbike oriented. Even just for a short distance, people tend to go by their motorbike rather than biking or using public transportation. One person said, “This is a habit not just in big cities, but also in peri-urban areas. Moreover, since last year there is a boom in the number of mobile-app based motorbike transportation (similar to Uber but the vehicle is motorbike), and the number of motorbikes is raising significantly”. With a large number of motor-based vehicles and extensive use of air-conditioners, most likely the generation of anthropogenic heat is getting stronger.

Discussion: Anthropogenic heat

The growing population in Indonesian cities resulted in highly increased anthropogenic activities. It is inevitable because the rapid urban development such as housing area, industry and public facilities changing the land use in Indonesian cities (Maru and Ahmad, 2015). There should be strict regulations in Indonesia to limit the use of motorized vehicles and air-conditioning buildings to lower the severe anthropogenic heat. The implementation of land use and zoning regulation has to be more strict, since many land use changing because of urbanization. Moreover, non-regret adaptation measures such as rooftop garden and green walls can be implemented in Indonesian cities to help reduce the UHI effect in Indonesian cities (Maru and Ahmad, 2015).

Increase Awareness about Urban Climate Adaptation Measures

Interview questions 6: In case awareness is low, what is needed to increase the awareness among those groups of the four urban climate adaptation measures mentioned in question 5?

Most of the interviewees agree that for citizens, education and knowledge sharing through popular media like television or social media are important for urban climate adaptation. It is essential to put the urban climate adaptation measures into daily-life context; therefore, it will be easier for citizens to understand. For politicians and government institutions there should be training and education to increase their knowledge so that they can adopt and infuse these measures into the policies and government programs. For urban planners and designers, they can help spread the knowledge through education, seminars or workshop for planning and design practitioners about urban climate adaptation measures. It is important to publicize the knowledge about urban climate adaptation measures, not just for architectural study but also for urban planning study. One of the interviewees (10A) emphasized that these activities should be done repeatedly and in continual phases to make sure the information is absorbed and understandable.

Discussion

Many people considered to “know about the issue” or at least to have heard about climate change issue, but there is a lack of deeper understanding about how to address this issue properly. The four

urban climate adaptation measures that mentioned above has to be put into more practical tools to be easily understandable for all groups of society. Trainings and workshops for smaller scale, for instance in neighbourhood, will be necessary to escalate awareness level and knowledge about urban climate adaptation measures. Adaptation measures should be in local scale to be more attractive and beneficial (Biesbroek et al, 2009). To raise the awareness about adaptation measures, there is should be good coordination “horizontally (between sectors and disciplines), vertically (within different scale) and diagonally (between different sectors and disciplines at different scales)” (Biesbroek et al, 2009 p.232).

4.2 Interview Results: Planning and Design Processes for Implementation

In this part of the research, there are three categories of planning and design process of urban climate adaptation explored: communication, planning instruments and concrete implementation of urban climate adaptation.

Communication

Interview question 7: Which roles do citizens, government officials, planners and designers and urban climate experts have in the processes of planning, designing and implementing urban climate adaptation measures?

Citizens: They are the object and beneficiaries of climate adaptation implementation programs. They are the important part of any successful implementation program for urban climate adaptation (1A and 10A). For instance, the citizens can apply the urban climate measures to their own house/building or their neighbourhood.

Politicians/Government: Most of the interviewees (1A, 2A, 3A, 4A, 5A, 6A, 7A, 8A, 10A) thought that in implementation of urban climate adaptation measures, government has the main role because they have the power and authority to make policy and programs in their city or region. In Indonesia, the political leaders are the key people to implement any developmental program. Therefore, to enable planning and implementation of urban climate adaptation programs, first the political leader should have the awareness and sense of urgency about urban climate issues.

Urban planners and designers: Majority of the interviewees (2A, 3A, 4A, 6A, 7A, 8A, 9A) said that urban planners and architects has the important role of “bridging” the citizens and government. This can be done by the advisory role for government programs and involving the citizens in planning processes. Urban planners and designers are expected to know how to translate the urban climate adaptation measurements into practical actions that can then be more easily understood by the citizens. They are also expected to monitor and evaluate the implementation of governmental programs in general.

Urban climate experts: Most of the interviewees agreed that the urban climate experts have the role of spreading the knowledge and information about urban climate and any other climate-related issues. In addition, they also have the role of advising and influencing the government in policy-making and decision-making processes regarding climate-related issues. However, based on experience in

practices (1A and 3A), some of their advice might not be included in the policy and implementation processes. This happens because when finalizing the decision-making process, the political leader has the power to decide which policy or program should be implemented.

Discussion

Each stakeholder group has different roles in the process of planning, designing and implementing urban climate adaptation measures. Because in Indonesia, governance structure is mainly top-down system, government institution or politicians has the main role in implementing any policy. Meanwhile, citizens have more passive role, where they just being the object of program implementation. Therefore, urban planners and urban climate experts should have more intense communications, since they tend to be in the same scientific circle. These two groups also have similar role, as advisor to government institutions and as educator for citizens regarding climate adaptation issues. The methods to reach the groups of stakeholders should be specifically addressed to effectively communicates the urgency of climate adaptation (Biesbroek et al., 2012). For instance, they should use less-scientific terms of language for citizens group while discussing and planning climate adaptation program.

Interview questions 8: What are the relationships between these actors in the communication strategies?

- Citizens-Government: According to some of interviewees (5A, 9A, 10A) they agreed that citizens are the beneficiaries of the government's development program. The government creates the policy, programs and also the budget. Ideally, this process involves the citizens in the implementation process, but most of the time in Indonesia the implementation is more likely a top-down approach (1A). Therefore, the communication between citizens and the government tends to be one way only.
- Citizens/ Urban planners and designers: Three of the interviewees (1A, 2A, 9A) agreed that the relationship between citizens and urban planners is generally a two-way exchange. Urban planners or designers can help to educate and raise awareness about urban climate or climate adaptation measures. Three of the interviewees (4A, 6A, 7A) mentioned that planning scholars had some social responsibility to help the citizens to improve their knowledge about this issue by doing neighbourhood-scale projects to help the citizens cope with urban climate phenomena and climate change in general. Citizens can participate as the beneficiaries of the program and/or provide data for further urban climate research.
- Citizens/ Urban climate experts: Almost all interviewees agreed that urban climate experts can educate the citizens about urban climate and how to cope with that, although the relationship is not direct. Urban climate experts can cooperate with the local government, NGOs or citizen initiative groups for sharing knowledge and awareness about climate adaptation through

seminars or workshops. Citizens can participate by being involved in those activities or by being respondents and/or providing data for urban climate analyses.

- Government/ Urban planners and designers: According to the majority of the interviewees (1A, 4A, 6A, 7A, 8A, 10A) the relationship between government actors and urban planners features two-way communication. Government needs the advisory role and expertise of urban planners to compile the spatial planning policy. Whilst urban planners and designers can use this role to infuse the climate adaptation measures to the spatial planning practices.
- Government/ Urban climate experts: Almost all interviewees (1A, 3A, 4A, 6A 7A, 8A, 10) said that the relations between these two actors should be strengthened. Urban climate experts should have more intense communication with government actors. They can share the data/information about the urban climate and share the risks or negative effects of UHI, then give the advice or alternative for solutions to the government actors. Therefore, the government can include urban climate adaptation in their program (for instance: more budget allocation, priority program in policy or regulation, etc).
- Urban planners and designers / urban climate experts: Most interviewees (1A, 2A, 3A, 4A,6A, 7A, 8A, 9A, 10A) agreed that these two groups have a close relationship and should work together both in research and practices for climate adaptation implementation. Urban planners and climate experts should have strengthened their communication and cooperation to formulate a competent urban climate adaptation program. The expertise from the two groups can be combined to develop an adaptation plan and spread awareness of urban climate. This should be done for the citizens and to governments institutions with suitable approaches.

Discussion

The interview results showed these stakeholders have a weak relationship in the communication process and need to be strengthened. In Indonesia, the communication or interaction between actors mentioned above are already exist, but not really intense and sometimes only one-way communication. The study form BBC ClimateAsia (2012) in Indonesia, showed that government institutions and educated community have communicated to wider society about climate change issues. However, there is missing in the “depth of understanding” about the issue. This should be underlined, that not just an intense and two-ways communication between stakeholders but also the content and how to make this issue more understandable for each groups of society.

Interview questions 9: What is the role of communication to support the planning, design and implementation of adaptation measures?

All the interviewees agreed that communication holds a very important role, especially in a less-aware society like Indonesia. To reach the decision makers, a good two-way communication should be established between urban scholars (planners and climate experts) and government actors to support the planning, design and implementation of climate adaptation measures. According to one interviewee who often works with government projects (1A) the communication process has several layers. It starts from lobbying with the central government, and if they agree then it comes to the local

government for an implementation program and then down to the citizens. Sometimes, however, their advice is not directly included in the final resulting policy documents.

Discussion

A wide spread communication initiative is important to support the awareness of climate change issues (EEA, 2012). Communication is important to give the basic information first and then increase the awareness. Moreover, in planning, designing and implementing adaptation measures, there should be an effective communication process between related stakeholders. The two-way communication should be more intensive between the urban scholars and citizens for more efficacy in implementation of climate adaptation measures. This is because the awareness and level of knowledge about urban climate adaptation in Indonesia is generally low, and therefore the form of communication has to fill the knowledge gap to bring the society (government and citizens) to the implementation phase. For instance, creating campaign through social media and organizing events or workshop that involved citizens to do simple climate adaptation measures voluntarily.

Interview questions 10: Are there formal guidelines or policies that drive the use of communication in the planning, design and implementation of adaptation measures?
If yes, can you please name them?

Currently in Indonesia there are not yet any formal guidelines or policies that drive the use of communication in the planning, design and implementation of adaptation measures.

Interview questions 11: What are the strengths and weaknesses of the communication process?

There are no sufficient answers for this question because at the moment there are not yet formal guidelines or policies for communication in planning, design and implementation of adaptation measures. However, two of the interviewees (9A and 10A) try to give their thoughts regarding this issue.

Strength: The communication process can improve the awareness and knowledge regarding urban climate adaptation issues. Better communication can also enhance the quality of data collected for compiling the policy making and analysis.

Weakness: The climate related issues are still not utilized enough in the making of urban planning regulations and policy because generally the awareness about climate related issues is still low.

Discussion question 10-11

The interview result shows there is more weakness in the communication process for planning, design and implementation of climate adaptation in Indonesia. The absence of formal guidelines or policies being the main weakness of the whole communication process, which is very weak and rarely happened between different stakeholders group. This condition is similar with findings from study in Bulgaria (Arabadzhiyeva, 2016) and Kenya (Scheltema, 2017) where there is no formal guidelines to drive the communication process in planning, designing and implementing climate adaptation

measures. Hence, there should be development of communication guideline for climate adaptation process.

Interview questions 12: Is there a need to improve the communication process?

Most of the interviewees agreed that there is a need to improve the communication process in Indonesia to reach many more citizens with various levels of education and diverse economic levels. This can be done by various methods of communication such as the use of simpler terms (4A, 5A, 6A), neighbourhood-scale campaigns through daily activities (4A, 6A, 7A, 9A) or even through social media (10A). One of the interviewees also proposed an idea of clear guidelines and/or strong regulations for communication processes.

Discussion

An appropriate and effective communication process is a necessity to raise the awareness and spread more information regarding urban climate adaptation issues. The communication process among stakeholder groups, namely government institutions, urban planners and designers, and urban climate experts, should be more intensive. Currently in Indonesia there are no official documents or guidelines which specify the application of communication within the planning, design and implementation of climate adaptation measures. It would be helpful if there were a communication guideline about how to raise the awareness of climate issues (in general), because the understanding about climate issue comes through communication process to each group in society (EEA, 2012). In addition, it should be specifically communicating how to overcome the adverse effects through the implementation of urban climate adaptation measures.

To thoroughly engage citizens groups, the climate adaptation issues should be communicated using simpler terms in place of scientific phrasing. For upper or mid class citizen, the knowledge shared should promote an even deeper understanding about the issue, how it affects their lives and what adaptations should be made to cope with those changes. Knowledge sharing can be done by several methods, such as workshops in cooperation with neighbourhood coordinators (Rukun Warga or Rukun Tetangga scale) (BBC ClimateAsia, 2013). For lower class citizen who lives in slums or squats (*kampungs*), many interviewees thought that the climate adaptation programs should be accepted and useful for their daily lives, and that the result can be seen concretely. For instance, the *kampung* improvement program and river cleaning activities.

Indonesian citizens are growing fond of electronic media, mainly television and internet news site or social media apps, and prefer that as their main source of information (BBC ClimateAsia, 2013). That electronic media and social media apps can be a good platform to spread the information and communicate the urgency of urban climate adaptation. The idea of spreading the knowledge about climate adaptation through popular media is also found in similar studies in Bulgaria (Arabadzhieva, 2016) and Kenya (Scheltema, 2017).

Instruments

Interview questions 13: Are there legally binding instruments (e.g. zoning plans) used to implement urban climate adaptation measures? If yes, please explain how they work?

All of the interviewees said there is not yet a policy or legally binding instruments designated for the implementation of urban climate adaptation measures. In the municipal scale there are zoning regulation maps and detailed spatial plans. However, these legally binding instruments are not arranged and are being used for climate adaptation implementation. The existing zoning regulation they have now in Indonesia is as part of the detailed spatial planning document (in Bahasa Indonesia: *Rencana Detail Tata Ruang* or RDTR) which contains the operational action plan, area development plan, and urban design guidelines. It also has the mapping of existing built areas and its designated land use function. This detailed spatial planning (RDTR) is derived from the spatial planning (RTRW) which is used for keeping the consistency of the development of built areas in cities. Also, the Green City Development Program (P2KH) from the Ministry of Public Works focuses on greening programs, including urban green space and green building which can be used as urban climate adaptation measures. However, it is not specifically designed to implement urban climate adaptation.

The urban climate expert said that even in Jakarta, the capital city and the benchmark of urban development, the municipality does not yet have a specific urban climate adaptation program or policy. However, some of interviewees mentioned several programs, for instance Green City Development program (P2KH) from Ministry of Public Works, which focus on green infrastructure implementation in cities. Besides that, the local governments of Bandung and Yogyakarta also implement similar urban green programs that restore and build many green spaces in their cities. Other instruments that possibly can contribute to urban climate adaptation are city zoning regulations, detailed spatial plans (RDTR), green building standards and, on a national scale, the National Climate Change Adaptation Program (RAN-API).

Discussion

Currently in Indonesia there are no legally binding instruments that are specifically designated for urban climate adaptation. The urban climate adaptation is not considered as an issue yet, thus no policy instruments are made to address these issues. These findings are similar with situations in Kenya, where there are no legally binding instruments designated for urban climate adaptation implementation (Scheltema, 2017). The situation is different in the Netherlands and Belgium where they have many policy instruments regarding urban climate adaptation measures that are being strictly implemented (van der Schans, 2017). Even in Belgium there is a compulsory building regulation and financial incentives for implementing adaptation measures, although the requirement for receiving the subsidy is quite complex (van der Schans, 2017). In China, based on a similar study by Qiu (2016), there are more mitigation instruments, rather than adaptation measures. Therefore, there should be a clear and structured regulations to differ climate adaptation from mitigation and to support adaptation measures implementation like one in the Netherlands and Belgium.

14. What are the strengths and weaknesses of the legally binding instruments used?

Strengths: According to one interviewee from governmental institutions, the zoning regulation maps that they have made already covered all the land use in the city. The map is clearly illustrating each block of the city area and what it is designated for. This will be an advantage for the government, or private sector if they want to see the land regulations and keep the existence of protected areas like green or conservation areas and urban heritage areas.

Weakness: there is no legally binding instruments about urban climate adaptation yet in Indonesia. The current instrument is zoning regulation like one in Yogyakarta City. The zoning regulation includes

maps that covered all the land use in the city. The map is clearly illustrating each block of the city area and what it is designated for.

Discussion

The policy and planning instruments in Indonesia mostly focus on other issues that are considered more important than climate change or urban climate adaptation. The implementation programs that they have now are incidental, rather than being explicitly intended as an adaptation measure or climate adaptation program. Initially the policy or programs are not designated as urban climate adaptation measures, but for other objectives, which eventually have multiple benefits including climate adaptation measures and sometimes mitigation measures.

As we know, developing countries still focusing on social issues like poverty and education first, rather than climate change or environmental related issues (Biesbroek et al., 2009). However, there is a positive indication that in the future, Indonesian cities will move towards actual adaptation measures and could have policy instruments that are specifically designed for urban climate adaptation. For instance, the zoning regulation maps. This will be an advantage for the government, or private sector if they want to see the land regulations and keep the existence of protected areas like green or conservation areas which can lead to the urban climate adaptation measures. However, the lack of support from regulation and policy programs is considered as delaying the implementation process of climate adaptation measures (EEA, 2012).

15. Are there certain opportunities missed when using the legally binding mentioned instruments (e.g. coupling with other instruments)?

The interviewees that comes from the government and academic backgrounds said that there is a lack of synchronization between related institutions when forming the policy instruments. Each agency or institution has their own planning and policy documents, the contents of which sometimes contradict each other. For instance, the spatial planning agency released the spatial planning document (RTRW), and the planning and development board released the general development plan (RPJM) for the environmental program issued by the environmental agency (BLH), all of which is related to building and infrastructure planning issued by the public works agency. Moreover, there are no local governmental institutions or agencies that handle the climate change issue specifically. The urban climate expert (3A) said that “currently, there is no comprehensive urban climate adaptation plan yet which includes spatial components and other related sectors. The adaptation plans we have now (RAN-API) are still very general and lack in detail to be derived into spatial regulation”.

There are many aspects of planning and policy documents that contradict one to another. For instance, the zoning regulation map is coming within RDTR (detailed spatial planning) which is a different document from RTRW (spatial planning). According to spatial planning law, every city and municipality is obliged to have a spatial planning document (RTRW). For cities, there is also the obligation to have detailed spatial planning which is derived from the spatial planning document (RTRW). However, in practice, there are still very few cities that have complete documents of detailed spatial planning. For smaller cities, sometimes there is a lack of resources, including budget and expertise, to compile this document. In some cases, the detailed spatial plan came a few years after the spatial planning which made it difficult to synchronize the implementation.

Discussion

There are many planning or policy instruments that are not specifically designed to be urban climate adaptation measures, but there are some climate adaptation aspects within them. National plans, sectoral plans or municipal programs should be organized and synchronized to be used as climate adaptation measures. There should be better socialization or information sharing about the policy instruments so they can be more widely recognized by different stakeholders. The legal aspects of the instruments are also important, because if they are considered compulsory or defined as strict regulations, then people are more likely to implement them.

16. Are there other policy instruments used to implement urban climate adaptation measures?

If yes, please explain how they work?

According to three of the interviewees (1A, 9A, 10A), there are policy documents from the national government to address climate change adaptation issues. In February 2014 the government of Indonesia launched the document of the National Action Plan - Climate Change Adaptation (RAN-API *Rencana Aksi Nasional - Adaptasi Perubahan Iklim*) by the National Planning and Development Agency (BAPPENAS). As an adaptation planning, RAN-API has five sectors and each has several sub sectors and clusters as pictured below:

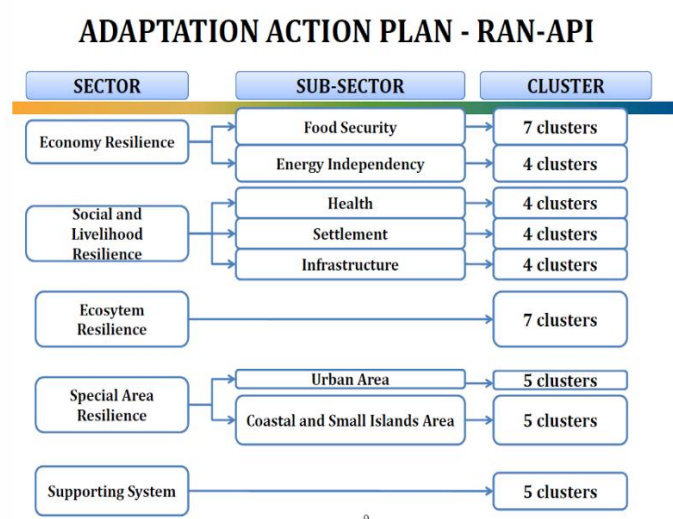


Figure 20 National Action Plan - Climate Adaptation (BAPPENAS as presented in 22nd Asia-Pacific Seminar on Climate Change Hanoi, 2013)

According to the RAN-API document there is no particular section addressing urban climate adaptation, but from the whole document, the most relevant part is in the Urban Area sub-sector, which consists of five clusters of strategies which will be implemented in three main programs. The programs focus on 1) integration of climate change adaptation into urban spatial planning regulation; 2) adjustment of urban infrastructure for climate adaptation including the implementation of the Green Cities Program; and 3) citizens' capacity building regarding the climate change issues. This means there is a tendency to create a specific policy instrument for urban climate adaptation in Indonesia.

Discussions

According to Biesbroek et al. (2009) an effective climate adaptation strategy should be “transdisciplinary by nature” and being specifically designated policy strategy for the context of application. The national scale of RAN-API makes its context very general and broad. In climate adaptation, there are many stakeholders involved at many different scale. Therefore, a transdisciplinary approach being very important, with two-way interactions between basic knowledge and the technical application to make it understandable and acceptable in society (Biesbroek et al., 2009). Integration between climate adaptation strategy with other “climate-sensitive policy domains” is important and must be well-coordinated with other non-climatic aspect to moving towards a sustainable development (Biesbroek et al., 2009 p.232).

17. What are the strengths and weaknesses of the other policy instruments used?

Weakness: At the moment, urban climate phenomena, including urban heat island and wind discomfort, and the urban climate adaptation measures such as city design, urban vegetation, material use and anthropogenic heat, are not yet included in the national adaptation action plan. The scale of RAN-API is very broad and addresses issues mainly about climate change adaptation in general.

18. Are there certain opportunities missed when using other policy instruments (e.g. coupling with other policies)?

The interviewees said that this is similar with the legally binding instruments (question 15), where there are multiple sectoral plans and a lack of synchronization. Because of the sectoral plans made by different institutions, sometimes the contents contradict one another. There is also the possibility of a “missing spot” which is not covered by any policy instruments because of the lack of coordination and synchronization amongst government institutions while making the policy.

For this section of interview questions, there are no sufficient answers for the questions above because at the moment there is not yet any concrete urban climate adaptation interventions being implemented in Indonesia. There are some of the programs or regulations that can contribute to urban climate adaptation or climate adaptation in general. Some of the interviewees tried to answer questions in this part with the most relevant implementation program they know. According to three interviewees (3A, 4A, 10A) the concrete urban climate adaptation interventions that currently exist happen “accidentally”, without anyone noticing it was an urban climate adaptation measure. It means, at first the interventions are not designated as urban climate adaptation measurements, but for other objectives, which has multiple benefits including implementation of urban climate adaptation measures. One interviewee (1A) underlined the local leader election (Pilkada) which oftentimes changing the current governor/mayor. It also changes the political interests and policy instruments thus, slowing down the implementation process.

Discussions (question 17-18)

In Indonesia, there are many planning or policy instruments that are not specifically designed to be urban climate adaptation measures, but there are some climate adaptation aspects within them. National plans, sectoral plans or municipal programs should be organized and synchronized to be used as climate adaptation measures. Climate adaptation measures should be more in local scale, to be more effective and attractive (Biesbroek et al., 2009). However, a successful climate adaptation

program is a result of active collaboration between local to regional stakeholders, also in national and international level and depends on evaluation criteria for each strategy at each scale (Adger et al., 2005 as cited in Biesbroek et al., 2009).

Therefore, there should be intensive socialization program or information sharing about the policy instruments so they can be more widely recognized by different stakeholders. The legal aspects of the instruments are also important, because if they are considered compulsory or defined as strict regulations, then local governments and citizens are more likely to implement them.

Implementation

Interview questions 19: Which concrete urban climate adaptation measures/ interventions are currently implementing or have been implemented in your city?

Urban climate experts (3A): One of the on-going programs in several Indonesian cities is the Green City Development Program (P2KH) which was initiated by the Ministry of Public Works. In general, this program functions as “the response to climate change, through mitigation and adaptation.” P2KH has eight green city elements, which include green space development, green building, water and waste management. The idea of the program is to switch from a business-oriented city to more green and sustainable development. It can be considered as implementation of urban climate adaptation measures although it is not designed specifically only for climate adaptation. The implementation of the greening program is different in each city, because the program is not compulsory but more like initiatives to join. Each city usually has their own green program that depends on their spatial programs and budget allocation, mostly at the neighbourhood scale or greening the streets. However, the implementation of the greening program is a low priority because of the limited amount of land. If there is any vacant space, it can be used for more profitable functions, such as a commercial area.

Urban climate lecturer and architect (4A): green building standard. Green building evaluation and certification in Indonesia is managed under Green Building Council Indonesia (GBCI) since 2009. GBCI has a rating system used as a tool to assess the building according to their green standard called “GREENSHIP”. It is a green building standard which serves the same function as LEED in the USA, Green Mark in Singapore and Green Star in Australia. Although this green building regulation has been issued for a while, not many people know it and it is not compulsory. Therefore, the implementation is still very limited.

Environmentalism and climate researcher (10A): Jakarta province has adopted the RAN-API into a local action plan. The plan outlines a related series of programs as adaptation measures to climate change. There is also sectoral policy issued by the Ministry of Public Works which adopted the National Adaptation Plan (RAN-API) into their ministerial sectoral plan, which is related into their authority in public works infrastructure and housing (RAN-MAPI PU). The Ministry of Public Works also volunteered for their new building to follow the green building regulation. However, the implementation of green building is still not significant, and only happens in big cities like Jakarta and Bandung. She said, “not many people want to follow the regulation because green building is considered more expensive”. Therefore, the Ministry of Public Works usually gives the certificate as appreciation for those who comply with those standards.

There rest of interviewees said there is no concrete urban climate adaptation implemented in their city.

Document study from green building standard in Indonesia “GREENSHIP” can be seen as follow:

GREENSHIP is divided into six assessment categories issued by Green Building Council Indonesia (GBCI) in 2009. Each of these consists of several criteria which contain credit points with particular values that will be processed to determine the assessment. Those six categories are:

1. Appropriate Site Development (ASD)
2. Energy Efficiency and Conservation (EEC)
3. Water Conservation (WAC)
4. Material Resources and Cycle (MRC)
5. Indoor Air Health and Comfort (IHC)
6. Building and Environment Management (BEM)

Discussion

Based on the interview results, it can be claimed that some concrete methods for implementing urban climate adaptation in Indonesia are: revitalization of urban parks, building new green spaces, conserving the existing green areas, planting more trees as green corridors in streets and sidewalks and green building application. Green vegetation and green infrastructure are the most mentioned urban climate adaptation measures in Indonesia. This result is in line with other similar studies in South Korea (Park, 2015), China (Qiu, 2016), the Netherlands (van der Schans, 2017) and Kenya (Scheltema, 2017) where urban green is mentioned the most as a possible urban climate adaptation measure. In China, the urban green measures that are mentioned most are green roofs and its implementation as a citizens’ initiative (Qiu, 2016). However, green roofs were never mentioned by any interviewees in Indonesia or in Kenya (Scheltema, 2017). For building regulation and implementation, in Indonesia it is more a voluntary activity rather than obligatory as in Belgium and the Netherlands (van der Schans, 2017). Therefore, there should be policy instruments to support the implementation of urban green infrastructure in Indonesia and make it as compulsory regulation for urban development.

Interview questions 20: What are the strengths and weaknesses of these mentioned urban climate measures/ interventions?

Strengths: The current program that has been implemented can provide a baseline analysis and recommendations to build the further adaptation program and provide mechanism of implementation (such as funding).

Weakness: For the green building certification program, it is considered more expensive to build according to green building standards compared to non-green building, because of more expensive materials or certain design standards. Maybe the government can give subsidies or incentives for the developer or property owner that is willing to switch to green building standards.

Discussion

One of the issue with implementing urban climate adaptation measures is related to financial conditions. In Indonesia, there are cities and municipalities that already stipulate greening programs, but lack in implementation capacity because there is no budget allocated for that program. According to an interview result, if there is vacant land in a city, usually it will be converted to more profitable functions such as a commercial area, rather than reserved for green space. The same budget program

also happened with green building implementation. It seen as more expensive methods for the builders, rather than conventional building. Therefore, more incentives should be given for these two regulations, to push more intensive and broad implementation.

This financial issue is similar with findings in Bulgaria (Arabadzhieva, 2016) where there is lack of incentives and financing support from government to develop and implement climate adaptation program. Meanwhile, in American cities, such as Portland, Chicago and Atlanta, there are incentives for green roofs implementation which successfully expand the number of green roofed buildings in the city (Getter and Rowe, 2006). In Basel, Switzerland, there is a regulation which oblige all new buildings with flat roofs to applied green roofs (Brenneisen, 2004 as cited in Getter and Rowe, 2006). Based on good examples in other cities, the combination of financial incentive and law regulation are advisable to support climate adaptation measures/interventions in Indonesia.

21. Are there conflicts between aesthetics and these mentioned urban climate adaptation measures?

All three interviewees (3A, 4A, 10A) think there are no conflicts between aesthetics and the mentioned urban climate adaptation program. According to one interviewee (3A) in Bandung, the greening program had value added for aesthetics and city decoration. There are many people visiting the urban parks nowadays because it considered as an alluring and relaxing place. Many old and abandoned green space in Bandung has been restored and revitalized for better functions and more aesthetic value.

Discussion

Urban greenery in Indonesian cities is seen in terms of aesthetic value and is favoured by the citizens. This is similar with study results in South Korea by Park (2015) where they thought that urban vegetation increases the aesthetic image in the cities. Besides the aesthetic and recreational values, urban green also offers many environmental benefits and climate adaptive capacity. Although in Indonesia, the implementation of urban green is more as decorative or aesthetical values, a better education and socialization about climate issues can fulfil that knowledge gap. Therefore, urban green in Indonesian cities will not only provide aesthetical aspects, but also ecological functions including urban climate adaptation measures.

For the question below, there are no answers from the interviewees, because the programs they mentioned are not directly addressing urban climate adaptation measures.

22. Are there conflicts between urban functions and these mentioned urban climate adaptation measures?

23. Are there certain chances/ potentials (e.g. coupling with other interventions / 'no regret' measures) missed when implementing these mentioned urban climate adaptation measures?

24. What evidence is there that would tell what the citizens are feeling/thinking?

5. Result and Discussion: Green Infrastructure for Climate Adaptation and Barriers to Implementation

This chapter consists of the interview results and the following discussion of specific research about barriers in green infrastructure implementation for climate adaptation. The discussion will answer the research sub-questions. The first part will answer the general research sub-questions and the second part will answer the specific research sub-questions.

In this second part of the research, the questions will specifically ask about green infrastructure implementation programs for climate adaptation. As mentioned before, the Green City Development Program (P2KH) hosted by the Ministry of Public Works, addressed this as response for adapting climate change effects in cities through green infrastructure development. For this study, there are two cities being studies: Bandung and Yogyakarta. Bandung represents the city with various greening program but still a quite low amount of green space. Yogyakarta has achieved the target of urban green space which is 20% from the total city area.

5.1 Conceptualization of green infrastructure by key stakeholders

Question 1: What comes in your mind when hear the phrase “green infrastructure”?

Almost all of the interviewees, seven out of nine, said open green space (parks, gardens, public open space and trees/vegetation alongside the road) is the first thing that comes in mind when they hear the term “Green Infrastructure”. Only two of the interviewee (4B and 9B), said first she thought about green building or energy-efficient building (referring to the LEED standard). The urban climate expert (3B) emphasized the that term “infrastructure” is meant to create a network of the greenery that will contribute to shaping microclimates and serve other ecological functions. “When we talk about green infrastructure, it is important to remember that there is the linkage between those green spaces. Then it is not just an individual park or open green space, but they should influence one another as a network.”

Question 2: In your opinion, what elements define green infrastructure?

All of the interviewees said the green vegetation (trees, shrub, grass, etc) and parks or any other green space were the main elements of green infrastructure. One of the interviewees (6B) said “the word green is synonymous with vegetation and trees” and another interviewee (3B) said “often in Indonesia, the focus is only on the green element such as parks, trees or shrubs, without forming any linkage or network that is defined as infrastructure”.

Question 3: What parts of an urban area do you think are included in green infrastructure?

All of the interviewees said that the open green spaces like public parks, city squares, traffic islands/roundabouts and green vegetation corridors (alongside the street/sidewalks) are included as green infrastructure. Only one interviewee (9B) mentioned the river and riverbanks are also included as green infrastructure.

In addition, interviewees in both Bandung and Yogyakarta mentioned that green infrastructure is also relatable to public open space such as city squares (in local language: *alun-alun*) like the famous Yogyakarta's south *alun-alun* (Figure 22) or the Grand Mosque courtyard in Bandung (Figure 23).



Figure 22 South Alun-Alun Yogyakarta (Retrieved from https://www.kompasiana.com/anggawidianthara/wisata-keluarga-alun-alun-kidul-yogyakarta-jogja_55a341cde4afbde7063e69bb)



Figure 21 Grand Mosque Square Bandung (Retrieved from <https://www.jejakpiknik.com/masjid-raya-bandung/>)

Green infrastructure implementation in general

Question 4: How did the *quantity* of green infrastructure in your city/region change during the past 5 years? Please explain (and if there are maps or statistical data, please provide)

There are statistical data retrieve from Bandung's Parks and Green Space agency website (5B), which shows the growth of green space in Bandung city from 2008 until 2015.



Figure 23 Growth of Open Green Space in Bandung (Retrieved from <http://diskamtam.bandung.go.id/ruang-terbuka-hijau>)

Meanwhile in Yogyakarta, there are no statistical data about green infrastructure. However, according to a government institution in Yogyakarta (6B), the city government has a program to buy unproductive

or abandoned land from the citizens/private sector to be converted into green public space. This program hopefully will increase the quantity of green space and fulfil the 20% criteria.

Question 5: How did the quality of green infrastructure in your city/region change during the past 5 years? Please explain

In Bandung, there are some significant changes in the amount of green space that has been built since 2010 (as shown in Figure 24) and also in the function of green spaces as the new public open space. The greening program also upgrades the existing green space by conserving, restoring and renewing the vegetation and facilities there. One of the interviewees in Bandung (2B) said that there are some citizen's communities who frequently gather and have activities in some parks, and make the place "alive". Most of them are art or music communities and environmental activists, who use the public green space as places to engage with more people. This also supported by the program of the city government to make the green place not just a place of green vegetation, but as alternatives for public or community spaces besides the malls or cafes. meanwhile in Yogyakarta, most of green space is private area. Therefore, the city government have land-buying program to covert that land into public green space.

Question 6: How much emphasis does your city/region institution put on the following tasks?

a. Conserving green space and natural areas (Bandung average score 4/5) (Yogyakarta 4/5)

Interviewee BDG	Score
2B	4
3B	3
4B	3
5B	5
Interviewee YGY	Score
6B	4
7B	4
8B	4

b. Restoration of green space and natural areas (Bandung average score 4/5) (Yogyakarta 4/5)

Interviewee BDG	Score
2B	4
3B	3
4B	4
5B	5
Interviewee YGY	Score
6B	4
7B	4
8B	4

c. (Bandung average score 2/5) (Yogyakarta 1/5)

Interviewee BDG	Score
2B	1
3B	2
4B	2

5B	3
Interviewee YGY	Score
6B	1
7B	1
8B	1

In Bandung, according to a local green space agency (5B) there is an increasing number of green open spaces since 2010. The city is focused on conserving, restoring and creating new green spaces to reach the goal of 20% green area in the city. Meanwhile in Yogyakarta, one interviewee (6B) explained that the amount of green infrastructure has not increased as much as Bandung and more in constant number of area.

Discussion: conceptualization of green infrastructure

The three groups of interviewees namely urban planners or architects, environmental or climate experts and government institutions have various but similar conceptions of green infrastructure. The first group is urban planners or architects, who mainly mentioned green infrastructure as a spatial characteristic which is related to trees, green vegetation and public green space. The mentioned definition of green infrastructure is nearly correct, except there is no mention of keywords related to network or connection of those green features. Whereas, the network and linkage is an important point about definition of green infrastructure (Derkzen et al., 2017; Matthews et al., 2015; Benedict and McMahon, 2006; Naumann et al., 2011). All of them mentioned parks as the first thing that comes to mind when they hear the term “green infrastructure”. In the Indonesian perspective, the word “parks” refers to man made public green space, and not a natural or vacant space filled by wild plants. This perception is in line with definition from Byrne et al. (2015) who emphasized that green infrastructure is “highly modified or engineered as intentional landscapes (p. 133)”. The environmental or climate experts group is the interviewee who defined the green infrastructure most accurately. He underlined the “linking network and connection” as the core concept of “infrastructure” terms used in green infrastructure, not just the greenery features. This was missed among other interviewees, who see green infrastructure only as separate parks or trees or in other words as “patches” according to green infrastructure elements from Ahern (2007) and “sites” (Benedict and McMahon, 2006).

The third group is governmental institutions. According to interview results, the most frequently mentioned terms were parks, square, green corridor (alongside the street) and urban forest as the elements of green infrastructure. This is similar with the answer from the urban planners and designers group who identified green infrastructure as spatial features that related with green vegetation. There is one architect and one environmental researcher (with a background in urban planning) who mentioned that green infrastructure is related to buildings or built infrastructure which is constructed according to green building standards. This can also be included in the green infrastructure concept, or to be precise ‘greenable infrastructure’ according to Merk et al. (2012).

Retrieving from interview results, the key stakeholders in Indonesia still see green infrastructure as an amenity rather than a necessity (Benedict and McMahon, 2006). Most of interviewees said that green infrastructure in Indonesian cities is built for recreational or aesthetic purposes. This shows how they missed the importance of “network” concept in their understanding about green infrastructure. There is also a lack in understanding of greater benefits that can be gained from green infrastructure beyond

just aesthetic value. Seeing green space as an amenity suggests that it is nice and convenient, while seeing it as a necessity suggests that it is a natural life-support that must be protected and reserved (Benedict and McMahon, 2006). Seeing green infrastructure as amenity makes it less prioritized in governmental programs and less likely to be implemented. Meanwhile, understanding green infrastructure as concept of necessity will help key stakeholders to embody green infrastructure as an implementation of climate adaptation. Quoting from Sussams et al. (2015) “Green infrastructure is a concept that requires sectors to cooperate in a discursive policy environment [p. 190]”, emphasized that green infrastructure needs greater understanding in a trans-disciplinary approach as consequence of its multifunctionality. This also in line with Biesbroek et al. (2009) who say the more climate change adaptation being acknowledge, the more it needs to be explain with transdisciplinary research and intensive knowledge transfer.

5.2 Green infrastructure utilization in planning

Question 7: To what extent has green infrastructure been included in planning regulations?

Considering the municipality’s spatial planning documents, green infrastructure has been included in the spatial planning policy in terms of “conservation or protected area” (in bahasa indonesia: *kawasan lindung*). However, the “green” part has different meanings and understandings in each city or municipality. One of the interviewees (3B) said “The planning documents (RTRW) have decided which parts are supposed to be green or protected, however in practice and implementation the spatial planning is still far from the ideal condition.” For instance, in Bandung city, most of the urban green exists only as city decoration and aesthetic ornaments. Whilst in Yogyakarta, a famous tourist destination city, the green infrastructure is not a priority in city development. As one interviewee said (7B) “the environmental issue receives less attention in planning regulations. Business and economics are still the main priority, like building new hotels and malls to support the tourism industry.”

With the government program of Green City Development (P2KH), established by Ministry of Public Works in 2012, the aim is to invite as many cities governments as possible to shift from their business-as-usual approach into more green development approaches. However, in practice, the implementation is not very simple. The interviewee from the Ministry of Public Works (1B) said “*the main problem is the lack of awareness about green environment and climate change. We want the local government to have the spirit and deep understanding about the green city concept first. Not just build some green parks and follow (the program) as a trend without knowing the actual meaning behind it*”. So far, the implementation of the program is going quite well in some cities, even though the continuation and maintenance of the green space now becomes a new issue regarding this program. The other issue is to invite more cities to join this program, as the program is not compulsory for every city or municipality, but they had initiatives to join this program and then signed the green city agreement.

Question 8: Are there formal guidelines or policies that drive the use of green infrastructure in planning?

The green city development program (P2KH) from the Ministry of Public Works can offer guidelines for green infrastructure planning. The program includes 8 attributes of green city development:

1. Green Planning and Green Design

Improving the quality of city planning and design to adopt the concept of sustainable urban development. It covers the forming of detailed spatial plans (RDTR), built environment plans (RTBL) and regional masterplans, which includes the provision of conservation of green space area.

2. Green Community

Involving the active role of society, the community and private sector into green city development.

3. Green Open Space

Improving the quality of open green space in the city which is appropriate to the spatial characteristic of the city or municipality with a minimum proportion of 30% of the total city area.

4. Green Building

Developing energy efficient and environmentally friendly buildings through the implementation of green building principles.

5. Green Energy

Utilizing renewable (or alternative) energy resources which are more efficient and environmentally friendly, and using less non-renewable resources.

6. Green Transportation

Reducing the transportation problems, specifically the traffic congestion and automobiles emissions, through improving the sustainable transport system which have a less negative effect on the environment.

7. Green Water

Utilizing water resources efficiently for sustainability by maximizing water absorption, reducing storm water runoff and optimizing water use.

8. Green Waste

Municipal waste management towards zero waste through the implementation of 3R concept: Reduce (less waste), Reuse (value added for recycled material) and Recycle (waste recycle).

According to interviewee at P2KH secretariat (1B) this program tries to initiate the green city development with more practical guidelines: “but more than that, the city governments who agreed to join us must have the spirit about green development first, that it has the greater purpose of sustainable city development rather than just following the green trend”. However not all cities and municipalities have joined this program, because doing so is not compulsory. Doing so is a voluntary

action from a city or municipality government leader or from a local initiative and a statement of commitment to join and implement the green city program.

Question 9: What are the challenges or barriers for green infrastructure implementation in your city/region? Please explain and give examples

Interviewees from both cities, Bandung (2B, 3B, 4B) and Yogyakarta (6B, 7B, 8B) talked about the challenges and barriers for green infrastructure implementation:

a. The availability of land

Cities have very dense built areas which leads to limited vacant land. For instance, Yogyakarta has a total area only 32,5 square kilometers and a population of 433.539, resulting in a population density of 13.340 per square kilometer. Within the relatively small area they have, the city should provide basic services to its inhabitants while also serving as the center of business and economic activities. The land available for green infrastructure is very limited, especially considering many functions that a city should have. The interviewee from the government institution (6B) said “it is hard to find a vacant lot for green space within the city, even though the city government has a program to buy land to be converted to public green space in every *kampungs* (or sub district)”. Moreover, as the center of economic activities, the land price in the city is very high and rarely available for functions other than economic and business.

b. Legal aspect for implementation

The other emerging challenge is how to control the implementation after the legalization process. After the spatial planning document and zoning regulation has been formalized as regional law, there is a lack of regulation for monitoring and controlling the implementation phase. One of the interviewees said “in Indonesia, there are planning documents being legalized, and that’s it. We did not know the continuation of the planning, to be exact it is the lack of implementing action.” This is also related to which institution should do the monitoring process, or it might need cooperation between several institutions.

c. Human resources

One of the interviewees from a government institution said that currently there is a lack of expertise and number of civil servants to do the monitoring and control the implementation process. She said, “for our institution (land and spatial planning agency) which formed recently in late 2016, there is too much task to be done for such small number of people”. Therefore, the implementation process is quite hard to handle due to a lack of human resource.

d. Awareness of spatial planning regulation and climate adaptation

Almost all of the interviewees agreed that in Indonesia there is low awareness of spatial planning regulations in society. The municipality or city government already set the regulation, regarding for instance: building base coefficient, building area coefficient, and building demarcation line, etc.

However, in practice, there are some people who seem neither aware of it nor follow the regulations while building their property. One interviewee (3B) wondered, “If it has become an issue amongst urban planners and designers, how come some of the building projects have the permit (to build) when the building design is not in accordance with the regulation?”

**Question 10: What is going well with the green infrastructure implementation in your city/region?
Please explain and give examples**

Bandung: According to several interviewees (2B, 3B and 4B) in the past five years, especially since Ridwan Kamil served as city mayor, there are intensive greening programs in the city. This program includes creating new thematic parks, restoring the old green space and sidewalk renovation (especially in Juanda street and Riau street). These new parks have gained some attention from local citizens and have even become tourist destinations. One of the interviewees (2B) said “Nowadays the urban parks here start to feel alive again. There is quite some improvement about green space quality and quantity in Bandung”. The parks become a public place where people can have social interactions and do some recreational activities.



Figure 25 Cityhall Park in Bandung (Retrieved from <http://kaosgurita.com/2017/04/25/balai-kota-bandung/>)



Figure 24 Sidewalk in Riau Street, Bandung (Retrieved from <http://www.lindachristianti.com/asyiknya-jalan-sore-di-sekitar-jalan-riau-bandung/>)

Yogyakarta: According to all interviewees (5B, 6B, 7B, 8B) in Yogyakarta the conservation program of the heritage area, which also serves as public green space, is going quite well. There are some heritage or historical parts of the city that also served as public green space such as the city square (alun-alun), Kasultanan palace (keraton), old area in Umbulharjo street and Malioboro (famous tourist place) street sidewalks. The green infrastructure implementation is going well in these areas, where the main activity is conserving the existing parks or trees and also planting new vegetation in some spots.



Figure 26 New Sidewalks in Malioboro Street, Yogyakarta (Retrieved from https://www.kompasiana.com/sarashafira/yogyakarta-atasi-masalah-sampah-yang-klasik-dengan-cara-asyik_58ab7b955793737107730fb8)



Figure 27 New Sidewalks in Malioboro Street, Yogyakarta (Retrieved from <http://regional.liputan6.com/read/2684095/jelajah-malioboro-jogja-makin-asyik-dengan-jalan-kaki>)

One of the newest projects is the restoration of Malioboro sidewalks area. The local government institution said that “Malioboro pedestrian area is now serving as a green corridor and not for street vendors and motorcycle parking anymore. This year we built new parking building near the main road intersection to reduce the traffic in Malioboro street.”

Question 11: What innovation that have been involved in planning green infrastructure as climate adaptation in this city/region? (including: abiotic, biotic and cultural function of green infrastructure)

There are smaller-scale projects in upgrading urban kampungs (sub-district), such as in Cikapundung river banks area (Bandung) (4B) and Kali Code area (Yogyakarta) (7B). In Bandung, the program is focused on cleaning garbage from the river (as seen in Figure 28 below), and creating a cleaner and healthier living environment by preventing the slum inhabitants from littering or throwing their garbage to the river.



Figure 28 Cikapundung River, Bandung (Retrieved from <https://photo.sindonews.com/view/20996/bersih-bersih-sampah-di-anak-sungai-cikapundung>)



Figure 29 Kali Code riverbanks, Yogyakarta (Retrieved from <http://www.indonesia-tourism.com/forum/showthread.php?52849-Gondolayu-Bridge-at-Kali-Code-Yogyakarta>)

Although it is not literally design as urban climate adaptation program, it is effective to raise the awareness and knowledge about environmental issues and encourage the citizens to take care of their environment. Whilst in Kali Code, Yogyakarta there is a similar program for slum upgrading by preventing the inhabitants from littering in the river, cleaning the living squatter area and painting the houses in bright colours (Figure 30). These projects also creating a better ecosystem in riverbanks area, reducing the effect of pluvial floods and improving the quality of life for the inhabitants.

Question 12: How to improve utilization of green infrastructure for climate adaptation?

There are two main strategies to improve utilization of green infrastructure for climate adaptation in Indonesia. The first thing needed is a better understanding in the concept of green infrastructure and awareness for climate adaptation in general. According to these two case study cities, the creation or upgrading of green infrastructure in their cities is generally not for climate adaptation purposes. These happened because the government still have low awareness about climate adaptation and needs more urban climate experts to guide the implementation process. Two of the urban climate experts (3B and 4B) agreed that in the future, Indonesian cities should create green as an infrastructure, not just as street decoration or tourist attraction. Thus, the greenery can shape the urban climate and reduce the urban heat island.

Secondly, there should be a research about Indonesian habits regarding the green open space (2B) to find out what the most suitable method for climate adaptation is and how to utilize green infrastructure better. This is necessary to be done because in some areas, the open green space is abandoned due to the lack of people interested in utilizing the green space. One interviewee said, “We (urban planner and designers) should conduct a research about the Indonesian habits regarding the green open space. Because at some point the parks and any other green space is not being used as it supposed to be. Maybe the open green space is not suitable for Indonesian habits”. According to the urban climate expert (3B) this is related to the hot and humid climate in Indonesia, leading people to choose to do activities indoors: “if you ask people which one they prefer, having lunch in the park or inside a cool air-conditioned cafe, most likely they will choose the cafe.” Therefore, the green infrastructure implementation should be based on local wisdom and habit for better utilization. The citizen participation in green infrastructure planning and as climate adaptation measures is considered important to find out which adaptation measures will be suitable for Indonesian society.

Discussion: utilization of green infrastructure

How is the concept of green infrastructure utilized in planning regulation and plans?

Misconceptions of green infrastructure by urban planners and designers in Indonesia leads to a lack of utilization of green infrastructure generally and specifically for urban climate adaptation. In spatial planning regulations (RTRW), green infrastructure is categorized as “protected areas” which addresses it mainly as a conservation area with limited activities that can be done there. Zoning regulations also strictly determine each block of the cities for a certain function. This concept sees green infrastructure as a form of capital with a pragmatic and rationalist planning approach (Matthews et al., 2015). The rationalist paradigm leads to a stable and firm condition, in this case where green infrastructure is known mainly as a conserved nature area with limited activities and limited benefits to be derived from it. This circumstance can generate ‘path dependency’ which means the institutions get used to certain situations and become reluctant to respond to new emerging issues (Matthews et al., 2015). Spatial planning regulations in Indonesia indicate the conventional functions of green space and green infrastructure, which limit the innovations. Whereas, according to Matthews et al. (2015) the innovation process is important to overcome the path dependency situation. Innovation in green infrastructure can improve spatial planning contributions to ecological and social functions (Ahern, 2007). The rational thinking and path dependency slow down the capacity to pursue more current objectives, such as climate adaptation. This results in a lack of green infrastructure utilization in planning regulations and a more practical climate adaptation program.

The multifunctionality of green infrastructure sometimes makes a confusion among urban practitioners to implement it. According to Sussams et al. (2015) there are overlap between three concepts under green infrastructure: biodiversity conservation, ecosystem services and climate adaptation. In general, the utilization of green infrastructure that given by the current policy instruments is lack of detail and explication. Its multifunctionality makes the understanding of its contribution in different sectors even more complicated. Moreover, climate adaptation comes as an “emerging objective” in a situation where each land parcel is a competition, makes it less-favourable compares to other “politically-friendly” sectors or more profitable activity. Without proper governance, at some point, climate adaptation function of green infrastructure only being achieved unintentionally, considered as “co-benefits” from higher priority objectives (Sussams et al., 2015).

However, there is a positive response from the citizens in terms of green space utilization. Based on the interviews in three cities, Jakarta, Bandung and Yogyakarta, there are many people that spend time

in open green space which has been recently restored as part of a city program. The Green City Development (P2KH) program can be a good starting point to encourage more green infrastructure in spatial planning because the program has a “green spirit” which has more values. Rather than just being green, this aims to develop the green infrastructure concept to be the solution of many environmental problems, including climate change and urban climate adaptation. There are also emerging citizens’ initiatives that are doing some activity in open green space. The citizens are enthusiastic to come to the parks and use it for some recreational functions and social interaction. This positive response can be enhanced by encouraging more greening programs, therefore cities can gain more benefits from urban green infrastructure.

5.3 Managing Uncertainties

Question 13: What kind of uncertainties do you think might happen in the future regarding urban green infrastructure and/or climate adaptation issue? How to overcome these uncertainties?

A lot of things can happen regarding this issue. Most of the interviewees (1B, 3B, 4B, 7B) agreed that the development and planning in Indonesia is still oriented towards political interests, and business-economics. Therefore, there is need to raise the knowledge and awareness regarding the urban climate, climate adaptation and environmental-based planning and design in general. The term “sustainable development” should be understood fully by the leaders and decision makers. As one of the interviewees (3B) said “the term sustainable development that they know is still a slogan or gimmick for the development products. There is lack of understanding about the true meaning behind sustainable development.” He added that the hardest challenge is to shift their mind set, because the environmental-based development might be less profitable in the present (but sustainable for the future). “For developing countries like Indonesia, the focus of development is in economic growth. The awareness and attention for environmental issue like urban climate adaptation or climate change is still low”. The other challenge is the political situation. One of the interviewees (9B) said that “I am not sure the new elected governor will continue the adaptation program from the previous governor”. This has been an open secret in Indonesia, where the implementation of governmental programs is largely depending on the willingness of the leader. If the new elected leader thinks that a program is less favourable, then most likely the program will be discontinued. For instance, according to one of interviewees in Yogyakarta (6B) the car-free program and bike to work program for civil servant that was established in the early 2000s, has been discontinued in the era of the new city mayor. The similar condition might happen to any climate adaptation or green infrastructure implementation program in the future.

The second thing is the issue of land availability. All of the interviewees agreed that it is quite hard to find vacant land to be converted to open green space, in such a dense city like Bandung or Yogyakarta. Therefore, the Yogyakarta city government (6B) has a program to buy a land (from private sector or citizens) to be converted as public green space in each sub-district (*kelurahan*) or *kampungs*. While the Bandung city government (5B) said that they have more concern in conserving and restoring the existing green space to become a new place for recreation and public place for social activities.

Question 14: Will these uncertainties influence the planning and implementation process? If yes, how?

- a. Uncertainties in climate change or anthropogenic issue
- b. Wicked socio-political or institutional context

The issues in climate change are very broad and many components are involved. First, the climate change itself is full of uncertainty, as was emphasized by the interviewees with environmental backgrounds (1B, 4B, 9B). All we know is only the assumptions and forecast about how the climate is going to look in the future, but no one can guarantee that all the prediction will happen.

Even though the climate change issue starts to be included in the planning documents (namely RTRW or RDTR), still the action for implementation is not going very well because it is not the main priority for the local government. Meanwhile the socio-demographic issue is the main concern, because the growth of the urban population is high in Indonesia, and the urban infrastructure is not sufficient to support their activities and quality of life. Four of the interviewees (1B, 3B, 4B, 7B) agreed that most of Indonesian cities still doing “business-as-usual” meaning that the main concern is to build major infrastructure to support the economic activities and accommodate population growth. This is related to the anthropogenic heat generated in Indonesian cities. If this trend continues there will be higher anthropogenic in the future and UHI effect will be even worse.

The majority of the interviewees (1B, 2B, 3B, 4B, 6B, 7B, 9B) agreed that one of the most talked-about issues regarding planning policy in Indonesia is related to the political situation and institutional context. The political situation caused by most of the policy and implementation actions is decided based on whose orders, thus the interviewees depend on their political leaders for any urban climate adaptation program and implementation. Moreover, in Yogyakarta province, the governor is a Sultan (comparable to a king) who is very respected by the people. Therefore, the government system is different there, because each policy or program must be approved by the Sultan. For instance, a car-free day program in Yogyakarta which happened few years ago, (circa early 2000s) is being discontinued by the current mayor. This is what makes the continuation of climate adaptation process highly uncertain in the future. Secondly, the institutional context, which means what institutions have the authority to initiate a climate adaptation program and influence the relations between other stakeholders.

Discussion: managing uncertainties

What kind of uncertainties are considered and how do these influence the process of planning?

According to interview results, the development of Indonesian cities generally involves business-as-usual where the development focuses on major hard infrastructure to support economic growth. This development pattern will generate more anthropogenic heat because of extensive car use, more traffic congestion and more air-conditioner use. Besides anthropogenic heat, urban climate is also influenced by climate change that occurs globally. Even though it has high uncertainty, there is the possibility of future disastrous impacts from climate change such as storms, heat waves and massive flooding. According to EEA (2012 p.86) climate adaptation should be a “proactive implementation” for an extensive economic periods and strategy for sustainable development, rather than a fast-response or defensive activity. Thus, climate adaptation strategy should consider all types of climate projections in a long- term period.

Another uncertainty that can influence the implementation of green infrastructure for climate adaptation is related to the institutional context. The study from European Environmental Agency (2012) shows in adaptation process, climate change uncertainty is not the only aspect that influence the output. There are many other aspects such as political situation, economic priority and social issue which makes climate adaptation vulnerable. The interview results indicate that green infrastructure and climate adaptation programs are not seen as a priority by the political leaders. The government or political leaders in Indonesia have the main authority and power to implement certain policies or regulations. The low priority programs like urban greening do not have many implementation actions. According to Matthews et al. (2015 p.159) a new set of “institutional and socio-economic considerations” is needed in planning and managing green infrastructure. Therefore, the feasibility of implementing green infrastructure depends on the political leaders and government institutions, as well as social and economic support from other stakeholders. One of the important role of green infrastructure is to overcome the undesirable negative effects of economic growth, instead of promoting it. In addition, climate change adaptation is meant to create system resilience, which means the system maintains the same function and structure despite external changes (Matthews et al., 2015).

To sum up this discussion, Indonesia is still lacking in implementing green infrastructure for climate adaptation. There are many barriers and challenges encountered in the process of implementation. Even though there are certain greening program that have been established, in practice the implementation is way more complicated, in part because of the low awareness about climate adaptation issues and a lack of depth-understanding about the green infrastructure concept. The other barrier is the general failure to prioritize climate-related issues, which means that green infrastructure does not get allocated much space allocation because there are other urban functions that are considered more important. The last barrier is the institutional and political situation which is very much a top-down approach, and therefore many governmental programs do not successfully implement any changes because it considered unfavourable to the leaders.

6. Conclusions

This chapter will describe the conclusions of this study based on the analysis and discussion of general research and specific research in chapters 4 and 5. This chapter contains conclusions for both parts of the research, limitations of this research and recommendations for future study.

6.1 Current State of Urban Climate Adaptation in Indonesia

6.1.1 Sense of Urgency and Awareness

In Indonesia there is some sense of urgency and awareness to adapt to climate change, however it is still low and uneven in each group. For citizens, the varied educational backgrounds and economic classes means the level of awareness tends to differ. The awareness of citizens is also influenced by the tropical climate in Indonesia, which makes it harder to identify urban climate phenomena. The equatorial latitude leaves Indonesia with only two general seasons, rainy and dry, neither of which generates many winds. Overall, the sense of urgency to adapt to climate change in Indonesia is still low. Only certain groups of society are well informed, mainly the urban scholars or climate experts who have higher awareness and deeper knowledge related to urban climate and climate adaptation issue. The government institutions or politicians are lack of deeper understanding about climate change-related issues and how to address this issue properly. Therefore, it is important to raise the awareness and sense of urgency about climate adaptation in urban scale and also in national scale.

There are several methods suggested to raise the awareness. The first is by information and knowledge sharing. This can be done through seminars, trainings or using popular media like television and social media. The second is practical workshops or programs that involve daily activity that are considered easier to understand for many citizens. The government institutions and political leaders need to put more attention to climate-related issues because people look up very much to their leaders. Similarly, urban planners and designers should be given more trainings or seminars about how spatial planning can contribute to urban climate adaptation and how they can influence the implementation of adaptation measures through their expertise. Urban climate experts and urban planners and designer should work together closely through their expertise to bring the awareness of climate adaptation into practical solutions.

6.1.2 Communication Strategies

In general, communication is essential in planning and development processes. This is especially true when approaching topics that are considered new or unfamiliar in Indonesia like urban climate and climate adaptation. Communication is important to give the basic information first and then to increase the awareness. Indonesian citizens are very engaged with electronic media, mainly television and social media apps, and prefer them as their main source of information. Those electronic media can be a good platform to spread the information and communicate the urgency of urban climate adaptation.

Currently in Indonesia there are no official documents or guidelines which specify the use of communication within the planning, design and implementation of climate adaptation measures. To reach a wide variety of citizens' groups, the climate adaptation issue should be communicated using simpler terms to replace scientific phrase. For upper or mid class citizens, the knowledge shared should

encourage a deeper understanding about the issue, how it affects their lives and what adaptations should be made to cope with those changes. The knowledge sharing can be done by several methods such as workshops in cooperation with neighbourhood coordinators. For lower class citizen who lives in slums or squats (kampung), many interviewees thought that the climate adaptation programs should be accepted and useful for their daily lives, and that the result can be seen concretely (for instance, the kampung improvement program and river cleaning activities).

Meanwhile the communication between other stakeholder groups, namely government institutions, urban planners and designers, and urban climate experts, should be more intensive. There is a lack of two-way communication between these stakeholders. Therefore, the role of urban planners and climate experts should be able to communicate the climate-knowledge to the politicians effectively. Their expertise is valuable information for policy making, including the implementation programs for climate adaptation. Urban planners and climate experts are also expected to share their knowledge with citizens through practical education. In other words, urban planner and climate experts should be trained in how to communicate climate issues to different society level and acts as “the link” that connects higher authorities (government institutions) with citizens. Intensive communication can fill the knowledge gap about climate adaptation issue and raise the sense of urgency to take action for adaptation measures. Thus, it would be helpful if there is a communication guideline about how to raise the awareness of climate issues (in general) and specifically to communicate how to overcome the adverse effects through implementation of urban climate adaptation measures.

6.1.3 Planning Instruments

Currently in Indonesia there are no legally binding instruments that are specifically designated as urban climate adaptation measures. Even in Jakarta, the capital city and the benchmark of urban development, the municipality do not yet have specific urban climate adaptation programs or policies. However, there are some related policy instruments that can also contribute climate adaptation. For instance, Green City Development program (P2KH) from Ministry of Public Works, which focuses on green infrastructure implementation in cities that create many benefits, one of those is as urban climate adaptation measures. In addition to this program, the local government of Bandung and Yogyakarta also implement similar urban green programs that restore and build many green spaces in their cities. Other instruments that can possibly contribute to urban climate adaptation are city zoning regulations, detailed spatial plans (RDTR), green building standards and the National Climate Change Adaptation Program (RAN-API).

The climate adaptation program that they had now are “accidentally” happened, without they noticed it was an adaptation measure or intended to be climate adaptation program. It means, at first the policy or programs are not designated as urban climate adaptation measures, but for other objectives, which eventually has multiple benefits including for climate adaptation measures and sometimes mitigation measures too. It shows that there is willingness to move towards an actual climate adaptation measures although the climate adaptation issue is not yet being a priority in Indonesia. Regardless, the support from regulation and policy instruments potentially accelerate the implementation process of climate adaptation measures.

With many types of policy instruments, there is lack of integration and coherency between different sectors. Furthermore, national plans, sectoral plans or municipality scale programs should be organized and synchronized better to be used as climate adaptation measures. There should be better socialization or information sharing about the policy instruments, thus it will widely recognizable to

different stakeholders and makes it easier to work together towards effective climate adaptation implementation.

6.1.4 Implementation

Although there are some policy instruments which contains climate adaptation measures, there is still lack of concrete climate adaptation implementation in Indonesia. This is because in fact many policy and programs are just written in the documents, but the implementation process is happening very slow mainly because many layers of bureaucracy that took so much time. Too many policy instruments which not integrated and synchronized to each other makes the implementation process taken for granted and unrecognizable. Also, there is lack of understanding in diversity about climate adaptation measures, which resulted in limited concrete implementation.

The concrete implementation of urban climate adaptation in Indonesia can be summarized to the followings: revitalization of urban parks, built new green spaces, conserving the existing green area, planting more trees as green corridors in streets and sidewalks and green building application. Therefore, green vegetation and green infrastructure are the most mentioned urban climate adaptation measures in Indonesia. It is implying that Indonesian cities are initially implement urban climate adaptation measures.

The other issue in implementing urban climate adaptation measures is related to financial conditions. In Indonesia, there are cities and municipalities that already stipulate greening programs, but lack in implementation because there is no budget allocated for that program. The government budget mainly goes to other programs that are consider more urgent or in higher priority such as education, health, staple food production and fuel subsidies. The same financial problem also happened with green building implementation. It is seen as more expensive for the builders, when compared to conventional building. Therefore, more incentives should be given for these two regulations, to push more intensive and broad implementation. Private sectors can be approached to get more financial funding. Also, the legal aspects of the instruments are important, if it being compulsory or defined as strict regulations, then people are more aware to implement it.

6.2 Green Infrastructure for Climate Adaptation and Barriers to Implementation

The conclusions on specific research part will answer the question: What are the barriers for implementing green infrastructure as a strategy for climate adaptation in Indonesia? This question will be answered in three sections according to the three sub-questions: conceptualization, utilization and managing uncertainties.

1) Different perspectives in conceptualizing green infrastructure

To be able to implement green infrastructure as climate adaptation, it is important to understand the concept of green infrastructure thoroughly. There are various definitions about green infrastructure, but the key points are: network, green or natural features and benefits for human and ecosystem.

However, there is still a lack of understanding and many misconceptions in green infrastructure by stakeholders in Indonesia. Most of the people only understand green infrastructure as parks, trees and other green vegetation that are nice to have in their city because it has aesthetic value and a recreational function. In other words, green infrastructure is seen as an amenity. The concept of green infrastructure is broader than just having parks in the cities, as it refers to the creation of an interconnected network between nature and green space that can deliver various benefits for humans and the ecosystem. The concept of green infrastructure seen as 'ambiguous' and less explicit definition to it because there are different perspectives attached to it. The sophisticated concept of green infrastructure makes the implementation inconsistent, moreover in a government structure which not prioritize environmental-related programs like in Indonesia. Every stakeholder at all levels have to master the concept of green infrastructure. Therefore, first it is important to have a shared understanding about green infrastructure among key stakeholders to lessen the misunderstanding and misconception for a better implementation process.

2) Problems with utilizing green infrastructure with planning regulations and processes

The concept of green infrastructure has been recognized in spatial planning for quite some time. However, in practice for Indonesian cities, it is not yet being utilized enough in planning regulations and as climate adaptation implementation. Moreover, climate change has complex structure of information which oftentimes slowing down the action from politicians. The planning regime in Indonesia sees green infrastructure as a form of capital with a rationalist planning approach. This means that planning regulations indicate the conventional function of green space and green infrastructures. This circumstance can lead to the 'path dependency' which means the institutions get used to certain situations and become reluctant to respond to new emerging issues. The path dependency could be overcome through institutional innovations which enable the planning system to quickly respond to a new change such as climate change. The innovation in planning systems can help spatial planning adopt the new idea of utilizing green infrastructure for climate adaptation. Also, innovation processes will change the perspective of urban green, as we stop taking it for granted and begin to translate it into more practical climate adaptation measures.

Although there is a lack of utilization of green infrastructure in planning regulations, some urban greening programs that have been implemented gained a positive response from citizens. For instance, the program of green space revitalization in Bandung and sidewalk renovation in Yogyakarta draw the citizen's attention to utilize the green space. Now they feel more familiar with green space and experience the benefit of having a decent amount of green open space, such as places for recreation and social interaction. Even though the environmental benefits such as carbon sequestration and evapotranspiration, are less recognizable for the citizens, this positive attitude can be a good starting point for Indonesian cities to improve the quality of green infrastructure in the future.

3) Managing risks and uncertainties related to implementation of green infrastructure

At last, the barriers in implementing green infrastructure as climate adaptation relies in managing risks and uncertainties. There are many issues that can affect the implementation process of green infrastructure in the future. One of it is climate change itself. Climate change has many related variables that are less predictable and cross the scales of nature. The second risk is higher anthropogenic heat release from economic and development activities. As we know, climate and environmental issues are not a priority for development programs in Indonesia. The government is still

focused on building major infrastructure that can support the country's economic growth. This will generate more business and economic activities that come from traffic congestion, air-conditioner use and carbon excess from factories. If the development goals did not shift to more green and sustainable concepts, then in the future the adverse effects of climate change will be enhanced in Indonesian cities. The third challenge is related to political and institutional situations. In Indonesia, the government or political leaders have the main authority to implement certain policies or programs. If the government leaders did not have sufficient knowledge and awareness about the issue, oftentimes it is considered not important and less-prioritized. Seeing those situations, urban scholars and practitioners need to approach the government and encourage the implementation of green infrastructure. They should have underlined that green infrastructure is a low-regret, politically-safe and offers the multiple benefits at the same time. Although climate change might be happening slowly, the urban scholars and climate experts in Indonesia have to start their act now, to set the clear focus and objectives of climate adaptation implementation in Indonesian cities.

6.3 Research Limitations

This study is far from perfect, and there is plenty of room for improvements for further study. During working and writing about this research, there are some limitations in this study which can be noticed and might be useful for future research.

First, there are limited number of people that can be interviewed regarding this topic. There are some people that declined to be interviewed because they thought they did not have sufficient knowledge on the urban climate topic. It is quite hard to find an interviewee that is willing to be interviewed because this topic is rather "new" and unfamiliar in Indonesia, also not much research has been conducted previously. In Indonesia, there are many experts with environmental and climate-related background, but very few that has depth understanding about urban climate, as many of them still cannot differentiate it with climate change concept in general. However, the experts tried to give their best knowledge and expertise to answer the interview questions.

The lack of expertise and knowledge about this topic is apparent as there are many interviewees who said, "do not know" in closed questions for Part 1, because they never heard before about the urban climate measures or they were not sure about what to say regarding that measures. The same thing happened with the document study, because there is a lack of policy instruments or documents about this topic. Thus, the data and information gathered is limited. It cannot go deeper and the information is not as accessible as expected. The government institutions also are not easy to reach, because there is a complicated bureaucratic and permit process for a study that is seen as coming from a foreign university, although I am Indonesian. Therefore, there is a lack of interviewees that came from government institutions. This study also did not involve citizens as respondents or interviewees, therefore the citizens' opinions and perspectives regarding this topic are unexplored.

6.4 Future Research

This study takes broad a perspective of urban climate adaptation in Indonesia with a specific focus on identifying barriers and challenges for green infrastructure implementation. There are many interesting topics yet to be explored from here. Further study can be focused in Indonesia major cities such as Jakarta or Bandung where there are emerging government programs related to climate

adaptation and green infrastructure. It is interesting to see the sustainability of the programs from technical aspects and political perspectives. Moreover, if there is alteration in political leaders.

The other three urban climate adaptation measures can be taken as the focus of the research. Because there is lack of awareness of city design, use of materials and anthropogenic heat in planning and development Indonesian cities, these topics can fulfil the knowledge gap in that field and give more understanding about urban climate adaptation implementation. Another further research possibility for Indonesian cities is assessment for urban climate adaptation index, to see how far the adaptation implementation has been done and which city has the most concrete climate adaptation.

Furthermore, it is also important to include citizens in climate adaptation research, to explore their knowledge, awareness and perspective regarding this topic. The citizens can be involved through a neighbourhood-scale case study or included in a citizens' initiative group. A quantitative approach perhaps will be suitable for the citizens to give their perspective regarding urban climate adaptation measures that already implemented in some area. For instance, using questionnaires or the Likert scale to show how they think about the improvement of urban green in their city.

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Figure 13: Analysis Result, 2017

Figure 14: Analysis Result, 2017

Figure 15: Analysis Result, 2017

Figure 16: Analysis Result, 2017

Figure 17: Analysis Result, 2017

Figure 18: Analysis Result, 2017

Figure 19: Analysis Result, 2017

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Annexes

Urban Climate Adaptation Interview Questions

2017

Awareness

1. What is the sense of urgency to adapt the urban environment to climate change amongst the following groups in the future in your city?

Groups	Very urgent	Urgent	Neutral	Less urgent	Not urgent	Don't know
Citizens		1: 2A	2: 7A, 10A	2: 5A, 9A	5: 1A, 3A, 4A, 6A, 8A	
Government	1: 10A	1: 1A	3: 2A, 5A, 9A		5: 3A, 4A, 6A, 8A, 7A	
Urban planners & designers		8: 2A, 4A, 6A, 8A, 7A, 5A, 9A, 10A	1: 1A		1: 3A	
Urban climate experts	2: 9A, 10A	8: 3A, 2A, 4A, 6A, 8A, 7A, 5A, 1A				

2. In case the sense of urgency is low, what is needed to make those groups feel more urgent about adapting the urban environment?

Groups	Measures to sense of urgency
Citizens	<p>1A: n/a</p> <p>2A: raise awareness through campaigns</p> <p>3A: campaigns, includes climate issues in education process</p> <p>4A: don't use technical or scientific terms like "urban heat island" to citizens. That's too difficult for them to understand</p> <p>5A: module distribution or socialization in neighbourhood</p> <p>6A: campaign with daily activity</p> <p>7A: Citizens is vary. The well educated is quite aware of climate change, but the other might not really know it, only said the weather is getting hotter. Again in implementation or application in daily live, there is still lack of action.</p> <p>8A: social campaigns</p> <p>9A: Knowledge (sharing) provided through socialization, module distribution, training, etc. regarding the cause and adverse impact of</p>

	<p>climate change at small scale (i.e. community level). Introduce technical approaches applicable to prevent and adapt with the impacts. 10A: Education and socialization to raise their awareness</p>
Government	<p>1A: trainings/seminars 2A: workshops or trainings 3A: short course 4A: workshops or trainings 5A: seminars, trainings, knowledge-sharing sessions 6A: trainings or short course 7A: course, seminars or trainings 8A: seminars or trainings 9A: Workshops that introduce technical approaches applicable to prevent and adapt with the impacts. 10A: Training and education to increase their knowledge and to make the realize that they have the most important position regarding the development implementation</p>
Urban planners & designers	<p>1A: n/a 2A: includes climate-related issues in education curriculum 3A: the awareness in this category is quite good, but it is hard to put it into practices. The architects and urban planners “forced” to do business-as-usual and conventional planning/design because it considered more profitable 4A: Architects and urban planner can take part to raise the awareness through small projects to urban kampung, to educate the people about urban climate. For instance, how to keep the environment clean, not to litter to the river, etc 5A: they have better awareness about this issue 6A: organize campaign in cooperation with local governments, NGOs or citizens or by initiatives that are related to the issues. 7A: involved more in climate adaptation projects 8A: take course/trainings about climate adaptation 9A: workshops/seminars with more focus about climate in urban planning issue 10A: Adapt the climate change adaptation strategy into urban planning concept</p>
Urban climate experts	<p>1A: n/a 2A: they have high awareness already 3A: the awareness in this category is quite good, but it is hard to put it into practices. The architects and urban planners “forced” to do business-as-usual and conventional planning/design because it considered more profitable 4A: help the government and urban planners to raise the awareness with their expertise 5A: they have expertise and good knowledge about this issue 6A: organizing seminars, campaigns or workshops in cooperation with</p>

	<p>local governments, NGOs or citizens</p> <p>7A: this group can help the government and urban planners to raise the awareness with their expertise</p> <p>8A: no need to raise awareness for this groups</p> <p>9A: they have good awareness level</p> <p>10A: Spread the knowledge and awareness about climate change</p>
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3. How aware are the groups of the following two urban climate phenomena?

I. Urban Heat Island

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens			1: 2A	2: 7A, 9A	5: 3A, 4A, 10A, 1A, 8A	2: 5A, 6A,
Government		1: 2A		2: 9A, 10A	5: 3A, 4A, 7A, 1A 8A	2: 5A, 6A,
Urban planners & designers		2: 2A, 7A	4: 6A, 8A, 9A, 10A		2: 3A, 4A	2: 5A, 1A

II. Wind Discomfortability

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens				1: 9A	7: 3A, 2A, 4A, 7A, 10A, 1A, 8A	2: 5A, 6A
Government				1: 9A	7: 3A, 2A, 4A, 7A, 10A, 1A, 8A	2: 5A, 6A
Urban planners & designers		3: 6A, 8A, 7A	2: 9A, 10A		3: 3A, 2A, 4A	2: 5A, 1A

4. In case awareness is low, what is needed to increase the awareness among those groups of two urban climate phenomena mentioned in question 3?

Groups	Measures to increase awareness
Citizens	<p>1A: socialization, education 2A: socialization and campaign 3A: education process 4A: The problem is, here in Indonesia we have “comfortable” climate all year long. It is difficult for society to feel the difference of climate (raising temperature or wind discomfort) because we’re not really have those different seasons. Indonesian people never even check the weather or temperature before going outside. To explain such a complicated situation to simple and understandable terms is not easy. Maybe through media and advertising 5A: campaigns, socialization 6A: use simple terms and not too scientific 7A: small-daily-activity campaign 8A: socialization and education 9A: Knowledge sharing provided through socialization, module distribution, training, etc. regarding the cause and adverse impact of the phenomenon at small scale (i.e. community level). 10A: Education and socialization, maybe from TV or social media (because they are accessible for the public), that these phenomena happen due to climate change.</p>
Government	<p>1A: trainings or seminars 2A: reach the city mayor first 3A: short course or education process 4A: Make the right policy, with efficient program. 5A: Mayor or political leader should have the awareness first 6A: trainings, seminars 7A: education process 8A: education, seminars or trainings 9A: Knowledge supported by scientific data and analysis, on the factors triggering the phenomenon, adverse impact they could impose to government program implementation. Input to policy development which aims to provide comprehensive prevention approaches to tackle the impact. 10A: Training and education to increase their knowledge</p>
Urban planners& designers	<p>1A: n/a 2A: include climate-related issues in planning/design curriculum 3A: they already have the awareness and knowledge 4A: Through simple project or educational project like urban farming 5A: n/a 6A: awareness is quite high 7A: include climate-related issues in planning/design curriculum 8A: they already have the knowledge about this issue</p>

	<p>9A: the level of their awareness is good</p> <p>10A: Try to make the urban design which can adapt these phenomena.</p>
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5. How aware are the groups of following four urban climate adaptation measures?
- City design (e.g. street orientation, adapting to wind and solar orientation of building and streets, type of land use in the surrounding areas)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens				2: 4A, 9A	6: 3A, 2A, 6A, 8A, 7A, 10A	2: 5A, 1A
Government			1: 9A	3: 2A, 4A, 10A	4: 3A, 6A, 8A, 7A	2: 5A, 1A
Urban planners & designers		7: 2A, 4A, 6A, 8A, 7A, 9A, 10A			1: 3A	2: 5A, 1A
Urban climate experts	4: 4A, 9A, 10A	4: 2A, 6A, 8A, 7A				2: 5A, 1A

- Urban vegetation (e.g. green roofs, urban forestry, parks, strategically placed trees and shrubs, vegetated walls, vegetated rails and roads)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens			1: 2A	3: 7A, 9A, 10A	4: 3A, 4A, 6A, 8A	2: 5A, 1A
Government			3: 2A, 9A, 10A	1: 4A	4: 3A, 6A, 8A, 7A	2: 5A, 1A
Urban planners & designers		7: 2A, 4A, 6A, 8A, 7A, 9A, 10A			1: 3A	2: 5A, 1A
Urban climate experts	4: 3A, 4A, 9A, 10A	4: 2A, 6A, 8A, 7A				2: 5A, 1A

- Use of materials (e.g. low albedo and longer cooling time-lag materials)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens				1: 9A	3: 3A, 2A, 10A	6: 4A, 6A, 8A, 5A, 7A, 1A
Government				1: 9A	3: 3A, 2A, 10A	6: 4A, 6A, 8A, 5A, 7A, 1A
Urban planners& designers		1: 10A	1: 9A	1: 2A	1: 3A	6: 4A, 6A, 8A, 7A, 5A, 1A
Urban climate experts	3: 3A, 4A, 9A	2: 2A, 10A				5: 6A, 8A, 7A, 5A, 1A

- Anthropogenic heat (e.g. less air conditioners, lower car use)

Groups	Very aware	Aware	Neutral	Less aware	Not aware	Don't know
Citizens				2: 9A, 10A	2: 3A, 2A	6: 4A, 6A, 8A, 7A, 5A, 1A
Government				2: 9A, 10A	2: 3A, 2A	6: 4A, 6A, 8A, 7A, 5A, 1A
Urban planners & designers		1: 9A	1: 10A	1: 2A	1: 3A	6: 4A, 6A, 8A, 7A, 5A, 1A
Urban climate experts	2: 3A, 4A	2: 9A, 10A				6: 2A, 6A, 8A, 7A, 5A, 1A

6. In case awareness is low, what is needed to increase the awareness among those groups of four urban climate adaptation measures mentioned in question 5?

Groups	Measures to increase awareness
Citizens	<p>1A: n/a</p> <p>2A: The education is very important to spread the knowledge about this issue. Started from the student elementary school or middle school, to give them the knowledge and awareness from early age.</p> <p>3A: education, knowledge-sharing session, campaign</p> <p>4A: put the measures in daily activity</p> <p>5A: n/a</p> <p>6A: campaign for urban climate adaptation measures in the context of daily-life</p> <p>7A: small activities/campaign</p> <p>8A: socialization and campaign</p> <p>9A: Knowledge on the scale of preventive impact could be contributed of each measure to tackle the adverse impact of climate change Knowledge on how to benefit from the four measures in order to prevent and cope with the impact of climate change</p> <p>10A: Education and socialization, maybe from TV or social media (because they are accessible for the public), that these measures are important to be applied in order to adapt to this UHI phenomenon</p>
Government	<p>1A: training/seminars</p> <p>2A: workshop or short course</p> <p>3A: education or short course</p> <p>4A: trainings, seminars</p> <p>5A: seminars, workshop</p> <p>6A: trainings or seminars</p> <p>7A: trainings and education</p> <p>8A: seminars, trainings, education</p> <p>9A: Knowledge on how to benefit from the four measures in order to prevent and cope with the impact of climate change. Assessment towards the existing capacity of the city and politicians (human resource, funding, development orientation, etc.) to use the four measures. Input to policy formulation on the development of required program/activities aiming to promote the leverage of the four measures to adapt with climate change</p> <p>10: Training and education to increase their knowledge so that they can adopt these measures into the policies and programs</p>
Urban planners & designers	<p>1A: n/a</p> <p>2A: includes urban climate adaptation in education curriculum esp. for architects</p> <p>3A: include it in education process</p> <p>4A: includes the climate adaptation measures in teachings (university level)</p> <p>5A: n/a</p> <p>6A: includes the climate adaptation measures in education curriculum (dept. urban planning and architecture)</p>

	<p>7A: includes the climate adaptation measures in education curriculum (dept. urban planning and architecture)</p> <p>8A: includes the climate adaptation measures in education curriculum (dept. urban planning and architecture)</p> <p>9A: n/a</p> <p>10A: Spread the news that climate change is real and keep doing it continuously and in repetition.</p>
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Planning and design processes for implementation

Communication

1. Which roles do citizens, government, planners and designers and urban climate experts have in the process of planning, designing and implementing urban climate adaptation measures?

Citizens:

1A: the citizens are the object and beneficiaries of climate adaptation program. Groups or citizens initiatives in some of the cities can be a good start for the bigger impact

2A: there are some of the citizen group that now enliven the public space with various activities to create intangible value and social interactions in the society. Thus, through the social activities, the function of public green can be preserved.

3A: not really have important role

4A: they're the object of adaptation program

5A: important role for program implementation

6A: important

7A: they rarely involved in policy-making program

8A: important, but not really involved yet

9A: Planning and designing:

- Provide information and clarification towards the historical changes occurred within the affected area, including the initial environment conditions, causes that trigger the phenomenon, scale of impact, and measures taken to cope with the impact (in some extent, to prevent the adverse impact)
- Provide inputs as needed to policy-makers in terms to promote the application of reliable measures to adapt with the impact of climate changes

Implementation:

- Carry out climate change adaptation activities as rolled out by the local officials/government
- Participate to oversee the implementation of relevant program/activities

10A: They are the object and beneficiaries of climate adaptation implementation programs. Also in implementing climate adaptation measures (maybe for their own building)

Government:

1A: they have the authority that can drives and stir the other stakeholders and the society

2A: the most important role, because they have the power and authority to regulates

3A: they have the main role in planning, designing and implementing urban climate adaptation measures

4A: in a top-down government like Indonesia, the authority of government in implementing any development program is very strong.

5A: Here in Yogyakarta, the governor is a Sultan. The people are really respect their Sultan. Unlike in any other province, here we have different rules and regulation based on Sultan's decree. Thus, some of the policy he made cannot be intervene by the lower institution (exp: dinas/badan). The local government here will obey any of Sultan's orders, and translate it into the policy and regulation.

6A: The central government need to push the local government for more concrete actions. For instance: set the target for climate adaptation to be achieved, with some rules or regulation.

7A: main role in planning, designing, and implementing climate adaptation program

8A: All their roles are important, because all of them need collaboration, only they need the initiator, in this case it might be the NGO or the city-mayor to make the movements and raising the awareness. The central government need to push the local government for more concrete actions. For instance: set the target for climate adaptation to be achieved, with some rules or regulation.

9A: Planning and Designing

- Provide policy support to the preparation of urban climate adaptation plan
- Provide funding resources to preparation and implementation plan of the urban climate adaptation

Implementation

- Oversee the implementation of urban climate adaptation related program

10A: main role in planning, designing, and implementing climate adaptation program

Urban planners and designers:

1A: they had their own mission/concern topic, and they worked on that constantly with steady funding

2A: for the architects, even they know about the urban climate issues, eventually they just follow the client's orders, because sometimes we have no choice. We try to convince the clients with our knowledge about urban vegetations and microclimate, etc but sometimes there are architects who did not know about this issue. It depends on where they educated, because not all school of architecture taught about this issues well. Some of them taught to utilize all the space as profitable object.

3A: bridging the citizens and government, through spatial planning project consultation and advisory

4A: They are also expected to monitor and evaluate the implementation of governmental programs in general.

5A: project consultation

6A: Urban planners and designers are expected to know how to translate the urban climate adaptation measurements into practical actions that can then be more easily understood by the citizens.

7A: need more actively involved in planning and designing climate adaptation program

8A: All their roles are important, because all of them need collaboration, only they need the initiator to make the movements and raising the awareness.

9A: Planning and Designing

- Mainstreaming the climate change issue to the formulation of urban plan
- Promote the climate change adaptive urban plan and design to be applicable as per approval of the government

Implementation

- Oversee the obedience of urban development to climate change adaptation measures

10A: planning and design the urban climate adaptation measures

Urban climate experts:

1A: Research center/ university: there is research or related activity for climate change issues but sometimes it's not happen continuously. But sometimes, the study results might not be included in the policy and implementation processes

2A: can help with their expertise in spreading the knowledge

3A: advising and influencing the government in policy-making decision-making processes regarding climate-related issues. However, sometimes that advice is being ignored and not included in the policy.

4A: actively involved in campaigns or education process for climate-issues

5A: we need more climate experts to help government compile climate adaptation program

6A: Very important, maybe they can be the initiator, to make the movements and raising the awareness.

7A: spreading the knowledge and information about urban climate and any other climate-related issues

8A: should help to raise awareness about climate change and the importance of climate adaptation

9A Planning and Designing

- Build robust rationale through scientific data analysis on the causes and potential adverse impact of climate change to urban
- Present solutions on measures to adapt to climate change in urban

Implementation

- Implement regular oversight towards the reliability of measures on urban climate change adaptation and provide improvement as needed

10A: planning and designing the climate adaptation program

2. What are the relationships between these actors in the communication strategies?

Citizens/ Governments or Politicians

1A: top down approach in government framework

2A: they're just there and not directly related

3A: not really close to each other, because of development more like top-down

4A: no direct relation

5A: the government development programs are made for citizens

6A: not really have a close communication

7A: citizen cannot have active role in government

8A: no direct relations

9A: Citizen in the beneficiaries of politician's development program

10A: government create the programs (and also the budget) and involve the citizens in the implementation process. Or maybe the citizens taking the adaptation measures and then push the government to do something in order to react to the climate change.

Citizens/ Urban planners and designers

1A: two-ways communication even if it's weak

2A: there is relation and communication between these two but still weak

3A: the relation is weak and indirect

4A: urban planners/architect should help citizens in improving or upgrading their living environment

5A: not aware

6A: planning scholars can help solving the citizens urban problems, including climate change and other environmental-related issues.

7A: urban planners/architects have to be more involved in concrete implementation program that includes the citizens

8A: n/a

9A: Citizen as the respondents and/or data provider to the preparation of urban plan

10A: urban planners or designers can educate the citizens on how to do the adaptation.

Citizens/ Urban climate experts

1A: climate experts should spread the knowledge more to citizens (indirectly)

2A: maybe climate experts can help to educate and raise citizens awareness about climate change

3A: climate experts should spread the knowledge even it is indirectly

4A: there is weak relationship between this two. Experts needs to have more concrete project in the field.

5A: not aware

6A: still weak, citizens need to be participated more

7A: both should be more active and involved together in climate adaptation projects

8A: citizens need more education about the climate issue

9A: Citizen as the respondents and/or data provider to the urban climate analysis

10A: urban climate experts can educate the citizens on how the climate change affects their life and how to adapt.

Politicians or Governments/ Urban planners and designers

1A: urban planners are the consultants/advisors for government projects

2A: urban planners/architects usually being consultants for government project

3A: they should have closer relation and more communications

4A: work together with their expertise for better implementation

5A: weak relation

6A: still weak, should be more intense

7A: there is quite close relation between these two actors

8A: there are relation between this two. Usually for consultation development projects

9A: Politicians as the decision maker on the urban plan developed by planners and designer

10A: As we know that our government do not have the capacity about adaptation measures to the UHI, then the Government should learn from the experts or involve the experts in planning and designing the adaptation measures in urban area.

Politicians or Governments/ Urban climate experts

1A: their relation should be more strengthened

2A: not aware

3A: they should have closer relation and more communications

4A: work together with their expertise for better implementation

5A: not aware

6A: still weak, should be more intense

7A: weak communications

8A: need more communication between these two

9A: Politicians as source of data and in some extent, funding, for urban climate analysis

10A: Urban climate experts can increase the Government awareness about the risk and loss, therefore the government can relate the climate change impact to their condition (ex. Budget, government expenses, social cost, etc.)

Urban planners and designers / urban climate experts

1A: close relation

2A: they have close relation or relatively same background

3A: they should have closer relation and more communications

4A: work together with their expertise for better implementation

5A: not aware

6A: they should work closely

7A: work together both in research and practices

8A: they have close relations

9A: work together and more communications to spread the awareness

10A: close relation

3. What is the role of communication to support the planning, design and implementation of adaptation measures?

1A: the communication process has several layers and it's very important. It starts from lobbying with the central government, and if they agree then it comes to the local government for an implementation

program and then down to the citizens. Sometimes, however, their advice is not directly included in the final resulting policy documents.

2A: it's important to share the knowledge about climate adaptation to citizens, students, government and urban practitioners

3A: communication is very important to raise awareness, moreover among governments institutions, to support the involvement of climate-related issues in planning and development.

4A: important to raise awareness among the citizens, government leaders and urban planners/architects. The communication process should be active and two-ways communication

5A: communication process can help wider society to understand and aware about climate-related issue

6A: communication process between related stakeholders (urban planner, government, citizens) should be intensive and proactive.

7A: I think it's important because many class in our society did not aware about climate change or climate adaptation issue.

8A: an effective communication is needed to support planning, design and implementation of adaptation measures

9A:

- Verify the information collected for urban climate analysis
- Increase stakeholders' awareness on the issue or urban climate change adaptation and the planning process

10A: communication is important to share the information so that all of the stakeholder has the "same frame" in terms of CC adaptation for urban aspect.

4. Are there formal guidelines or policies that drive the use of communication in the planning, design and implementation of adaptation measures? If yes, can you please name them?

1A: no policy/guidelines

2A: no formal policies

3A: no there aren't

4A: no policy

5A: no policy/guidelines

6A: no

7A: n/a

8A: no there aren't

9A: no

10A: I'm not sure about it. We have the "MUSRENBANG" scheme and maybe some province use it to share the information about climate impacts and how to deal with it.

5. What are the strengths and weaknesses of the communication process?

Strength:

1A: n/a

2A: n/a

3A: not aware

4A: not aware

5A: n/a
 6A: n/a
 7A: n/a
 8A: not aware
 9A: Better communication can also enhance the quality of data collected for compiling the policy making and analysis.
 10A: The communication process can improve the awareness and knowledge regarding urban climate adaptation issues

Weakness:

1A: n/a
 2A: n/a
 3A: not aware
 4A: not aware
 5A: n/a
 6A: n/a
 7A: n/a
 8A: not aware
 9A: climate related issues are still not communicated and utilized enough in the making of urban planning regulations
 10A: In general, the awareness about climate change and related issues is still low means the communication process is not going well.

6. Is there a need to improve the communication process? If yes, how to improve ?

1A: n/a
 2A: yes
 3A: Yes, there is need to improve communication process.
 4A: Yes. Through neighborhood/kampung improvement program. Use daily language to make it easier for citizens to understand the issue.
 5A: yes. Use more simple terms and focus on technical solutions
 6A: yes. To reach more people need an easier language that not too scientific.
 7A: yes. Campaign or workshop that involved daily activity
 8A: yes
 9A: Approach to diversify methods of communication that makes it close to community ability to understand
 10A: use social media for campaign. Also provide strong regulation and clear guidelines for it.

Instruments

1. Are there legally binding instruments (e.g. zoning plans) used to implement urban climate adaptation measures? If yes, please explain how they work?

1A: No. The regulatory instrument such as RAN or RAD it's for climate change in national level
 2A: no legally binding instruments

3A: no, there aren't. Even in Jakarta, the capital city and the benchmark of urban development, the municipality does not yet have a specific urban climate adaptation program or policy

4A: no instruments

5A: Retrieve from the RDTR document (detailed spatial planning), there is no urban climate adaptation measures yet included in the planning. They do have the specific classification for buildings (KDB, KLB dll) but not for climate adaptation, but more for standardize the building coefficient and the adjacent land use.

6A : no instruments for urban climate

7A: no there aren't

8A: Not yet. There is a regulation about green building, but the implementation is only for government office building (not for individual settlement/housing area). It is still far from perfect either, to follow the KDB KLB rules yet is difficult.

9A: RAN API (National Action Plan for Climate Change Adaptation). It serves as the policy frameworks to ensure the national development carried out in sustainable manner

10A: Sectoral policy, i.e. the one that PU has (RAN MAPI PU). RAN-API, but it's not that specific about urban climate adaptation measure.

2. What are the strengths and weaknesses of the legally binding instruments used?

Strengths:

1A: n/a

2A: n/a

3A: n/a

4A: n/a

5A: zoning regulation maps in RDTR already covered all the land use in the city. The map is clearly illustrating each block of the city area and what it is designated for. This will be an advantage for the government, or private sector if they want to see the land regulations and keep the existence of protected areas like green or conservation areas and urban heritage areas.

6A: n/a

7A: n/a

8A: n/a

9A: it provides policy recommendation for all sectors of development and mechanism of implementation

10A: n/a

Weakness:

1A: no instruments for urban climate adaptation

2A: n/a

3A: no instruments for urban climate adaptation

4A: no instruments for urban climate adaptation

5A: no instruments for urban climate adaptation

6A: n/a

7A: n/a

8A: n/a

9A: no instruments for urban climate adaptation

10A: Even if the instrument is provided, there's still weak commitment from our stakeholder, esp. government to implement the instrument.

3. Are there certain chances / potentials missed when using the legally binding mentioned instruments (e.g. coupling with other instruments)?

1A: lack of synchronization between related institutions when forming the policy instruments

2A: n/a

3A: currently there is not yet a comprehensive urban climate adaptation plan which includes spatial components and another related sector. The adaptation plans we have now (RAN-API) are still very general and lack in detail to be derived into spatial regulation

4A: there is lack of institution support

5A: the policy and regulations needs to be integrated one another and also certain institution to handle climate-related policy and programs

6A: n/a

7A: n/a

8A: too many policy instruments, needs to be synchronized

9A: n/a

10A: Not engage with the right experts for the strategy formulation and implementation as well.

For this section of interview questions (no.4-6) there are no sufficient answers for the questions above because at the moment there is not yet any concrete urban climate adaptation interventions being implemented in Indonesia.

4. Are there other policy instruments used to implement urban climate adaptation measures? If yes, please explain how they work?

1A: Because the urban climate adaptation in this context is about microclimate, I am not sure there is national policy/document which regulates about that. But check the RAN-API documents and I think in city detailed plan (RDTR) there might be included.

2A: not aware

3A: no instruments

4A: no instruments

5A: not aware

6A: not aware

7A: not aware

8A: not aware

9A: National Action Plan - Climate Change Adaptation (RAN-API Rencana Aksi Nasional - Adaptasi Perubahan Iklim)

10A: National Action Plan - Climate Change Adaptation (RAN-API Rencana Aksi Nasional - Adaptasi Perubahan Iklim)

5. What are the strengths and weaknesses of the other policy instruments used?

No sufficient answer for this question because there are no policy instruments that accommodates urban climate adaptation measures (city design, urban vegetation, material use and anthropogenic heat) or urban climate phenomena, including urban heat island and wind discomfort

6. Are there certain chances/ potentials missed when using other policy instruments (e.g. coupling with other policies)?

1A: Deceleration in implementation because of recent local leader election (Pilkada). There might be changing in leader's political views and interests, so the policy instruments mostly affected by that.

2A: not aware

3A: not really, because the instruments are not designated as urban climate adaptation measurements, but for other objectives, which has multiple benefits including implementation of urban climate adaptation measures.

4A: the concrete urban climate adaptation interventions that currently exist happen "accidentally", so far there is no problem with that.

5A: not aware

6A: not aware

7A: not aware

8A: not aware

9A: not aware

10: I don't think there is a problem with other policy since every adaptation measures are useful.

Implementation

1. Which concrete urban climate adaptation measures/ interventions are currently implementing or have been implemented in your city?

1A: The urban climate adaptation that I know is more about reducing gas emission, so it doesn't really relate to this topic and more to mitigation action. Indonesia's climate adaptation action is now more focusing in forest fire, droughts and crop fields.

2A: urban green parks

3A: One of the on-going programs in several Indonesian cities is the Green City Development Program (P2KH) which was initiated by the Ministry of Public Works. Each city usually has their own green program that depends on their spatial programs and budget allocation, mostly at the neighborhood scale or greening the streets. However, the implementation of the greening program is a low priority because of the limited amount of land. If there is any vacant space, it can be used for more profitable functions, such as a commercial area.

4A: Because the current Mayor is an architect, he starts to have concern about the urban climate issue. One of the main program is slum alleviation, because microclimate is related with slum area. There is increasing number of slum area in Bandung from 200ha to 1500ha in 2-3years (data from PU). So, we are stuck with the slum problems, because we cannot have the green area or have a good microclimate if the slum area is keep increasing and the number of inhabitants also increasing.

This is a very complicated problem.

5A: It might not be the exact interventions for UCA, but some of green/environmental program had been implemented in small scale neighborhood.

6A: Never heard about that program

7A: I don't think there is urban climate adaptation program yet in Yogyakarta

8A: Not yet, I haven't heard yet in the past years.

9A: no concrete urban climate adaptation implementation

10A: In Jakarta and Bandung, the government already built garden for green open space, and many green building are started to be built now. In Jakarta, the mass transportation (TransJakarta) have already use gas to replace the fossil fuel but it's more to mitigation act.

From document study:

GREENSHIP is divided into six assessment categories. Each of these consists of several criteria which contain credit points with particular values that will be processed to determine the assessment. Those six categories are:

7. Appropriate Site Development (ASD)
8. Energy Efficiency and Conservation (EEC)
9. Water Conservation (WAC)
10. Material Resources and Cycle (MRC)
11. Indoor Air Health and Comfort (IHC)
12. Building and Environment Management (BEM)

2. What are the strengths and weaknesses of these mentioned urban climate measures/interventions?

Strengths:

1A: N/A

2A: N/A

3A: the greening program had value added for aesthetics and city decoration. There are many people visiting the urban parks nowadays because it considered as an alluring and relaxing place. Many old and abandoned green space in Bandung has been restored and revitalized for better functions and more aesthetic value.

4A: I don't think so

5A: N/A

6A: N/A

7A: N/A

8A: N/A

9A: provide analysis to build the recommendation adaptation program, provide mechanism of implementation (such as funding)

10A: For example, PU has released the voluntary obligation for the new building to be green building and give the certificate for them who comply with PU's standard. Many developers are willing to build the green building to get the certificate and they can use it for branding their building

Weakness

1A: N/A

2A: N/A

3A: For the green building certification program, it is considered more expensive to build according to green building standards compared to non-green building, because of more expensive materials or certain design standards. Maybe the government can give subsidies or incentives for the developer or property owner that is willing to switch to green building standards

4A: it's not obeyed in concrete implementation because it's not profitable and expensive

5A: N/A

6A: N/A

7A: N/A

8A: N/A

9A: N/A

10A: it's expensive to make green building or other adaptation measures so maybe the government can give subsidies for the materials.

3. Are there conflicts between aesthetics and these mentioned urban climate adaptation measures?

1A: N/A

2A: N/A

3A: the greening program had value added for aesthetics and city decoration. There are many people visiting the urban parks nowadays because it considered as an alluring and relaxing place. Many old and abandoned green space in Bandung has been restored and revitalized for better functions and more aesthetic value.

4A: I don't think so

5A: N/A

6A: N/A

7A: N/A

8A: N/A

9A: N/A

10A: no conflict

For the question below, there are no answers from the interviewees, because the programs they mentioned are not directly addressing urban climate adaptation measures.

4. Are there conflicts between urban functions and these mentioned urban climate adaptation measures?
5. Are there certain chances/ potentials (e.g. coupling with other interventions / 'no regret' measures) missed when implementing these mentioned urban climate adaptation measures?
6. What evidence is there that would tell what the citizens are feeling/thinking?

Transcript Interview questions for part 2

Conceptualization of green infrastructure by key stakeholders

1. What comes in your mind when hear “green infrastructure”?

1B: GI is an ecological structure for sustainability of environment, socio-economic and give benefits to human life.

2B: amount of space that have trees or green vegetation like parks, garden, etc

3B: Green infrastructure is way beyond than just green space, which is included there. When we talk about green infrastructure, it is important to remember that there is the linkage between those green spaces. Then it is not just an individual park or open green space, but they should influence one another as a network.

4B: Green infrastructure is very broad terms. For me the green terms is related to metric measurements, like to what extent a building is called ‘green’ by amount of nature elements can be catch by the building materials, sunlight, water, etc. So it is more like greening the existing infrastructure we already built (roads, bridges, buildings, etc). Because where I used to live in Japan, the green is measured in quantitative research. The most common standard used is LEED by USGBC or in Japan we used CASPEE. Therefore in this research, we need to equate our perception about green first.

5B: parks, city forest and green open space including cemetery

6B: open and green space

7B: Green space, open space, trees and vegetations in the sidewalks

8B: parks, garden, city square, green corridors, open water bodies

9B: The infrastructure which is built by environmentally friendly materials, and also the infrastructure which don’t destruct the environment.

2. In your opinion, what elements that define green infrastructure?

1B: it has natural structure, like parks, green area/conservation also water bodies

2B: green vegetation like trees, grass, shrubs etc

3B: often in Indonesia, the focus is only on the green element such as parks, trees or shrubs, without forming any linkage or network that is defined as infrastructure”.

4B: I am used to quantitative research, and as architect and urban designer, at first, I thought GI that you mean is about green building, not the green vegetation.

5B: open space that has greenery/vegetation on it

6B: the word green is synonymous with vegetation and trees

7B: trees or vegetation

8B: trees, shrubs and any other vegetation

9B: The materials, the function.

3. What parts in urban area which you think included as green infrastructure?

1B: In this program, we defined Green in 8 elements for a green city implementation program: green planning and green design, green community, green open space, green building, green energy, green transportation, green water and green waste.

2B: public open space, parks, mosque square

3B: parks, open green space, open water body, riverbanks

4B: green buildings according to certain standard

5B: neighbourhood parks, urban forest, cemetery, and the green corridors alongside the street, toll road, railway, rivers and high-electricity hub.

6B: in City of Yogyakarta, these are the area that includes as GI

- RTH Kebun Binatang (RTH-1) (Zoo)
- RTH Taman dan Hutan Kota (RTH-2) (Parks and City Forest): taman RT, taman RW, taman kelurahan, taman kecamatan, taman kota, hutan kota, alun-alun
- RTH Fungsi Tertentu (RTH-3) (Cemetery)
- Subzona Sempadan Sungai (Riverbanks)

7B: public parks, city squares (alun-alun), traffic islands/roundabouts

8B: green corridor (alongside the road), square, trees, parks, city forest, city squares (alun-alun),

9B: Public garden, park, and all infrastructures and building which contain the green material.

Green infrastructure implementation in general

1. How did the *quantity* of green infrastructure in your city/region change during the past 5 years? Please explain (and if there is maps or statistic data, please provide)

1B: you can see it in our document

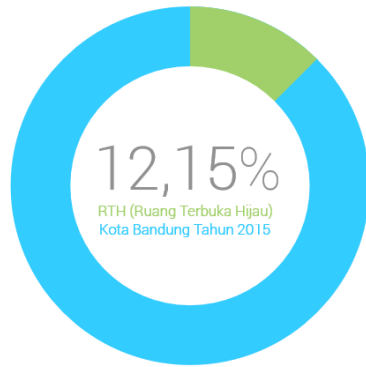
2B: not aware. Maybe there is statistical data from local green parks agency (dinas pertamanan)

3B: there is increasing area of green space/parks in Bandung, but to be sure check the data with local agency

4B: nowadays i think there is some new urban green space, but some of that only as street decoration, not really built as the "green infrastructure". But to be exact we have to measure it again to have the specific amount.

5B:

Here the data about the quantity of green space in Bandung



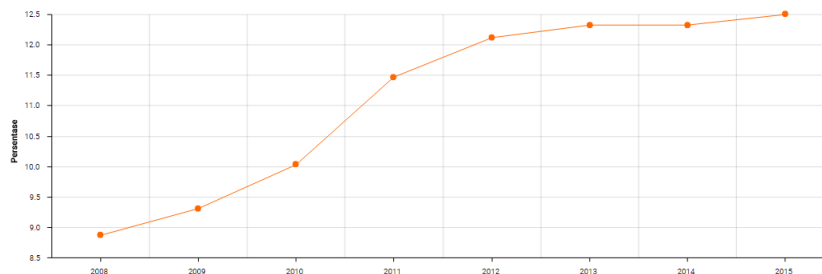
Keterangan:

- o Luas Wilayah Kota Bandung (PP. Nomor : 6/1987) = **16.729,65 Ha**
- o Luas Ruang Terbuka Hijau Kota Tahun 2015 = **2.032,21 Ha**
- o Persentase luas RTH terhadap luas wilayah kota Bandung **12,15 %**

Proporsi terhadap Luas Wilayah Kota Bandung

#	Ruang Terbuka Hijau	Luas (ha)	(%)
1	Taman Kota dan Kebun Bibit	218,07	1,30%
2	RTH Pemakaman	148,39	0,89%
3	Tegangan Tinggi	10,17	0,06%
4	Sempadan Sungai	18,31	0,11%
5	Jalur Hijau Jalan	176,91	1,06%
6	Sepadan Kereta Api	6,42	0,04%
7	Hutan Konservasi	4,12	0,02%
8	Penanganan Lahan Kritis	416,92	2,49%
9	RTH dari Bag. Aset	74,43	0,44%
Jumlah (a)		1073,74	6,42%
10	Potensi RTH Lainnya :		
-	RTH Kawasan Pemukiman	122,12	0,73%
-	RTH Pendidikan	56,18	0,34%
-	RTH Kawasan Militer	114,01	0,68%
-	RTH Kawasan Perdagangan & Industri	225	1,34%
-	RTH Perkantoran dan Gedung Komersial	441,16	2,64%
Jumlah (b)		958,47	5,73%
Jumlah (a) + (b)		2032,21	12,15%

Perkembangan RTH Kota Bandung



6B: we don't have the statistical data here, but we can see from the maps. Yes, it is true that the city of Yogyakarta, has more than 30% green space (from PU green city report), but the composition is made from only public green 16%, the rest of it is the private space. That is why we do the land-buying program.

7B: There is not much public green space in this city, the biggest open space is Alun-alun (main square) and Gembiraloka zoo. The other part of city is very dense, we don't have "the big central park". It is not change much in the past five years. The last period of Mayor has the 1 park 1 kampong program, but the program is discontinued because of the changing mayor.

8B: It is quite surprising to hear that jogja city has that much number of green space (18%) because as far a i can see this city is very dense and quite small, so i don't think the statistic is represented in the real situation. Because I don't think this city has many public green space, so the number might be consist of mostly private green space.

9B: For Jakarta, the government has added more public open space (garden), clean the river banks and transform it to green open space, and many developers have claimed their building as green building.

2. How did the quality of green infrastructure in your city/region change during the past 5 years?
Please explain

1B: the quality of the GI that has been built is vary, depends on the maintenance they performed. In some place the quality of the greenspace is good, because of some community helped to mantain it, but there is some greenspace that neglected or even damaged

2B: increasing, but sometimes citizens still littering too much in green public space

3B: also increasing in quality, but still need good maintenance

4B: there is upgrading in quality in recent years

5B: we try our best to take care and maintain green open space in Bandung

6B: The amount of public green is not much, but the private green area is quite much so we can reach the amount of 30%. There is a lot of plans and programs regarding the spatial planning, but there is lack of implementation.

7B: I don't think the quality change that much. It's quite stable

8B: I think the quality is not changing much, most of green areas maintained well

9B: implementation in green open spaces are good, but I'm not sure about the green building because I don't know about the standard and how they measure whether the building comply the qualifications.

3. How much emphasis does your city/region institution put on the following tasks?

this program includes all the type of activities, from creating, restoring and creating green space

a. Conserving green space and natural areas (Scale : 1 2 3 4 5)

Interviewee BDG	Score
2B	4
3B	3
4B	3
5B	5
Interviewee YGY	Score
6B	4
7B	4
8B	4

b. Restoration of green space and natural areas (Scale: 1 2 3 4 5)

Interviewee BDG	Score
2B	4
3B	3
4B	4
5B	5
Interviewee YGY	Score
6B	4
7B	4
8B	4

c. Creating new green space or green infrastructure (Scale: 1 2 3 4 5)

Interviewee BDG	Score
2B	1
3B	2
4B	2
5B	3
Interviewee YGY	Score
6B	n/a
7B	n/a
8B	n/a

Green infrastructure utilization in planning

1. To what extent green infrastructure has been included in planing regulation?

1B: green city has been included in Short-term National Development Program (RPJMN) target (2014-2019) and some cities has commitment in green city program (through P2KH) or through their own target/program. However, the implementation program is not easy. The main problem is the lack of awareness about green environment and climate change. We want the local government to have the spirit and deep understanding about the green city concept first. Not just build some green parks and follow (the program) as a trend without knowing the actual meaning behind it

2B: there is more public parks in Bandung esp. since Mr. RK being the mayor. Also, there is revitalization program for existing green space

3B: The planning documents (RTRW) have decided which parts are supposed to be green or protected, however in practice and implementation the spatial planning is still far from the ideal condition. The green space that has been built neither well-structured with the bigger environment nor well-integrated with the whole planning and development of the city. What happened now in Bandung, is they built the parks and greenspace without making any structure or having linkage to one another and to the surrounding environment. It is more like a street decoration or revitalize the old and abandoned space.

4B: there is one ongoing projects is in river banks area (since 2005) for creating new green space, but it is very difficult. As we know, there is a lot of illegal settlements (slum) alongside the river (Tamansari, Pasir Luyu, etc). We try to clear up to 4m riverside area from any buildings or human settlements. In Tamansari, the situation is very unlikely because the society rejected to move. But in other case in Pasir Luyu, the society is very welcome with our project and willing to clear up the river banks area.

5B: if it included in policy plan or Mayor's decree then that green space become our responsibility (UU No. 26 Tahun 2007 terdiri dari ruang terbuka hijau publik dan ruang terbuka hijau privat)

6B: there is no legal regulation specifically for GI planning, but in other planning documents (RTRW, RDTRR) we try to always include GI elements on it.

7B: Currently, the GI is not yet being the priority in city's programme. The environmental issue receives less attention in planning regulations. Business and economics are still the main priority, like building new hotels and malls to support the tourism industry, but there are some programmes that started to include green elements. For instance: planting vegetation along the main road. Most of the programme is held by BLH (Local Environmental Agency).

8B: many of parks/green open space being built but more for recreation or aesthetic purpose, not as the whole green infrastructure

9B: As far as I know, RAN API has mentioned about the green infrastructure and so did the RAN MAPI PU (only for the building). But they are not strong enough to push the implementation.

2. Are there formal guidelines or policies that drive the use of green infrastructure in planning?

1B: the P2KH program has green planning and design components, but it's not really regulate strictly, because in P2KH the initiatives to join the program has to come voluntarily from the city/region first. That is the main rule of this program. The green city development program (P2KH) from the Ministry of Public Works can offer guidelines for green infrastructure planning. The program includes 8 attributes of green city development: green planning and green design, green community, green open space, green building, green energy, green transportation, green water, green waste.

2B: not aware

3B: There is general guidelines from Bappenas about sustainable and smart city, but it is hard to define it to the detailed planning document. It is hard because the guideline very general and not clear enough about the parameter, etc. And that might not focus in green infrastructure but only said "sustainable and smart city generally.

4B: Some of the green space happens accidentally, however it is not included in bigger planning regulation. It just appens to be there and somehow gives the benefits to the surroundings area just like a 'real' green infrastructure does. There is a program called 1 RW 1 Architect, where the architect helps to design the neighborhood scale based on the area's potential and inhabitants needs, including green space.

5B: not aware

6B: The particular thing about Yogyakarta, we are the "distinctive" province, thus we have abit different rules in many aspects, including spatial planning. For instance, we have sultan ground, pakualam ground, etc. The local law (perda) will give us more authorization, to manage slum area in river banks, for example. But sometimes we cannot act right away, because we need the permission from Keraton (Sultan's palace), if the area is inside the Sultan ground or Keraton ground. The Sultan doesn't want the frontal movement, so everything has to be done in very polite way. So oftenly we waiting for each other movements. In the past 2 years we did successfully manage the Alun-alun area (big park in front of Keraton, which is one of the main tourist area). We arrange the parking lots and the street vendor so now the area is more tidy and comfortable for walking.

If the laws has been legalized, then we have more authorization power, for instance we want the restoration of the old city fort. We have that possibly could be done if we have the new laws. For the budget, the 'distinctive' province laws, came with more budget to do some of those type of program.

7B: The last RTRW (spatial planning documents), only put the program of planting vegetation in some area. There is no program to build a new parks or new green space, which supposed to be integrated in one particular detailed plan. I never heard any city/municipality in Indonesia has that kind of plan.

8B: local government have their own greening program, but it's not in separate documents. More like inside spatial planning program (RTRW/RDTR)

9B: Yes. The RAN API, RAN MAPI PU, and some regulation from PBL unit in PU.

3. What are the challenges or barriers for green infrastructure implementation in your city/region? Please explain and give examples

1B:

1. Lack of understanding about green city or environmental-based development concept.

There spirit and initiative in this field is still rare and not popular in Indonesia.

- Institution capacity, which explain below: between the Central govt -> provincial -> city/municipal is oftenly miss-coordination, and miss-communication, influenced by many factors.
- cross-sector coordination: the Cipta Karya is the acting chair of this programme but this program includes multiple sector outside their (Hman Settlement Development directorate = cipta karya) territory, which make it difficult to interfere and organize.

2. city characteristic:

- larger city size has more complexcity
- the land use priority (in the city) usually not for green space
- smaller town usually has better implementation because more land and less activity

3. Land:

- sometimes there is difference in land size that stated in the masterplan and built area
- unstrategic location which less accessible from the centre of activity
- different interest in land use program: there is another plan of using the land, because of the strategic location, etc

2B:

1. The limited amount of land: the city is now very crowded
2. The government has not ready yet, they still grow together with the people
3. The policy instrument is unclear: for example what time to cut the trees, etc

3B: in practice, there are some people who seem neither aware of building regulation or any other spatial planning regulation (RTRW/RDTR) nor follow the regulations while building their property. If it has become an issue amongst urban planners and designers, how come some of the building projects have the permit (to build) when the building design is not in accordance with the regulation?

4B: The main challenge is in each area, the society is different. There is differs responds to the green design projects. Some of them will welcoming the green projects, some others will reject. Tamansari area is the most extreme one, because the people is totally reject any kind of settlement upgrading program.

5B: n/a

6B:

- climate change brings more rainfall, so that affected the built infrastructure (roads).
- Limited budget
- Limited number of civil servants and lack of capability
- Legal aspect: political will from the current leader is not prioritizing spatial planning

- There is lack of implementation of the plans that have been made. Often the plans is just being made without any follow-up
- Awareness: the people is quite aware of changing, but they not take action or have initiative to make movement (gotong royong). They tend to be more “spoiled” and wait for the government to take action.

7B: The main challenge is: the government did not make the green infrastructure as priority for spatial planning. In general they don’t have much attention for spatial planning, moreover to the green aspect.

8B: Even though the greenery has many benefits for human life, it might not really suitable with Indonesia’s society preference. When it comes the hotter days, they choose to buy AC (air conditioner) besides plants more vegetation or creating tree shades etc. thus, it makes green infrastructure seems least favorite for the people here, besides it takes quite some time to grow plants.

9B: a) The expensive cost for building materials, b) the land acquisition conflict (related to the create the green open space)

4. What is going well with the green infrastructure implementation in your city/region? Please explain and give examples

1B: Within the past 5yrs, we can say that City of Malang (East Java) has good progress in implementing green infrastructure. There are quite number of green space and active community that maintain those green space with various activities.

2B: In past few years, to be exact since Mr. RK (Ridwan Kamil) being the city mayor, I can see there is more public parks in Bandung. Nowadays the urban parks here start to feel alive again. There is quite some improvement about green space quality and quantity in Bandung

3B: there are improvement and upgrading in green space since RK become mayor. Many new parks being built although not all the space focusing in green vegetation or aiming in shaping urban climate.

4B: I think since Ridwan Kamil become city mayor, we can see there is improvement in green space in Bandung. The most recent are restoring the old green space and sidewalk renovation, especially in Juanda street and Riau street.

5B: not aware

6B: There is Kampong hijau (green kampong) program, arranged by BLH (dinas lingkungan hidup). Each kampong (RT/RW) represents the district, for environmental aspects and socio-cultural aspects. It is emphasizing in greening the area (with hydroponic and hanging gardens, etc) and municipal waste-management. Also, Ecodistrict program (continuity from P2KH program): is one of our succeeding program, which mainly focused in riverside area. But the scale is very small, we divided the segments of the riverside. Each segments has their own function, such as for inspection road and public green area. There is three main principle, 3M (mundur, munggah and madep sungai). Mundur (the literal translation is: step back) means the buildings has to move back behind the line of river safety area, so we have more space in the riverside and also for water stream when it’s flooding. Resilient city program : more focused on disaster mitigation and to recovery after the disaster (earthquake, volcano eruption, flooding etc). We also redesign the Malioboro area (famous street-shopping area), to be more pedestrian friendly. We removed the on-street parking and street vendor from the sidewalk and made the new parking building. We do this gradually (per segment), and hoping someday the whole street is car-free area. It is not an easy task because they have been there for years, but with the help from Keraton, people are tend to obey the rule.

7B: Kampung greening: planting more vegetation (for food and for decoration) >> Kampung Patehan urban farming. Some heritage tourism place t also served as public green space such as the city square (alun-alun), Kasultanan palace (keraton), old area in Umbulharjo street and Malioboro (famous tourist place) street sidewalks. The maintenance of those area is quite well, because there are the tourism icons of Yogya.

8B: There is some parts of the city that has been renewed, for instance: in Malioboro street (from Galeria to Kali code bridge), they removed the on-street parking area to become pedestrian and put more vegetation. Another one is in Lempuyangan street, the vegetation is quite large, and the canopy is quite large too so it is comfortable for pedestrian. But the vegetation in Lempuyangan area is been there since colonial era, therefore the trees is very big now.

9B: The strong commitment and political will from government as the decision maker, otherwise we can't do anything.

5. What innovation that have been involved in planning green infrastructure as climate adaptation is this city/region? (including: abiotic, biotic and cultural function of GI)

1B: the main rule in built the green space in this P2KH program is 30% hardscape and 70% softscape. Thus the nature area become the main priority in green space and will have more ecological function than before.

2B: The green space is used more for socio-cultural function, such as there is some community that use the space to have music event or other creative event. The activities are more focused in community or society engagement.

3B: there are no programs that specially designed for climate adaptation. However, some environmental-related program like slum upgrading, riverbanks normalization, green parks can have adaptation measures in it.

4B: smaller-scale projects in upgrading urban kampungs (sub-district), such as cleaning and upgrading Cikapundung river banks area

5B: not aware

6B: One of our program is, to buy the unoccupied land (100-200m) every year in each kampung (kelurahan) to be converted to public and green space to achieve the 30% of total green space in the city. Currently we have around 20 locations have been made from that program. The program starts in 2000s. The problem is the city is very dense and crowded, so it is not easy to find the space and the land price is quite high too. So, our strategy is to find the small lot inside kampungs (not the one in the main road) to give the dense area more open space that they rarely had. It will be a multi-functional space, not only for green area, but also can be a place to gather and for evacuation area (Yogyakarta had severe from earthquake and volcano eruption frequently). Those small lots also affordable within government budget, so we think this program is feasible. Our goal is someday each kampung will have their own public green space.

7B: slum-upgrading in riverbanks in Kali Code

8B: In the touristy area, such as Malioboro and Keraton, there are previous research that seen the PET and UHI level is high. Therefore, the greening program in Malioboro area is very good to reduce the urban heat and makes the environment adapt to climate change. Recently there are new park in the

southern area, Umbulharjo, but it has been built not for climate adaptation, but for recreational functions to attract income from visitors. The main objective is to create economic activity.

9B: In Jakarta, the government removed the slum areas from riverbanks area and make it as green space now.

6. How to improve utilization of green infrastructure for climate adaptation?

1B: local and national government should put more priority for GI in their development program and from there try to develop and improve climate adaptation policy

2B: First, we have to find the habit and significant meaning of green infrastructure for Indonesian people, because now I did not see the people have the stewardship to the greenery yet. We have to find our original position first (our origin), what are we, who are we. Do not just copied the western system, it is all can be done by research. Stop comparing Indonesia with western country, we should have our own typical research, the development that corresponds to our characteristics. That is our main weakness, lack of research. The civilization level is different.

3B: hot and humid climate in Indonesia, leading people to choose to do activities indoors. if you ask people which one they prefer, having lunch in the park or inside an air-conditioned cafe, most likely they will choose the cafe. Indonesian people are not growing fond to green open space. We should include local wisdom more and more into green infrastructure planning and climate adaptation. Also, create green space as an infrastructure, not just as street decoration or tourist attraction. Thus, the greenery can shape the urban climate and reduce the urban heat island.

4B: green infrastructure is important to shape the urban climate and reduce the urban heat island, esp. in humid climate like Indonesia.

5B: n/a

6B: For climate issues, we still learning by doing. Because recently there is restructuration in the city's government institution, so we try to manage it gradually. Maybe for now there is not yet an exact planning or regulation for urban climate adaptation, but we began to incorporate the environmental value into our spatial planning.

7B: make more campaign or program about "green city" or "healthy city" and give the comprehension about what it really is. Also more cooperation about environmental issues with university/research. Don't make it just as a "project" in a short time. Education to the citizens through media, social-meetings etc. Every stakeholder has important role: collaborative planning is important, including in green infrastructure.

8B: Urban planner has to have more knowledge and initiative, to include the climate and environmental measures in the spatial planning practices.

9B: Maybe we can start it by having a good understanding about climate change itself and also the impact, so that we can figure out what we need to do to adapt it, especially for urban context.

Managing Uncertainties

1. What kind of uncertainties do you think might happen in the future regarding urban green infrastructure and/or climate adaptation issue? How to overcome this uncertainties?

1B:

- a. there is possibility to discontinue the P2KH program in next presidential period, because it depends on the order of next minister/president
- b. the development focus is still prioritized for socio-economics objectives
- c. the link between green infrastructure and climate change is not explicitly defined in the documents, so it might affect the process of implementation

2B: But I think we should re-evaluate that program, whether those parks are really needed? Are Indonesian people likes hanging out in the park? I don't think so. Some of those parks are just for taking pictures and then people leaves, go to mall, cafe, etc. I don't think the parks are suitable with Indonesian habit and fondness, because we have sunshine all year long, unlike in the western countries. Urban citizen is tend to avoid the sunshine. Therefore social approach in Indonesia is different than western countries. The theories like french garden is unsuitable to be implemented here, because people will ask what it is for, and maybe littering on it.

3B: the term sustainable development that they know is still a slogan or gimmick for the development products. There is lack of understanding about the true meaning behind sustainable development. The hardest challenge is to shift their mind set, because the environmental-based development might be less profitable in the present (but sustainable for the future). For developing countries like Indonesia, the focus of development is in economic growth. The awareness and attention for environmental issue like urban climate adaptation or climate change is still low.

4B: there should be clear definition about green infrastructure and also understanding its relation to climate adaptation, why is it important. Because environmental issues is not really favourable in Indonesia, rather that economic or political issue.

5B: not aware

6B: changing in political and government structure is slowing down the concrete implementation work. a. For instance, back then in 2008-2009 in previous mayor period, we have car-free day program (every Friday) in this government complex. That program is quite successful, as we can see the society followed the movement by (mostly) biking for their daily activities. So, we made the bike lane along the main road. But the car-free program is discontinued (in the current mayor period) and nowadays the number of bike is decreased drastically, more and more people choose the motorcycle.

7B:

- Urbanization, growing population, the need of housing and decent space
- Economic issues: the development is still business-oriented, how to raise the local income (PAD) because the city is lack of natural resources, so they focused to build the city as economic-business and tourism centre without concern into planning and environmental issues.
- To overcome: planning practices has to become more smart, not just focused on raising the economic activity. Spatial planning has to be a priority in a city. The most important is the willingness from the leader (city mayor in this case). Take Surabaya as the good example. They now have more green infrastructure, and become more liveable city.

8B: The development and planning is still in business-economic oriented. So, the land has to generate revenue. To resolve that, we had to “do the trick”. The good case is happened in Umbulharjo area, where there was a rice field near a lake wants to be converted as commercial buildings, but the society refused because they afraid the water source will be diminished. At the end, the government realized they need to concern about environmental function of the area, and built a park. The park can be used as water catchment area and also for recreational functions. Therefore, it will be advantages for all.

9B: The political condition. For example, I am not sure that the new elected governor will continue the work of CC adaptation in Jakarta. How to overcome: we need the voice of the experts to keep pushing and educating others and government about this thing.

2. Will these uncertainties influence the planning and implementation process? If yes how?

1B:

- Uncertainties in climate change or anthropogenic issue
 - lack of commitment for maintenance and sustainability
 - lack of environmental-minded culture
 - vandalism and damaging the green facility
 - climate change is highly uncertain
- Wicked socio-political or institutional context
 - the green city program is not on the main priority of the government, thus there is not much funding for this type of program
 - lack of initiative and awareness about green issues in government level
 - lack of institutional capacity for the implementation
 - there is not yet one institution appointed for supervision of the built area, because once it has been built, the PW ministry did not provide any supervision

2B:

- a. Uncertainties in climate change or anthropogenic issue: the habit urban-villagers has not changed yet. Development-boom that happening in Indonesia now, everything is built without concerning into sustainability issues.
- b. Wicked socio-political or institutional context: too many intervention from different interest / stakeholder. Each province and city is unique, the diversity is very broad, therefore the socio-anthropology aspect is very crucial for development in Indonesia.

3B:

- a. Uncertainties in climate change or anthropogenic issue: we still doing business-as-usual development, not yet sustainable development minded
- b. Wicked socio-political or institutional context: political leaders sometimes not support the implementation of climate

4B:

- c. Uncertainties in climate change or anthropogenic issue: climate change is highly uncertain and the awareness about that issue in Indonesia is still very low. The urban development in Indonesia is still conventional rather that sustainable.
- d. Wicked socio-political or institutional context: lack of policy/legal documents to support and guide the implementation of green infrastructure

5B: n/a

6B:

- a. Uncertainties in climate change or anthropogenic issue: climate change issue is very advance and not many people (esp. civil servants/public) really understand what it is about. It makes the possibility in the future (regarding this issue) very broad and uncertain
- b. Wicked socio-political or institutional context: program implementation is highly depends on City Mayor and Sultan (governor). Many programs are being discontinued after changing the city mayor. For instance, back then in 2008-2009 in previous mayor period, we have car-free day program (every Friday) in this government complex. That program is quite successful, as we can see the society followed the movement by (mostly) biking for their daily activities. So, we made the bike lane along the main road. But the car-free program is discontinued (in the current mayor period) and nowadays the number of bike is decreased drastically, more and more people choose the motorcycle.

7B: The leadership factor is very important. Here in Yogyakarta, the governor is Sultan, so the city-mayor has limited authority to take actions and make decisions. Moreover, Yogya know as famous tourist destination, so may new development area built to support the tourism business activity

8B: many natural disaster (earthquake, volcanoes, etc) could happened. Therefore, more of the research projects here focusing on resiliencies of disaster regarding climate change.

9B:

- a. Uncertainties in climate change or anthropogenic issue
Yes, because no one know about the future climate. All we know is only the assumptions and forecast about how the climate is going to look like in the future, but no one can guarantee that.
- b. Wicked socio-political or institutional context
Yes, as I mentioned in the previous question. And also the “political interests” which most likely drive the politic conditions and affect the CC adaptation plan.