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USING THE ZOPA MODEL TO SYNERGIZE THE DIFFERENT INTERESTS OF LOCAL AND CENTRAL AUTHORITIES IN AN ADAPTIVE CITY PLAN TOWARDS FLOOD RESILIENCE IN SURAKARTA CITY, INDONESIA

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Surakarta City, a secondary city in Indonesia, has been threatened by floods for many decades due to the overflow of rivers and an inadequate urban drainage system. On top of that, inelastic time-bound city planning has made the city susceptible to ever-increasing flood threats. The local authority has attempted to minimize flood risk through particular structural mitigations of the urban drainage system, which it has authority to do, while the overall responsibility for flood control and river management is under central authority. The different responsibilities of these two different levels of authority have led to gaps and overlaps in relation to the same objects of interest. On one hand, the city authority is concerned with city planning, and on the other hand, the flood control and river management authority is responsible for combatting flooding problems and river management within the watershed. This issue is an interesting point to investigate. In order for Surakarta to become a resilient city, it is imperative to synergize the efforts of these two different levels of authorities. This study aims to find the synergistic and optimal solutions by means of a negotiated planning and management system that involves both authorities. Critical evaluation and assessment of relevant documents, field observations, and measurements, as well as acquiring expert opinions were the main methods used in this study. We propose a ZOPA (Zone of Possible Agreement) model to optimize agreement among the stakeholders. The model essentially highlights the common interests and sets aside the conflicting points among stakeholders. The study found that there are potential points to negotiate with regard to the division of responsibilities through a shared vision of the coordinated institutions and shared planning and management in the direction of synergistic determination.

***Key words*: flood-resilient city, adaptive urban planning, synergistic determination, flood risks, Surakarta, Indonesia.**

INTRODUCTION

General Overview

Developing flood resilience in cities could be regarded as a response to their vulnerability due to flooding, which is one of the impacts of climate change (Jabareen, 2013; Bulkeley, 2013). We subscribe to NASA's (2020) definition of climate change, which is a long-term change in the average weather patterns of local, regional, and global climates, as a result of global warming. The most visible threat to the city by climate change impacts is flood risk that leads to the loss of life and property (Huong and Pathirana, 2013; Khailani and Perera, 2013). However, the flooding problem may not be the sole threat to the resilience of urban areas; the reality is that the impacts may either be cumulative or synergistic. Therefore, the challenge is for city plans to be able to dynamically respond to forceful threats resulting from temporal and spatial changes. A response to this challenge would require adaptive local-based city planning instead of time-bound inflexible master planning (Ahern, Cilliers and Niemelä, 2014). The international standard practice of flexibility in city plans in order to respond to external

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dynamics is applied in some countries, including Indonesia. Adaptive city planning to cope with flood dynamics must be tabled for discussion and negotiation with stakeholders, particularly with the authorities beyond the span of control of the city authority, for instance, the flood control and river management authority. Flood control and urban drainage plans must be streamlined into city planning (Boogaard *et al*., 2016), and equally importantly, cities must be an integral part of the overall river basin development plan. In reality, the integration of flood risk management into spatial planning is not easy to implement as many interests emerge. In many cases, during the early stages of flood control projects, the cities in question face the constraint of having to prepare spaces for adaptable flood risk reduction, as it requires vast floodable land areas to be utilized during flood events, namely, completely vacant urban land or land occupied by flood-proofing infrastructure. However, in the post-operation of a flood control project, economic development can go hand-in-hand with the flood control program, in that if a city can be freed from its flooding problem, urban economic development might be propelled to grow. While cities must provide space for economic activities that usually need high density built-up areas, in contrast, a large open space is needed to accommodate adaptable spaces for flood risk on limited urban land. Furthermore, cities are developing and need land to accommodate the growth of urban built-up areas. This issue has long been a persistent problem in many cities in Indonesia, including Surakarta City. In flood control projects in Jakarta, Surabaya, and Bandung, for instance, even though the land has been designated in the Official Gazette by the city for a particular purpose, the owners of the land are individuals, not necessarily the city government. In Indonesia's legal system, when a national law comes into effect, it must be obeyed by everyone after being passed by parliament, countersigned by the President of Indonesia and placed in the official gazette, the so-called, *Lembaran Negara*.

With regard to the study area, to understand the institutional setting of flood control responsibility, one must comprehend the complexity of coordinating two authorities in the event of concern over a flood. These authorities are Surakarta City Authority, and the Bengawan Solo Flood Control and River Management Authority. While Surakarta City is a local authority that has the administrative function of serving the citizens of Surakarta, the Bengawan Solo Flood Control and Water Management Authority, hereinafter called *BBWS-BS* (*Balai Besar Wilayah Sungai Bengawan Solo*), is a central government agency under the Ministry of Public Works and Human Settlements that has a technical function in controlling floods and managing water resources within the Bengawan Solo River Basin. These two authorities do not share a corresponding geographical boundary (Figure 1). However, both share the same interest in mitigating floods and droughts and providing a water supply to Surakarta City through Bengawan Solo and its tributary Kali Pepe, which are two rivers passing through Surakarta City that frequently cause flooding problems there. The unique correlation between the two authorities, most of the time, generates either overlaps or gaps in their operational functions that highlight the necessity for synergistic and coordinated action.

Surakarta City, the study area, is geographically located within the Bengawan Solo River Basin. The geographical intersection between these two entities and the complexity of their interests are schematically exhibited in Figure 1.

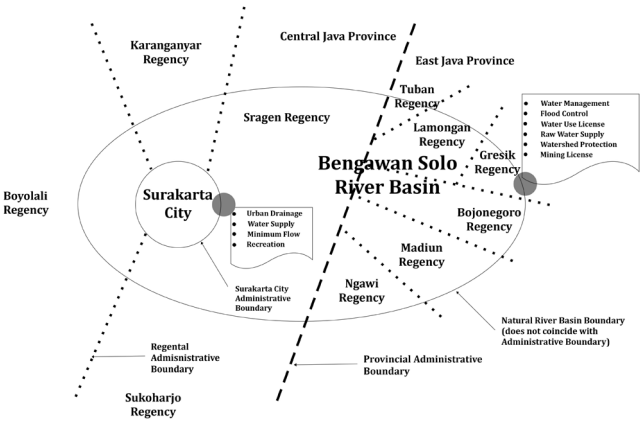


Figure 1. The intersection of Roles and Administrative Boundaries of Surakarta City and Bengawan Solo River Basin

Figure 1 presents the intersection between the administrative boundary of Surakarta City and the natural boundary of the Bengawan Solo River Basin. The figure also shows the roles of both authorities associated with flood and water management. Surakarta City lies within the river basin, and obviously, the Bengawan Solo River Basin covers parts of three regencies in Central Java Province: Sukoharjo, Karanganyar, and Boyolali. In the East Java Province, the Bengawan Solo River Basin covers the six regencies of Ngawi, Madiun, Bojonegoro, Gresik, Lamongan, and Tuban. This overlapping makes the roles of Bengawan Solo Flood Control and the Water Management Authority (BBWS-BS) extremely complex with regard to managing the river and water. This is the reason for the use of the hydrologic (natural) boundary of BBWS-BS instead of the administrative boundary.

In terms of its geographical characteristics, Surakarta City partly lies down in the floodplain of Bengawan Solo River, and it is passed by several tributaries, because of which it possesses a high risk of flooding. Pepe River is one of the Bengawan Solo tributaries that carries water inside the city. This river passes through the center of the city, and it, therefore, has a mutually important role in urban development. While Surakarta City needs this river for urban drainage, the river generates problems for the city. Floods have occurred in the city many times due to the overflow of this river. The high density settlements in Surakarta City mean that there is a higher risk of loss of life and property when a flood happens. The biggest floods in the city occurred in 1966, covering almost one-third of the city (Surakarta Disaster Management Agency, 2014). Recent floods occurred in 2016, and now there is a lower flood frequency. Responsibility for flood mitigation seems to overlap between Surakarta City Authority and BBWS-BS. Surakarta City Authority seeks to develop flood mitigation in order to create a flood-free city, while for BBWS-BS, as the river management authority, flood mitigation is one of its main roles. However, BBWS-BS does not focus only on flood mitigation in Surakarta City, but its responsibility for

flood mitigation is implemented in the entire river basin, which spans 548 kilometers in two provinces and seventeen regencies and cities. Because of this situation, gaps and/or overlaps concerning the flood mitigation responsilibilities of BBWS-BS and regencies or cities often occur.

The study aims to understand the constraints that exist in the two authorities i.e. Surakarta City and Bengawan Solo Flood Control and Water Management Authority (BBWS-BS) in their flood mitigation strategies, their efforts towards making Surakarta a resilient city, and their search for mutually exclusive solutions. The coordination of the city plan and BBWS-BS master plan are a prerequisite for synergistic works. Mainstreaming the city plan into the BBWS-BS master plan or integrating the local plans into the BBWS-BS master plan would be able to elevate the flood mitigation and adaptation efforts with regard to climate change impacts.

Adaptive City Plan and Resilient City: A Theoretical Background

A city with a high degree of vulnerability to floods and droughts needs to be an adaptive city (Jabareen, 2013; Verebes, 2013). To accomplish adaptive city planning, a collaborative planning process that works towards building consensus among all city stakeholders is necessary (Innes and Booher, 1999; Vandenbussche *et al*., 2017). An adaptive city means the city has strong assimilative power through the empowerment of the most dynamic city resources, namely people (Goldstein, 2012; CAC, 2018), which can eventually achieve a climate-adaptive city, in which the city greenery is abundant (Jim, Lo and Byrne, 2015). These arguments are suitable for Surakarta City.

An adaptive city plan can be seen as a reaction against the traditional static master plan and a strategic response to the need of urban dynamics (Whitehead, 2013; Jenks, 2000; Halleux *et al*., 2012). Nicholls and Cazenave (2010) argued that with the issues of global warming and a rise in sea-levels, the city is encountering a problem that needs high adaptability, and a rigid city planning response would not be suitable. The threat of the sea level rising, as an impact of global warming, is a clear danger for coastal cities (Yin *et al*., 2009; Nicholls, 1995; Hallegatte *et al*., 2011). The impacts of global warming on coastal cities were predicted by Gornitz (1991).

The key facet to coping with higher threats of flooding, as faced by Surakarta City, is the need for synergistic efforts among coordinated institutions and authorities, which is unavoidable if shared goals are to be accomplished (Merrey and Cook, 2012). Facilitating such coordination by the unification of an organizational framework is a pre-condition of synergistic efforts (Wright and Snell, 1998; Malone and Crowston, 1990; Burke *et al*., 2006). While there is no clear intersection of roles and responsibilities of the agencies involved, no coordination can be accomplished and silo effects hamper the synergy between related agencies, as presently reflected in the operation of Surakarta City and BBWS-BS.

A Brief Summary of the Planning Hierarchy in Indonesia

Indonesia has a unitary state system, which administratively consists of 34 provinces, 416 districts (some literature refers to regencies), and 98 cities. Amid the unitary system at the national level, all the regencies have autonomous authority in many aspects, apart from for monetary and defense systems. The planning system in Indonesia is primarily based on Law No. 26/2007 regarding spatial planning and management and its numerous derivatives, which consist of central and local government regulations, presidential regulations, ministerial regulations, and the like. Different provinces or regencies have a different style of planning system depending on the local conditions. However, it must be consistent with the higher legal entity and regulation (national planning system). Based on Law 26/2007, the spatial planning system in Indonesia essentially follows the political administration hierarchy of central-provincial-district/city, in which central or national planning is positioned at the top of the hierarchy, and therefore guides all lower plans i.e. provincial and district/city plans.

The planning system in Indonesia is an inter-departmental and inter-sectoral domain. It does not belong to a sole agency. Despite many actors in the planning system in Indonesia, which makes the planning coordination complicated and more difficult, there are two main agencies responsible for spatial planning, which are the National Development Planning Board (*Bappenas*), and the Ministry of Public Works and Human Settlements (*PUPR*). While the Bappenas is mainly responsible for administration and coordination, the PUPR is responsible for technical matters.

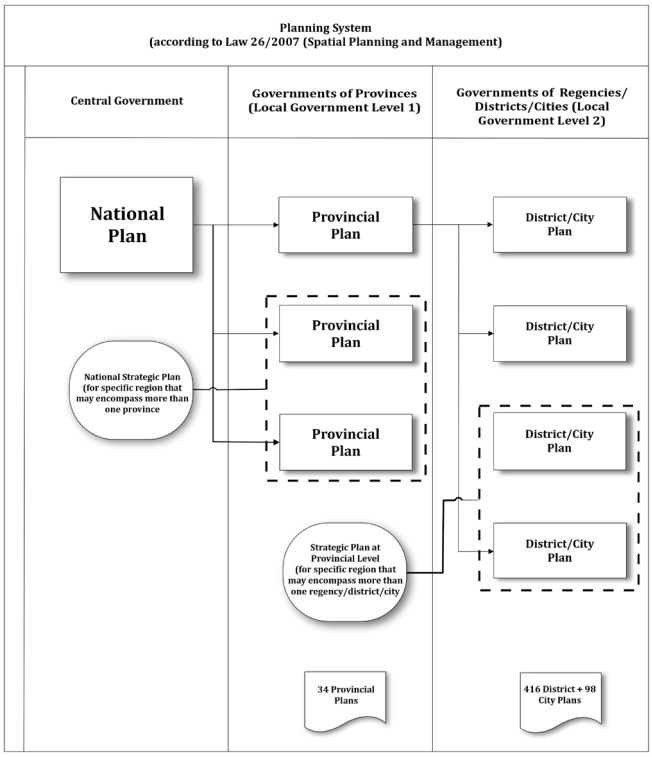


Figure 2. Planning Hierarchy in Indonesia (Source: Authors, based on Law No. 26/2007)

While the highest legal domain of the urban and regional planning system in Indonesia is the national plan, the first derivative of the national plan is the provincial plan, then the second derivative (of the national plan) or first derivative of the provincial plan is the local plan. the local plan can be either a district plan or a city plan. Besides those plans,

national strategic plans are also derivatives of the national plan. a national strategic plan is a plan for a special region within one or more provinces, with a strategic value from the national viewpoint and interest. Furthermore, there are the provincial strategic plans, which may cover two or more districts/regencies. Similarly, at the district/regency levels, a district strategic plan may also exist, depending on the district/regency. The hierarchy of the planning system in Indonesia is shown in Figure 2.

The Study Area

Surakarta City (Figure 3) is geographically a plain with an altitude of 95 to 105 meters above mean sea level. The city area is 44.06 km^2, with some tributaries passing through the city, namely the Anyar River, Pepe River, Jenes River, and Tanggul River that discharge into Bengawan Solo. About 93% of Surakarta City lies within 0.2% of the Bengawan Solo River Basin area (Ministry of Public Works and Housing, 2015), which is frequently flooded due to the overflow of Bengawan Solo and Kali Pepe. The existing capacity of the urban drainage of Surakarta City is about 50 m^3/second, which mainly comes from surface runoff, discharged into four tributaries, and finally into Bengawan Solo (BBWS-BS, 2017). However, if the water level in Bengawan Solo is high relative to its tributaries, the flow from the tributaries will not be able to discharge into Bengawan Solo. In this case, Surakarta City will suffer from floods.

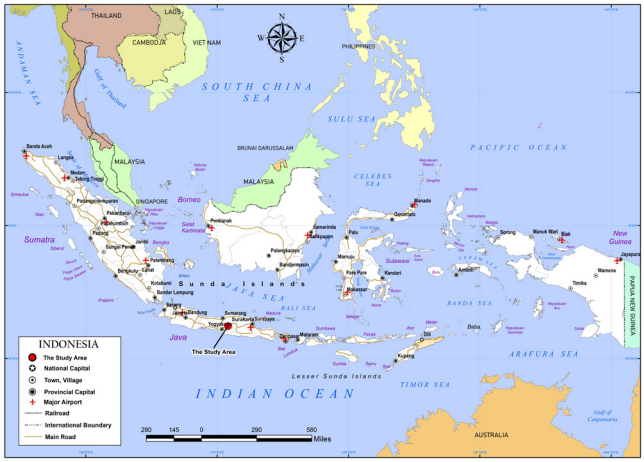


Figure 3. Indonesia and the Study Area (Surakarta City)
(Source: Nations Online Project)

Surakarta City has been experiencing annual floods due to the overflow of the Bengawan Solo River and its tributaries, particularly Kali Pepe. This flooding has been coupled with inundation from prolonged stagnant surface runoff resulting from inadequate drainage capacity. However, the root cause of the inundation is the intense built-environment in the city, in particular the extensive development of its hardscape e.g. buildings and roads, which significantly reduces the infiltration rate (Valinski and Chandler, 2015). Surakarta City is predominantly covered by built-up areas, as shown in Figure 4.

The built-up areas in Surakarta City, as shown in Figure 4, cover 82.37% (36.29 km^2) of the city, and non-built-up areas (including presently unutilized land) cover 17.63% (7.77 km^2) (Surakarta Statistics Agency, 2019). Built-up areas grew by only 0.23 hectares during 2014-2018, or only 0.005% of the total city area. The non-built up areas are scattered across the city in the form of small plots of land. Walk-through observation of the built-up areas found that the city is largely dominated by impervious surfaces, for example, roads, pedestrian areas, and paved yards. With an inadequate capacity of micro drainage and a lack of interconnection in the existing micro drainage and macro drainage systems, Surakarta City would be susceptible to flooding even without an overflow contribution from Bengawan Solo.

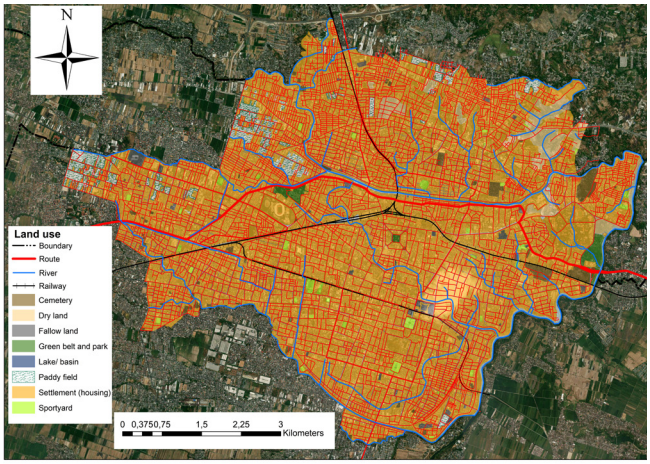


Figure 4. Predominant types of Existing Land Use in Surakarta
(Source: Municipality of Surakarta, 2012, with the author's modifications)

The Surakarta spatial plan, which indicates the future land use in Surakarta, is worrying because, for example, although the green spaces including city parks, river green belts, and cemeteries only cover approximately 807.7 hectares or 0.18% of the total area, and an increase of built-up areas is planned to a level of 95% coverage in 2031, increasing the density along particular roads three times, and decreasing open space and urban greenery to only 5% in 2031. Furthermore, there are no clear plans to cope with urban drainage i.e. a reliance on existing micro drainage rather than the construction of new drainage channels (Municipality of Surakarta, 2016). These situations highlight the absence of attention paid to the clear threat of flooding in the future.

River flooding is a stochastic process (Todorovic, 1978; Brath *et al*., 2006; Snyder *et al*., 2003), and so the size of a flood cannot be determined exactly. Similarly, urban drainage is dictated by rainfall, which is also a stochastic process. To determine the rainfall and drainage capacity, a statistical approach is usually employed. This statistical uncertainty must be carefully considered in the methodology.

METHODS

We investigated various interests of the urban and regional planning stakeholders in Surakarta City and three regencies in the Province of Central Java, as well as six regencies in the Province of East Java and those sharing administrative boundaries with the Bengawan Solo Flood Control and Water Management Authority (BBWS-BS). The stakeholders include local authorities, people affected by flooding, community-

based organizations, non-governmental organizations, and academics. The investigation of stakeholders' interests includes their roles in the regional and city planning process, their advocacies in a flood-resilient city, their contribution to the regional and city development, and their willingness to sacrifice egocentric interest for a shared vision and goal.

We gathered numerous critical documents from the Ministry of Public Works and Human Settlements, the National Planning Development Board, the Local government of Surakarta City, the Local Planning Board, Statistical Agency, BBWS-BS, and other associated agencies and offices. The theoretical background was assessed based on reliable scientific sources e.g. journals and books. A review of past research and reliable documents was carried out to look at the theoretical and experimental parts of similar issues. The roles, responsibilities, and functions of BBWS-BS were carefully assessed. Observations along the upstream part of Bengawan Solo River, which directly affects Surakarta City, and along Pepe River were undertaken to understand the estimated capacity of the existing primary urban drainage of Surakarta City under statistically uncertainty conditions.

The opinions of institutional experts were also acquired through a structured interview, in order to understand the negotiated responsibilities of related stakeholders towards a win-win situation. The interview was also carried out on a separate occasion to investigate the interests of the stakeholders. A set of designated experts from universities, government institutions, and independent observers were selected. Their opinions were recorded and tabulated in an aggregate format.

We employed a ZOPA (Zone of Possible Agreement) model in order to reach common ground related to a shared vision and goals among the stakeholders. No zero-sum game was introduced, that is sacrificing one side and benefitting the other side. The ZOPA model adopts four principles that must be understood and agreed upon by the stakeholders. These principles are (1) non-distributive strategies embraced by each stakeholder (2) no zero-sum game (3) share equivalent roles and responsibilities (4) accomplishing a win-win solution must be understood by both authorities. The ZOPA negotiation model is socially and culturally possible and acceptable within most societies in Indonesia, as most people are rooted in communities that value attachment and inseparableness. Indonesia's state philosophy also addresses this matter explicitly.

The ZOPA mechanism is implemented through a '*Musrenbang*' (*Musyawarah Rencana Pembangunan*), which is an annual meeting of the stakeholders, including citizens, to discuss issues relating to current and near-future development. Since we focused the definition of a resilient city on a disaster-associated issue i.e. a flood, the goal of a flood-resilient city is that it possesses an adequate capacity of human capital and infrastructure to cope with current and future threats of flood disasters. With this focus, the authorities concerned with water-associated disasters and water supply i.e. Surakarta City Administration and Bengawan Solo River Basin Authority, need to negotiate to accomplish a shared goal. The post-negotiation process of ZOPA is supposed to lead to a formal agreement between these two authorities on Surakarta being a resilient city, in which BBWS-BS acts as a technical advisor for the Surakarta City authority.

RESULTS AND DISCUSSION

Model of Negotiation towards the ZOPA (Zone of Possible Agreement)

The different interests of the existing authorities, particularly the Local Government of Surakarta City and Bengawan Solo Flood Control and Water Management Authority, can be synergistically combined into a common goal, as both authorities retain a strong and clear intersection. The intersection, which can be tabled for negotiation through the ZOPA mechanism, is Surakarta becoming a resilient city.

ZOPA should be introduced during the annual meeting hosted and led by the Surakarta City authority, with participants from BBWS-BS, representatives from the local government of Central Java Province, East Java Province, representatives from the Regencies of Karanganyar, Boyolali, and Sukoharjo (in Central Java Province), as well as the Regencies of Ngawi, Madiun, Bojonegoro, Gresik, Lamongan and Tuban (in East Java Province), academics, NGOs, CBOs, and representatives of Surakarta City citizens. The ZOPA aims to accomplish a shared goal, which is a win-win solution based on the four principles agreed upon by the stakeholders before the negotiation takes place. The ultimate goal is making Surakarta City a flood-resilient city, given its present status as a flood-vulnerable city.

Because the parties involved have different development goals and priorities, it is difficult to compromise without an optimal shared goal that is beneficial for both authorities. The goal of a flood-resilient city is then a reasonable one, with a systematic program of implementation and synergistic activities. Inauspiciously, the city authority has never explicitly launched a campaign for Surakarta to be a flood-resilient city, even though local academics have voiced their concerns on this matter. This gap has existed for years, and the post ZOPA would probably bridge this gap towards explicit progress in Surakarta becoming a flood-resilient city.

Increased density is encouraged from an urban planning viewpoint. However, increasing the density per se without being coupled with an increase in the amount of open space and urban greenery will trigger the possibility of an unsustainable city planning process. The most optimum approach from a sustainable development viewpoint, in order to cope with an increasing population and urbanization, is to increase the urban density, but at the same time leaving more open spaces. It means a transformational process from horizontal living to vertical living. The city authority's property rights for urban land must be expanded by acquiring vacant land, non-productive land, abandoned land, and brownfields through normal and legal transactions. By normal transactions, it means that the city authority acquires the land through commercial trading, while a legal transaction is acquiring abandoned land using legal non-commercial process. By this arrangement, the susceptibility of the city to floods will be reduced.

The role of BBWS-BS, according to the Minister of Public Works and Human Settlements concerning organizational

management (2016), is to plan, implement, maintain, conserve and control the destructive power of floodwaters, manage water resources e.g. rivers, lakes, irrigation systems, swamps, fish ponds, groundwater and other raw water sources, and the urban drainage system within the Bengawan Solo River Basin. By this legal designation, the planning and implementation of urban drainage in Surakarta City should also be under the jurisdiction of BBWS-BS. Then, the urban drainage system of Surakarta City could support the system of Bengawan Solo River Basin being managed by BBWS-BS. However, the city will not receive very much attention from BBWS-BS regarding its demand for urban drainage and water, unless a shared goal is agreed upon. The lack of attention from BBWS-BS has left the necessary plan untouched by both authorities, since the overall responsibility belongs to BBWS-BS, and it has not prioritized the demand in its own plan or program.

Despite the interdependence of the authorities, there is no integrated plan and policy, which may lead to a gap in the planning and policy with regard to a flood mitigation system. A severe gap may also hamper the program, and in the worst case may lead to disaster. For example, the delay in implementing urban drainage has already generated significant floods in the city because of the relationship between BBWS-BS and Surakarta City. A possible negotiation between BBWS-BS and Surakarta City should not be based on distributive strategies, or a zero-sum game or a win-lose approach, but rather a look into the shared vision and Zone of Possible Agreement (ZOPA) since both are government agencies working at a different level of authority with different scopes of work, and coercion would not be necessary, and therefore a win-win solution could be achieved. Distributive strategies need a prerequisite of a strong coordinating agency which is respected by both authorities and is currently non-existent. A zero-sum game may not be workable within the structure of the public administrative system in Indonesia, as Indonesia has a union system in which all elements of the system must synergistically collaborate. Thus, ZOPA is the remaining option.

During the negotiation, it is necessary to understand that both authorities are independent agencies. Surakarta City is not a subordinate of BBWS-BS or vice versa. They can both agree on a shared vision and unification of their framework, and also shared roles within their responsibilities. With these similarities, a Zone of Possible Agreement (ZOPA) can easily be reached, and an agreement can be accomplished. In order to achieve a ZOPA, its four principles must be understood by all of the stakeholders, and these two main agencies, in particular. When the ZOPA is agreed upon, a standard operation based on possible what-if situations must be formulated and agreed upon, and ultimately both must understand that the agreement is a shared accomplishment towards achieving a shared vision. This is illustrated in Figure 5. A similar process can also be applied to other cities or regencies within the Bengawan Solo River Basin for different roles. The negotiation processes and results can be documented and could become a precedent for when similar issues arise. Some adjustments would be needed for new situations as they would not be the same, but this could be a good example to follow by BBWS-BS or other cities and regencies.

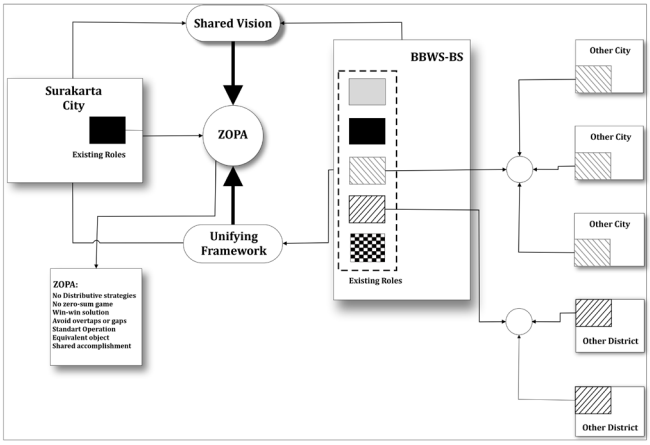


Figure 5. Negotiation towards shared Accomplishment

Since in Indonesia there are ninety big and small Flood Control and Water Management Authorities covering different scopes and areas, but with similar roles, the model could be applied to similar problems for a win-win situation and optimal solution in these ninety authorities.

Adaptive city plan for Surakarta towards becoming a flood-resilient city within the context of ZOPA

Upon agreement with the main agency, which is responsible for the provision of the system and infrastructure of flood mitigation and urban drainage, the path to becoming a flood-resilient city is practically dependent on the Surakarta City Authority, since potential constraints on coordination among related agencies have been settled. Historically, the main threat of natural disaster affecting the resilience of Surakarta City is flooding. However, recent studies have found that there is also a potential peril of earthquakes in Surakarta.

Within the framework of ZOPA, water-associated and other disasters, in the interests of Surakarta City and BBWS-BS, may also be tabled for negotiation. Based on data released by Surakarta Disaster Management Agency (BPBD), the prominent disasters associated with climate change that happened in Surakarta during 2010-2017 are shown in Table 1. Fire outbreaks could not be categorized as natural disasters, as they can be caused by the carelessness of human beings i.e. short circuits of electricity (the most frequent causes), uncontrolled fire during cooking, or arson. However, they are included in the table due to their remarkable frequency. Mitigating the effects of fire is made easier by improving building safety, which is fully controlled by human beings. Flooding and storms are two climate-associated events that cannot be precisely predicted, since they are a stochastic process rather than a deterministic one.

As shown in Table 1, there were no floods in Surakarta for three consecutive years, in 2009, 2010, and 2011, due to the successful flood infrastructure in the Bengawan Solo and Pepe Rivers. The mitigation of water-associated disasters is within the works scope of BBWS-BS. However, the flood frequency increased during the 2015-2017 period at the operational commencement of BBWS-BS. The other types of

disaster have not been a significant threat, although should be considered in the planning of a resilient city. The focus on Surakarta becoming a resilient city is on climate-associated disaster only, particularly water-associated disasters. Urban flood and urban drainage are two important climate associated aspects. A city that is resilient against urban floods attempts to minimize the loss of life and property without directly confronting the power of nature, but rather adjusting to this powerful force. In such a case, within the ZOPA framework, the BBWS-BS could become a leading authority.

The Surakarta Flood-resilient City Plan should consider drainage density since it is reasonable that the larger the density, the lower the probability of flooding (Baker, 1977; Patton & Baker, 1976). As defined by Horton (1945), drainage density is the ratio between the total length of drainage channels and the area of the watershed within which the drainage channels are situated. It also describes the degree of development of the drainage network. The total drainage capacity and drainage density should aim towards having fewer floods in the city. The present drainage density (D_d)

Table 1. Prominent Disasters in Surakarta: A Point for ZOPA Discussion [frequency]
(Source: National Disaster Management Agency, 2018)

Disaster	2009	2010	2011	2012	2013	2014	2015	2016	2017
Tropical Storm*	2	0	2	0	1	1	2	0	1
Floods	0	0	0	2	1	0	2	3	3
Landslide	0	0	2	0	1	0	0	0	4
Fire Outbreak	28	0	37	46	26	109	78	60	78

Note: *Category 1-3 on Saffir-Simpson Scale

To properly develop a flood resilient city plan, one must first understand the essential parameters of urban flooding from the viewpoint of the safety of people and property, as seen in Figure 6. The parameters contained in Figure 6 refer to the safety of citizens in terms of the flood velocity and depth of floodwater. These essential flood safety parameters should be taken into account in a careful analysis by BBWS-BS as a technical authority. These safety parameters are an important point to be discussed by the authorities, in order to avoid loss of life due to flooding. City planners under the Surakarta City Authority must carefully incorporate flood variables e.g. flood velocity, floodwater depth, and flood risk maps. A flood-risk map should usually be produced as a model for various scenarios regarding the flood return period and potential inundation, then the risks i.e. loss of life and property could be estimated for the inundated area, as well as the depth of floodwater, and flood velocity. Some scenarios of flooding and corresponding risks could be incorporated into the Surakarta Resilient City Plan.

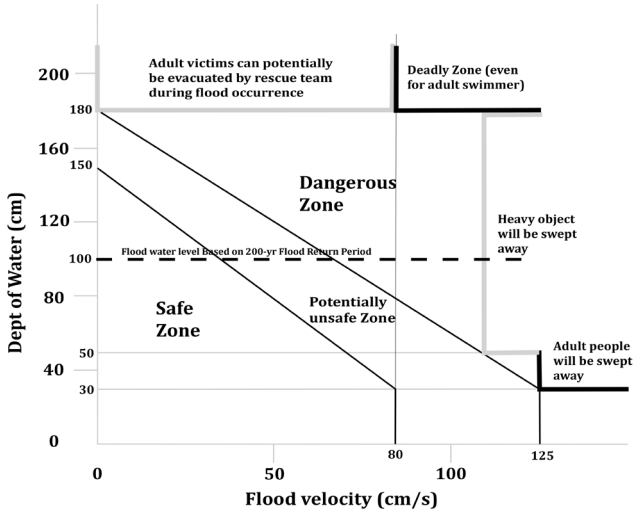


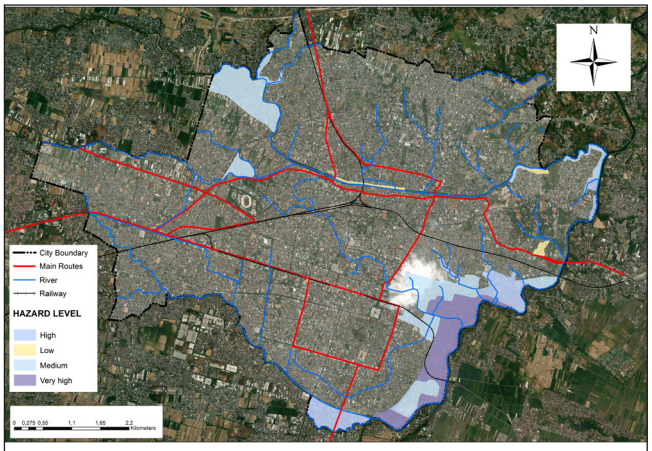
Figure 6. Fundamental Parameters of Flood Safety

in Surakarta is about 1.6. In the resilient city plan, the D_d should be about five times the current drainage density. The drainage density should be implemented in phases in order to adjust to the dynamics of the city. This specific issue in Surakarta City Plan is largely based on the inputs from the BBWS-BS in the post-ZOPA stage.

Based on the estimation of a 200-year flood return period, it is predicted that the flood discharge of Bengawan Solo River will cause a one-meter flood depth, covering one-third of Surakarta (refer to Figure 7). Based on the observation, the average ground slope of Surakarta City is between 8/100 and 15/100, and with the existing urban texture signified by a high building density, the estimated floodwater velocity is stagnant to 0.5 meter/sec. According to these variables, the flood-resilient city plan must designate a specific flood vulnerable zone and suggest that within this zone, the floor elevation must be higher than 1.0 meter from the existing ground elevation.

A zoning ordinance that designates the building types, flood level (which will be evaluated periodically), floor elevation, foundations, and a roofing system that withstands a certain degree of flooding and tropical cyclones must be in place and attached to the land use plan. The plan must provide some necessary examples of best practices for flood-proofing buildings and using cyclone-withstanding roofs, as shown in Figure 8.

Figure 8a exhibits an elevated floor above a designated flood level. The designated flood level was determined by means of a model. In this case, for the 200-year flood return period, the maximum flood water level will be about 1.0 meter above the existing ground level. Thus, the elevation of the floor must be above the designated flood level. If an embankment is cheaper than a concrete pile with the same degree of safety, the elevated floor is placed on the embankment, enhanced by a retaining wall, as shown in Figure 8b. These illustrations are the only example contained in the ordinance.



* Flood hazard level is based on the calculation of flood characteristics and land morphology classification. The flood characteristics include flood frequency, flood duration, and depth of inundation.
* The flood frequency is categorized into annual flood occurrence and uncertain flood occurrence. Meanwhile, the flood duration is classified by less than 12 hours, 12 to 24 hours, more than 24 to 48 hours, and more than 48 hours. The depth of inundation is divided into up to 50 cm, more than 50 to 100 cm, more than 100 to 150 cm, and more than 150 cm.
* The land morphology is identified into fluvial landform, volcanic landform, and structural landform. The fluvial landform has the highest risk of flooding, otherwise, the structural landform is the lowest risk of flooding.
* The classification of flood hazard levels is the result of a summary of the scores of flood characteristics and land morphology classification. Generally, the high flood hazard level is due to the high risks of flood characteristics, and land morphology classification. Meanwhile, the medium flood hazard level is related to the flood characteristics or the land morphology classification having low scores.

Figure 7. Flood hazard in Surakarta City (Source: Surakarta Disaster Management Agency, 2014, Municipality of Surakarta, 2012, with the authors' modifications).

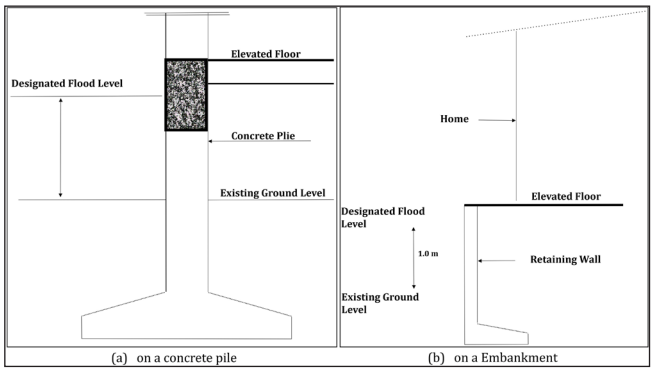


Figure 8. Elevated Floor

While Surakarta City Authority should implement specific details of the flood-resilient city, BBWS-BS should implement the overall flood control within the river basin. There should be a clear boundary between the responsibilities of BBWS-BS and Surakarta City Authority. BBWS-BS is expected to set a flexible floodplain plan, particularly in the surrounding areas of the rivers passing the urban centers. While the floodplain would only fulfil its role during the flood season, during the dry season, the floodplain could be utilized for temporary purposes such as a playground, sports field or city garden (Figure 9).

This synergy in planning should be reflected in the shared Surakarta Resilient City Plan, and it goes against the traditional silo mentality of uncoordinated planning between Surakarta City and BBWS-BS. Some potential advantages of a shared plan are shown in Table 2, which compares the uncoordinated silo plan and the resilient city plan.

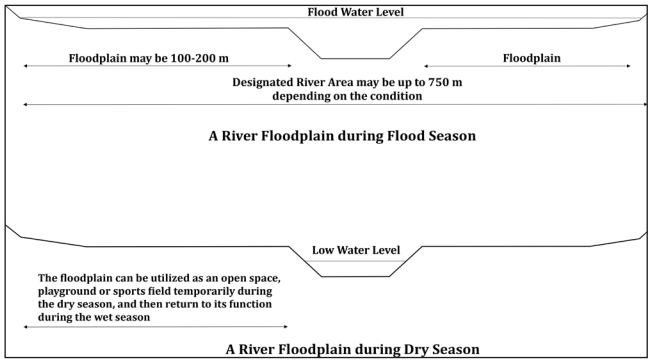


Figure 9. River Floodplain Plan by BBWS-BS

Table 2. Comparison between Silo Plan and Shared Surakarta Resilient City Plan

Aspect	Traditional Silo Plan	Surakarta Resilient City Plan
Characteristics	Silo and uncoordinated	Synergy and integrated
Time Horizon	10 years, rigid	5 years and adaptive
Outcomes	Some conflicts may exist	Synergistic goal
Guide to citizens	Only authority understand	Good practices available
Program	Some gaps or overlaps	Collaboration
Budget	Waste may be generated	More efficient budget
Target	Bias	Focus

The Surakarta Resilient City Plan with the support of BBWS-BS would be able to synergize and coordinate the implementation to accomplish the common (shared) goal of a resilient city against flooding. Two different levels of authorities negotiated by suppressing the respective egos and nullifying the silo mentality will give the advantages of urban development and sustainability. This process could be replicated, as BBWS-BS has a similar issue with regencies along the Bengawan Solo River.

CONCLUSIONS AND WAY FORWARD

Presently, BBWS-BS must deal with eleven regencies and one city along the rivers from upstream to downstream. Surakarta City is the most important city, as it has a strategic position as a cultural-based tourist city that needs a full infrastructure and facilities. Since the regencies have different characteristics, it would be unsuitable if a single strategic plan with the cities and regencies is proposed. Therefore, the negotiation process based on a shared vision must take place. If some of the regencies share their common vision, the process can be simplified.

A different thematic plan, for example, a resilient city plan, can be introduced by any regency based on its local spatial characteristics. There is a difference between the theme of flood resilience for a coastal city or regency and that of a city or regency with an irrigation (river) system in the inland region. The need to legalize the plan into a city ordinance or equivalent regulation in a regency is very

important. Implementation of the plan is the most crucial step in its success or failure. Once the plan becomes a city or regency ordinance, the plan must be guided and executed accordingly. Commonly an ordinance at the city or regency level needs operational guidance, but in this case, to shorten the bureaucracy and ensure the program's execution, the ordinance is expected to be written in a very detailed manner for smooth implementation.

Some ideas on the thematic plan for the regency can be proposed to be negotiated with BBWS-BS, for example, a Coastal City Development Plan for the Tuban and Gresik Regencies, or an Aquaculture and Agriculture Region Plan for Ngawi, Bojonegoro and Lamongan Regencies. The theme can be determined by the Development Planning Agency of the Regency in the respective regencies before the negotiation with BBWS-BS. One important mechanism for BBWS-BS is that this water management authority must be open for the best solution for the region.

If the ZOPA model is adopted by Surakarta City and Bengawan Solo River Basin in the planning process associated with the flood-resilient city and water resources management it could probably be upscaled to the international level, as it uses the universal principles of a non-distributive approach and win-win solutions. For instance, the Mekong River Basin, which encompasses China, Cambodia, Lao, Myanmar, Thailand, and Vietnam, could implement this model, even though the implementation process would face new challenges and constraints. However, with a non-distributive approach in mind, it would be possible to accomplish this. After the negotiation in this example, there would be the need for an international committee to be established to represent the respective countries, with members from all countries concerned. This model can also be adopted by international river basins like the Nile River and others.

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