Participatory Public Space Design Strategies for Water Sensitive Cities: Experiences in Bogor, Indonesia

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Abstract

Rapid urbanization and water scarcity in Indonesian cities are fuelling the demand for more diversified water sources to meet demand (ADB, 2016). The sustainable use and appropriation of public spaces in Indonesia is one of the lowest in the world (Althoff et al, 2017). This is partly because of the lack of connected and enjoyable walking tracks and open spaces, and lack of a more sustainable and integrated urban design approach including water and vegetation that can interact as active agents for the filtering, cleaning and reduction of stormwater runoff and greywater into the main urban streams or for re-use purposes (Tanan & Darmoyono, 2017). This paper presents the experience of a participatory approach applying a Water Sensitive Design Framework (Wong et al, 2012) to the design of public open spaces in the city of Bogor in Indonesia, with a focus on the active transformation of public space with Green-Blue Infrastructure as a catalyst for community integration, environmental recovery and resilience to the recurrent floods affecting most Indonesian cities and other environmental stresses. The Water Sensitive Framework aims to build more water sensitive cities and neighbourhoods, working alongside communities towards these goals. Community Visioning, Benchmarking and Scenario planning strategies have been used to understand local issues, determine the potential for change and explore the actions and roadmap needed to achieve the desired future in their communities to ultimately leapfrog to a more water sensitive future.

Keywords: Water Sensitive Urban Design, Public Space Design, Participatory Design, Water Management, Green Technology

Introduction

1. Introduction: Urbanization, Water systems and Case Study context

The relationship between human activities and water also indicates the impact of urbanization on the environment (Atlhoff, 2007), and the way that cities manage their water sources (including potable water, wastewater and stormwater runoff) shows the degree of sensitivity of a certain population or city towards the use of the natural resources. Many cities around the world who are affected by water shortage and water pollution are looking for ways to become more water resilient as well as improve their ability to adapt and mitigate the impacts of flooding or drought in their territories. Public spaces play a very important role in urban areas as a vital part for the interaction between people and communities, and their design can be a powerful tool to achieve vital and thriving cities, where communities interact in a more sustainable way with their natural resources such as water (Whyte, 1980; Dovey, 2005).

The Australian-Indonesian Centre - Urban Water Cluster (AIC UWC) project aims to support the transition of cities in developing countries to becoming more Water Sensitive. In such a city, water management is closely related to ecosystem services provision, environmental recovery and sustainable urban design. The area of intervention is Bogor City, a city of approx. 1 million inhabitants located on the island of Java, Indonesia. The city was selected because of its differing spatial, social and economic characteristics Four case study areas were thus selected, two in Bogor City (Pulo Geulis and Griya Katulampa) and two in Bogor Regency (Cibinong and Sentul City), each depicting different spatial and socio-economic characteristics. This paper will focus in the participatory process for engagement of the community of ***Pulo Geulis*** in the revitalization strategy which uses Water Sensitive Urban Design, which includes Green Infrastructure strategies to improve the social, economic and environmental conditions in this informal area where water management is concerned.

Pulo Geulis is an informal settlement in the central area of the City of Bogor, Indonesia, located in the middle of the Ciliwung River, with a population of approx. 2600 people and an area of 3.6 Ha. The island is extremely dense and has virtually no public spaces, only narrow alleys to access to the houses. The community is well organized and have a strong sense of belonging to the place and their multicultural values. Some parts of the island have access to potable water infrastructure provided by PDAM (local water service). Water from the river is used by some members of the community for washing and bathing, despite the high level of pollution of the affluent. Most houses in the island have a septic tank for wastewater management, however, some houses located at the river edge throw their waste water (black water and grey water) directly to the river using long pipes (see Figure 1, right). Alternative sources of water supply such as rainwater harvesting are currently not used. Figure 1 illustrates the island location and systems.

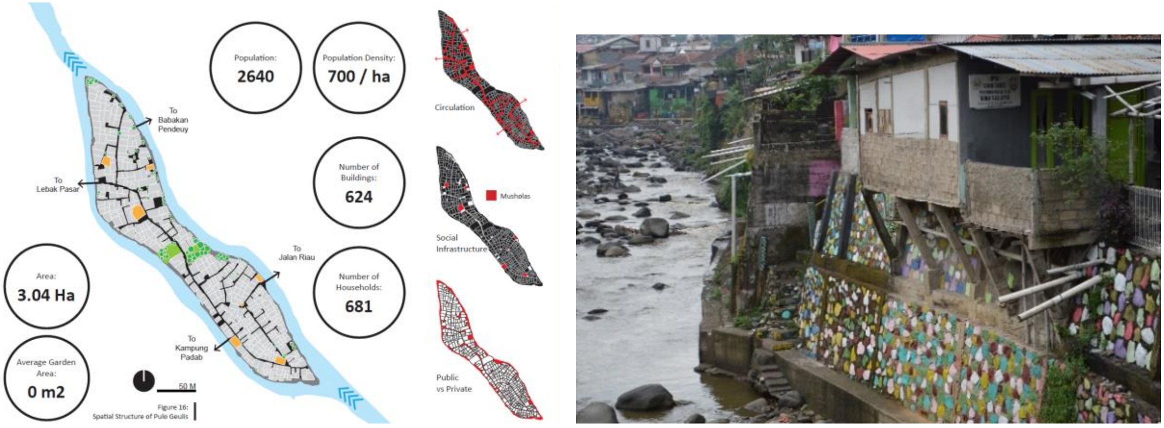


Figure 1: Pulo Geulis location, systems (left), and household wastewater discharge to the Ciliwung River (Right) Credit: Raul Marino

The following sections will present the framework behind the social and physical analytical tools used in this research and the Green Technology and the Water Sensitive Urban design solutions co-designed with the Pulo Geulis community to support their transition to a more water sensitive community. The key sections of the paper are:

- Literature Review: Water Sensitive City (WSC) and Leapfrogging framework
- Participatory urban Design review
- Green Technologies Review
- WSC Benchmarking Review
- Visioning Workshop methodology
- Urban Design Workshop methodology
- Main findings and recommendations for participatory informal settlements upgrading with WSUD.

2. Literature: Water sensitive city and leapfrogging

The Water Sensitive Cities (WSCs) framework is comprised of three pillars that promote resilient and sustainable urban water systems that positively engage the community (Wong et al, 2012). The first pillar considers a city as a water supply catchment in which access to a variety of water supply sources at multiple scales is readily available. The second pillar considers urban water systems that provide ecosystem services which enhance and support the natural environment. The third and last pillar considers communities that have water sensitive key decision makers and in which water has socio-economic capital (Wong et al, 2013). The WSC framework promotes diverse solutions that incorporate a blend of centralized and decentralized technology. WSCs display thriving and liveable green and blue spaces which are both enjoyed by the community and an integral part of the water catchment (Brown et al, 2014).

Unfortunately, there are many cities that are not considered water sensitive and many cities which have not always been. For many WSCs the path to becoming water sensitive commonly included pollution intensive and/or unsustainable stages. The concept of leapfrogging describes the potential for a city to jump over undesirable development stages on their path to becoming water sensitive (Binz et al. 2012; Sauter & Watson, 2008). It is common for authors to frame the concept of leapfrogging in the context of a developing country, e.g. Binz et al. (2012) define leapfrogging as "a situation in which a newly industrialised country learns from the mistakes of developed countries and directly implements more sustainable systems of production and consumption, based on innovative and ecologically more efficient technology". However, the leapfrogging concept is more broadly applicable and may be conceptualized as "*the idea that there are new paths to higher standards of living which bypass the mistakes that other communities made"* Jefferies and Duffy (2011). Of particular relevance to the WSC framework, Wong (2016) states that leapfrogging is about "*capturing and building on advancements and innovations in policies and technologies achieved in other places and avoiding the traditional evolutionary approach to infrastructure development and management."*

3. Literature: Participatory urban design and water

An important advance in urban planning in recent years is the understanding of the importance of community involvement and understanding of social structures in the process of urban planning and design (Fisher, 2007). Many urban theorists from Jacobs (Jacobs, 1961) to Gehl (Gehl, 2010) have highlighted the value of analysing urban social networks, people based urbanism to provide cities with more vibrant, and community based planning. The top-down ideas of early planners to address the problems and growth of cities (Le Corbusier, 1942; Moses, 1955), may not be the best approach as these have led to communities in many cities around the world affected by segregation, gentrification and lack of access to inclusive public spaces vital for social interaction and wellbeing.

One of the main aims of this research was to provide a better and more connected urban design framework to promote the sustainable use of the public space in Bogor. One of the main indicators of the successful design of public spaces is the Walkability Index (Giles-Corti, 2003), which measures how amenable a certain area is to walking. Factors influencing walkability include the presence or absence and quality of footpaths, sidewalks or other pedestrian rights-of-way, traffic and road conditions, land use patterns, building accessibility, and safety, among others. Walkability is therefore an important concept in sustainable urban design. The design of urban spaces can be done in several ways, from more top-down planning frameworks to more bottom up approaches that involve the community in the conceptualization, design, construction and management of public spaces and pedestrian ways. This approach has proven to be a more successful way to provide cities with public spaces that are more suitable and adaptable to the specific needs and cultural identity of their communities (Gehl, 2010; Dovey, 2014). This concept was explored with the Pulo Geulis community to obtain their feedback on how to improve the current and future public space of the area. Solutions also include the use of Green Technologies to provide water treatment (so as to reduce its environmental impact) and to increase community amenity.

The manner in which the community can be engaged and thus become an active participant in the design and transformation of urban areas has also progressed in recent years. It has evolved to include better ways to achieve an effective community participation that goes beyond that of a mere consultation process, which is what happened in many governmental campaigns of community outreach (Chambers, 2008). Sociologist and social workers have explored community interactions and the ways that the built environment affect people's lives and the functioning of streets, neighborhoods and cities (Sennett, 2006; DeCerteau, 2007). Another interesting contribution to the debate in recent years has been the inclusion of environmental psychology studies that improve our understanding of the psychological processes behind the way that communities engage with the environment. The leapfrogging (to water sensitive cities) strategy focuses on the use and engagement of water bodies within urban areas, creating cities that act as catchments and foster environmental and social transformation (Gifford, 2014; Low, 2016).

4. Green Technologies

Greenery has long been a feature of public spaces, typically in the form of trees, garden beds, lawns or potted plants. Green water treatment technologies can serve the same aesthetic purpose, whilst also providing multiple additional benefits. These vegetated systems include biofiltration systems (also known as biofilters, raingardens), green walls, green rooves, wetlands, ponds, detention basins and swales. Systems harness the chemical, biological and physical processes associated with plants, the microbial community and substrate (such as sand) to provide water retention and/or treatment. Stormwater runoff and in some cases 'light' domestic greywater (from the bathroom sink and shower or bath) are directed into the system where pollutant removal and flow attenuation occur, acting to mitigate the impacts of pollutants, excess flow and flooding on downstream environments (Hatt, Fletcher, & Deletic, 2009; Ladson, Walsh, & Fletcher, 2006).

Other benefits of green infrastructure include cooling of the urban microclimate (Coutts, Beringer, & Tapper, 2007), enhancing air quality, biodiversity (Kazemi, Beecham, & Gibbs, 2009), providing community education and, if present as a vertical system on a building façade or as a green roof, thermal insulation of the building (thereby reducing cooling costs) and in some cases noise mitigation (Horoshenkov, Khan, & Benkreira, 2013). Treated effluent can be reused for suitable purposes, such as toilet flushing or the irrigation of public green spaces such as ovals or parks (Fletcher, Mitchell, Deletic, Ladson, & Seven, 2007). In some cases biofiltration systems or green walls can be planted with vegetables, providing opportunities for urban agriculture and community gardens (*Cities Farming for the Future, Urban Agriculture for Green and Productive Cities*, 2006). The amenity value of greenery in public spaces is associated with documented benefits to human health and well-being of both the individual and community (Jackson, 2003; Swanwick, Dunnett, & Woolley, 2003). For example, attractive public open spaces and green environments promote walking, positive emotions and psychological well-being (Chiesura, 2004; Giles-Corti et al., 2005). The amenity benefits of green technologies also increase property values (Polyakov, 2015). Finally, at the very least, these passive systems can be self-watering gardens. Hence, green water treatment technologies provide multiple economic, human health and environmental benefits.

For optimal function, it is critical that the application and design of green water treatment technologies is adapted to suit the local context (Loh, 2012; Payne et al., 2015; Shaw & Schmidt, 2003; The Prince George's Country Maryland, 2007). Before technology selection, the objectives must be clearly defined. Understanding community needs and preferences, water use, management and the quality of water sources discharged to the environment is important. Space availability, maintenance requirements and cost are also key factors. In addition, technology selection and design must suit the local climate (including the intensity, volume and frequency of rainfall, temperature fluctuations, evapotranspiration and seasonal variation in these parameters) (Wang et al., 2017); vegetation (including availability at local nurseries); local site characteristics (such as slope, soils, groundwater proximity) and the availability of materials, including the media (see Figure 2).

In the context of Indonesian cities such as Bogor, there are both opportunities and challenges for green technology selection and design. For example, the tropical climate provides warm growing conditions for high plant growth and productivity year-round. Relatively regular rainfall minimises the likelihood of drought-stress, benefitting system functioning. However, the intense and high volume rainfall will require systems sized for a high treatment capacity and careful consideration of clogging potential and pollutant accumulation (Kok et al., 2016; Sidek, Muha, Noor, & Basri, 2013). Other challenges include the high density urban environment, with limited space for systems, the direct discharge of untreated wastewater into rivers and a high litter load, requiring pre-treatment systems (Mosyaftiani et al, 2017). On the other hand, the ornamental value of greenery is highly valued in Bogor, suggesting the local skills, community support and nurseries are available to support green technologies implementation. In addition, in the Indonesian context higher economic benefits may be associated with plants grown in green water treatment systems, relative to more developed countries. The scope for plant harvesting for consumption (if vegetables or fruit), fiber or fish food may contribute to significant economic benefits. Thus if green technologies are carefully selected and adapted to maximise their functioning in Indonesian cities, their multiple environmental, economic and social benefits can be realised.

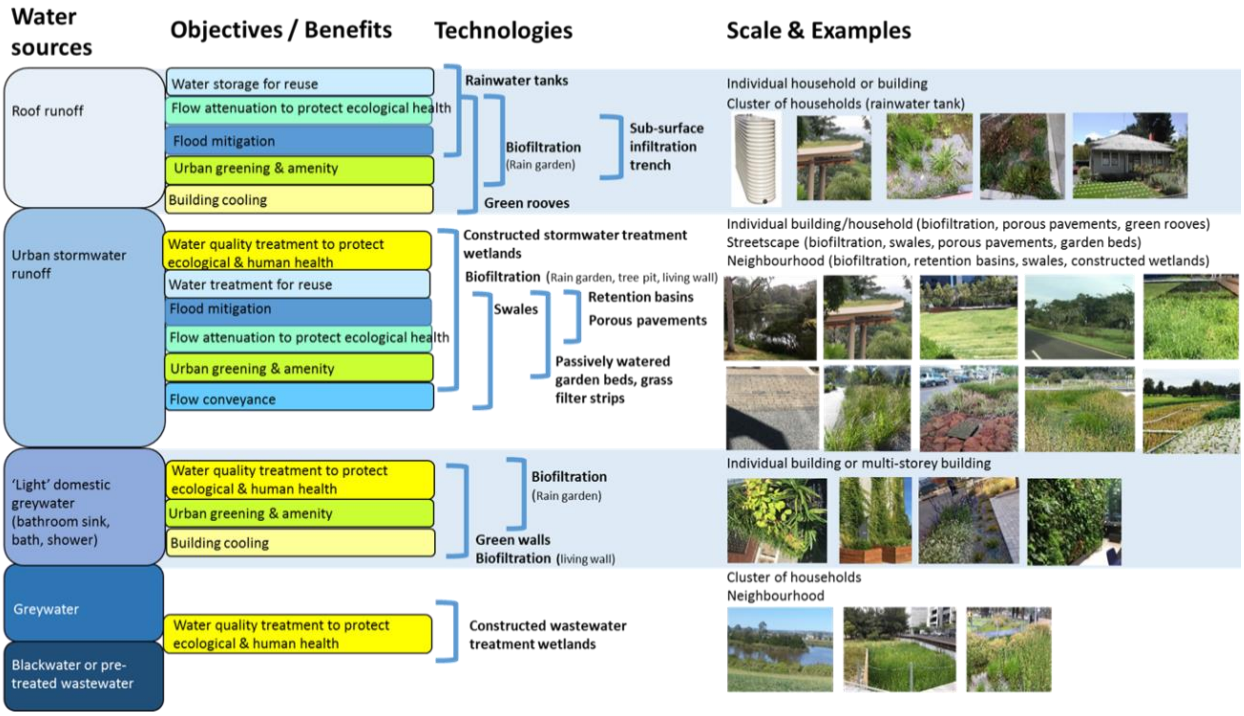


Figure 2: Matching the treatment of various water sources with the different objectives or benefits that can be achieved, and with technologies to achieve these targets (Credit: Payne & Fowdar, 2018)

From a water management perspective, green technologies provide a wide range of functions such as water quality improvement, waterway protection, flow conveyance, runoff reduction and flood control. In a water sensitive city, green technologies integrated with strategies for public open space will provide the best ecological and amenity benefits. This can be achieved by successfully combining landscape design and urban planning. For example, green technologies can be designed to effectively blend with the surrounding landscape through their choice of vegetation. Ideally, the choice of plants to use in these systems will not only consider their local availability, adaptability and pollutant removal capabilities but also their potential to contribute to the character and amenity of the surrounding landscape. For instance, the stormwater biofiltration guidelines in Australia recommend that 50% of plants be selected according to their nutrient removal performance while the remaining 50% can be selected based on their other amenity functions (Payne et al., 2015).

Green technologies can be incorporated across a range of landscape scales from residential gardens, local parks to road strips and highway verges. For instance, street trees (tree pits) can be used to infiltrate runoff during a storm event whilst providing other amenity benefits such as shade for the local community; bioretention swales can be incorporated along road strips to convey storm runoff and provide greenery; biofiltration systems (or raingardens) can be implemented into public parks for treatment of runoff from nearby roads and footpaths and the treated water re-used for irrigation of the surrounding open space. Indeed, in a city such as Bogor where access to clean water at an affordable price is often problematic, incorporation of treatment measures with a water harvesting function can help supplement water for urban farming and fish farming practices. Retention ponds used to control peak storm flows can also serve as public recreational areas at other times.

Finally, communities have a vital role to play in the success of green technologies, so consultation and discussion is vital in every stage of planning. Increasing awareness of the benefits of green technologies through community education and by developing on-ground examples will, undoubtedly, drive uptake of these water sensitive strategies in Bogor.

5. Benchmarking as a tool to assess WSC index

The purpose of the benchmarking methodology is to assess a city or a metropolitan area against a range of urban water indicators with the water sensitive city index. The water sensitive city index provides stakeholders with a tool that allows them to assess, monitor and ultimately improve their urban water management practices by identifying and prioritizing strategic management responses (Chesterfield, Urich, Beck, 2016). To this end, the next section will elaborate on a selection of preliminary findings that are most relevant for understanding public urban space design in Bogor, Indonesia.

The Water Sensitive City Index is a benchmarking tool that is developed by the Cooperative Research Centre for Water Sensitive Cities (CRCWSC). While the development of the Water Sensitive City Index is ongoing, it has already been applied in a range of pilot sites in developed and developing country contexts (Chesterfield et al., 2016). The Water Sensitive City Index comprises 7 thematic goals and 34 indicators which represent important elements of a Water Sensitive City across social, technical and ecological domains (see Figure 1). Scoring for each indicator was conducted in a stakeholder workshop that involved participants from government agencies, utility companies, planning departments and community representatives. The workshop was set up as a facilitated dialogue in which all participants share their views on water management issues and qualitatively score each indicator as a group from 1 to 5.

Important insights emerge when participants discuss the ratings in the context of their city, share different and sometimes diverging perceptions and elaborate on why they have given a particular score. It is this type of information that provides the rich contextual insights on strengths, weaknesses and priorities around Water Sensitive City attributes.

Regarding the indicator “connected urban blue & green spaces” workshop participants highlighted that the many public parks of Bogor are an iconic feature of the city. In particular, the botanical garden in the city center was seen as a key element of Bogor’s urban footprint. Different workshop participants highlighted its cultural (e.g. identity of Bogor) and ecologic (e.g. high biodiversity) significance. More generally, however, participants noted that many parks do not provide a lot of access and engagement opportunities. They are often fenced and designed to be ‘looked at’ rather than to facilitate a more engaging experience. Participants described them as “ornamental” with limited access or recreational opportunities.

Regarding the indicator “connection with water” the benchmarking workshops revealed the strong connection that citizens of Bogor have with their urban lakes (‘situs’ in Indonesian Language) and rivers. The situs fulfill a dual function of flood retention and irrigation purposes as well as providing recreational and amenity benefits to the general public. In particular, workshop participants highlighted their importance for fishing, which can help to support their livelihoods, as well as community interaction.

Finally, for the indicator “Public engagement, participation & transparency” participants pointed out that citizens are generally informed about certain outcomes in urban and water system planning if these decisions directly impact their livelihoods. However, meaningful participation opportunities in the decision-making process were perceived as weak and community engagement only done when certain decision-making outcomes need to be negotiated or discussed (e.g. compensation payments or resettlements). Participants pointed out that in most cases, community NGOs or local community leaders are the ones involved in public engagement and participation processes rather than the general public or the community at large.

6. Visioning, Scenario and Urban Design Workshops

The island of Pulo Geulis in the Ciliwung River in Bogor was selected as one of the demonstration sites for the AIC Urban Water Cluster project. The area was selected following a set of criteria comprising level of water management, location, socioeconomic level and others, as explained in the first section of this paper. The area is an old informal settlement located in a small island close the Botanical Garden at Bogor, upstream of the Ciliwung River. The participation process selected for our interventions design consisted of three main steps: Visioning, Scenario Workshop and Urban Design Workshop. In addition, the learnings from the benchmarking FGD described in section 5 provided important information for the evaluation of the area's environmental performance related to water issues. The Visioning workshops consisted of three steps: the Community mapping, the Problem/solution tree and the Transect Walk. Each of these tools will be described in detail in the next paragraphs, and figure 3 shows the social and spatial analysis tools used in the project (see Figure 3).

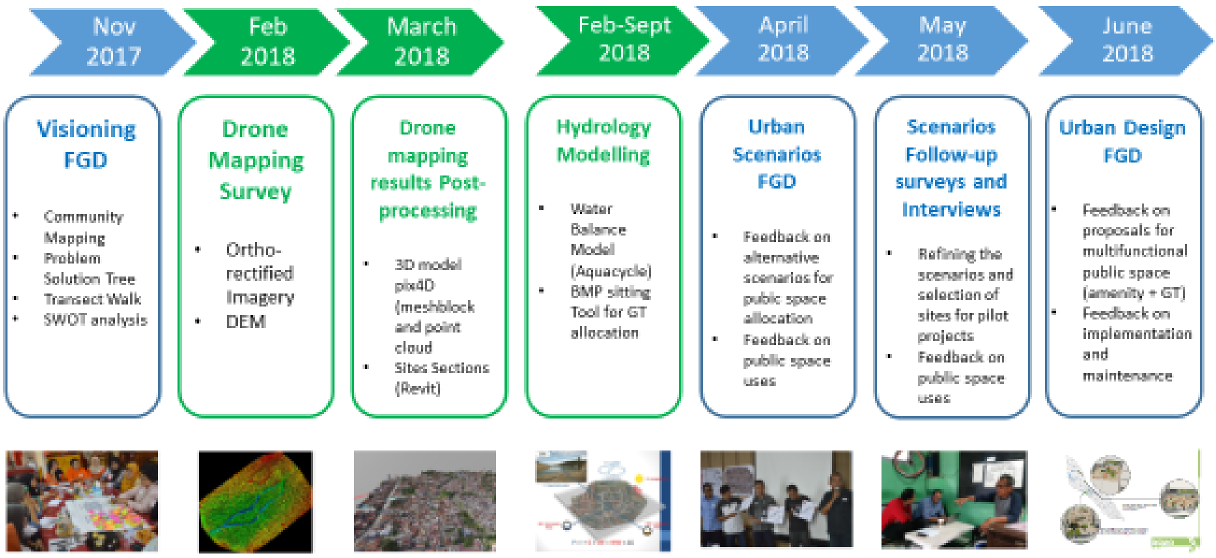
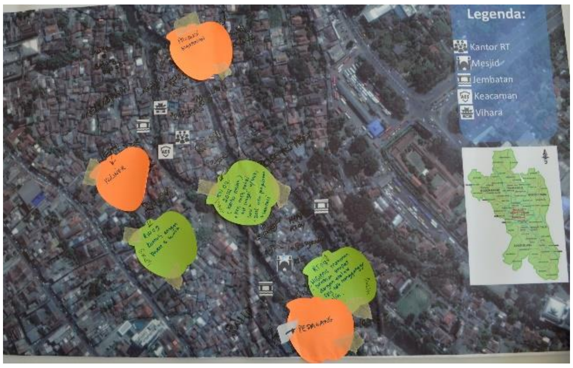


Figure 3: Spatial (in Green) and Social (in Blue) analysis tools and methodologies AIC UWC in Bogor

Understanding the community needs and aspirations: Community Mappings and Problem-Solution Trees

Community mapping is a valuable tool to visualize and locate geographically the main problematic and potential areas for intervention within the community land areas (Panek & Sobotoba). It allows the community to engage in the recognition of their territory and correlate certain aspects of their daily life with larger impacts on the natural environment. The activity used a big format satellite photo of the area as a tool for discussion and mapping of issues and opportunities in Pulo Geulis. In order to get a wider variety of inputs from different perspectives and daily life experiences in our areas of intervention, the community participants were divided into 3 main groups: Women, Men and Youth (a sample of the Community mapping outputs can be seen in Figure 4 and 5).



Figures 4 and 5: Samples of the Community Mapping and Problem/solution tree from Pulo Geulis Community FGD

The next step in the workshop was to identify the opportunities and challenges for urban design and sustainable water management. A problem/solution tree tool was used to achieve this. The actions needed to address the identified issues in the most feasible manner were also determined (see figure 5). Among other factors, the success of the activity is reliant on the role of the facilitators in engaging with all members of the group so that they are able to express their opinions, identify the links between problems' roots and causes, and put forward possible solutions to address the problems. The facilitators moderated the activities in the local language (Bahasa) and employed their experience in the field of social work and environmental studies to ensure the successful conduction of the activities.

Finally, the focus groups were asked to participate in the Transect Walk exercise. During this exercise, each focus group conducts a site visit to again identify potential places for intervention, -building upon the information gathered from the Community mapping exercise. Conflicting situations or possible transformation sites in their neighborhood are thus identified. The Transect walk route was decided with the participants of each focus group, and ideally covered most of the pre-identified places where the community have special interest in improvement or positive transformation with the use of Water Sensitive Urban Design and Green Technologies.

Engaging the transformation actors: Scenarios and Urban Design Workshops

One of the most important factors for the success of the leapfrogging strategy is to understand the rolls and organizational structures of all stakeholders involved in the process, from public to private sectors and also community leaders. A series of interviews were held with key stakeholders within the local and regional government sectors (Kota and Kabupaten Bogor) including the departments of planning (BAPEDA), Environment, and Water, Sanitation, Infrastructure and other departments relevant to the research. Also, interviews with private stakeholders involved in the process such as private developers (Sentul City Management) and decentralized agencies in charge of water management such as PDAM were held. The interviews were designed as semi-structured interviews with open questions to allow the interviewees to express their opinions and comments freely. Most of the interviews were held in the local language (Bahasa Indonesia) with the help of local translators and facilitators from the academic institutions associated to the research project (University of Indonesia, and IPB). The information collected at the interviews informed the structure and content of the leapfrogging strategy and gave a more solid and locally adapted framework to the overall approach.

The next step of the community engagement program involved the use of Scenarios as a tool to explore different intervention solutions to create the new open space currently lacking in the community. Scenario planning with communities have been used effectively in many cities and neighborhoods to inform community upgrading plans and decision making in urban areas faced with a high degree of uncertainty due to changes in land use and/or climate change (Star et al, 2016; Butler et al, 2016). The next step in the development of the revitalization plan was a Scenario workshop; this workshop involved consultation with the same Focus Groups from the previous FGD, in order to obtain a greater level of response from the different community members. This workshop used a Scenario Evaluation matrix to collect feedback from the participants regarding the impact of the different scenarios in their daily life activities as well as the factors that could drive the positive transformation of their environments. Figures 6 and 7 show the material used in the Scenario Workshop and the Women's Group roundtable discussion.

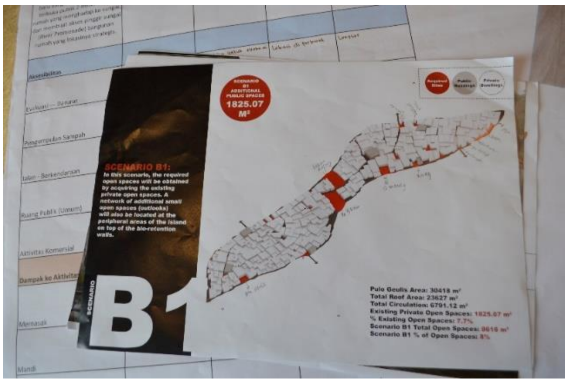


Figure 6 and 7: Scenarios workshop materials and paticipants in the workshop roundtalbles.

Urban Design Workshop: Collaborative public space design

The results of the Scenario Workshop for the selection and mix of activities in the new public space were translated into a series of urban designs for the selected 3 demonstration sites in the island, chosen by the community as the more feasible and strategic locations for the start of the revitalization plan (see Figure 9). The selected sites are presented in figure 8. Each site was designed following the multifunctionality approach, looking to obtain the full potential of places to provide amenity for the community, allocate the Green Technology (GT) solutions to reduce water pollution and provide a platform for the economic uplifing of the community. An urban design workshop was held with the community to present to them possible transformations of the selected sites, and to collect their feedback in order to refine the different uses, elements and GT allocation. Finally, the participants in the FGD provided their feedback for the revitalization roadmap for short, medium and long term (2023, 2038 and 2045 respectively) goals and possible implementation and management alternatives for the better adoption and use of the new public space and GT systems. Figure 8 and 9 show visualizations of some of the proposed new public spaces combining the green technologies.

Figures 8 and 9: Pilot Sites urban design demonstration and Urban Design Workshop participants

7. Discussion and conclusions

Engagement of communities and stakeholders early in the process of the design of public spaces is one the main factors behind their success and active use. The challenges faced by developing cities in relation to poor water management can be addressed with the use of a more Water Sensitive approach that helps to leapfrog cities and communities to a more friendly relationship with water, whilst simultaneously improving community life and public health by the promotion of active mobility options such as walking or bicycling, and helping to reduce the dependency on motorized transport options fueled by pollutants sources.

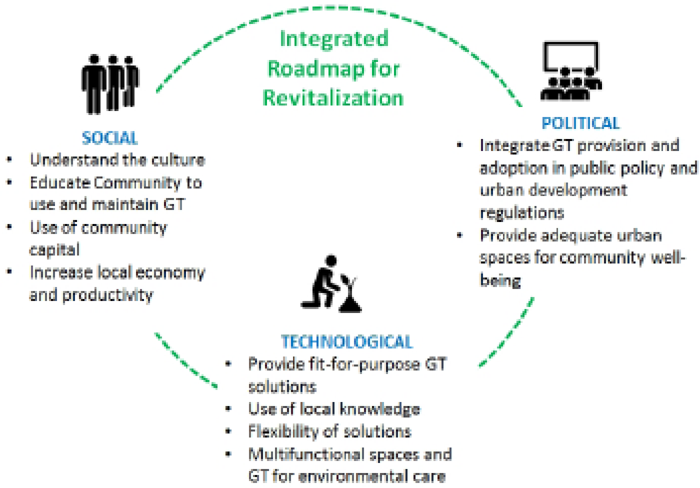


Figure 10: Integrated Roadmap for Pulo Geulis Revitalization

The proposed roadmap to achieve the revitalization of Pulo Geulis (see Figure 10) was based on understanding the social and cultural values of the community as main agents in the management and maintenance of the fit-for-purpose proposed GT infrastructure, looking to simultaneously increase their productivity and local economy in the different implementation phases of the roadmap (short, medium, long-term). It is also important to consider the need of local and national institutions to integrate the provision and adoption of GT into the regulations for the upgrading and development of new public spaces for the growing urban population in Indonesia. Initial public policy steps have been taken towards decentralizing water management agenda at the national level, and the AIC Urban Water Cluster project aims to support the process of adoption in policy and regulation (AIC UWC Report, 2016).

The process of community participation described in this paper will be a valuable source of information and experience for other cities and communities looking to improve their relationship with water. Additionally, it can help in the provision of thriving public community spaces and walkable pathways that could include Green Technology to process water flows and reduce or mitigate risks associated with urban floods, landslides and other environmental risks facing urban areas. Possible next steps to support the Leapfrogging process are the adoption of Green Infrastructure into urban design guidelines and promote the creation of local business providing the support for the delivery, maintenance and upscaling of Green Infrastructure. Cost-benefit analysis of GT is needed in order to support the economic adoption of decentralized water management systems, however the experience of other countries indicate that this approach can provide a feasible and also cost-effective solution vis-à-vis other engineered methods using grey infrastructure (Hoboken GI Report, 2015). Also, it is important to recognize the value of communities as main actors in the reduction in environmental pollution, enhancement of water supply security, and reduced risk associated with water-related natural disasters such as floods and landslides (Jones et al, 2015, UNEP-DHI, 2014)

The Planning Department of Bogor City is looking to improve the quality and quantity of their public spaces and improve walkability. Pilot projects such as the outer pedestrian and bicycle ring road around the Bogor Botanical Gardens have been well received and actively used by the community. Also, the city has stablish a pilot program for vertical gardens (Taman Vertikal in Bahasa) in the most congested streets in Bogor, aiming to provide more greenery, reduce urban heat island effect and reduce CO2 concentration in public spaces and streets (Muhammad and Arifin, 2017). The set of recommendations for the transformation of public spaces and streets with WSUD provided in this paper can be a valuable support for these ongoing processes, taking the next step in the positive transformation of public spaces and neighborhoods towards a more water friendly city.

The roadmap for the transformation requires a constant monitoring and evaluation of results, for that a Learning Alliance was started between Australian and Indonesian public, private and academic partners to provide together a viable way forward towards Water Sensitive Cities. The learnings from the proposed community participatory process have been incorporated into reports and other recommendations for public and private stakeholders in charge of the urban development of Indonesian urban areas and water bodies. This constitutes a positive step in the development of the leapfrogging strategy aimed at making communities, neighborhoods and cities more water sensitive.

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