A community-based approach to riverine management of the Kali Pepe in Surakarta

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Abstract. Most urban villages in Surakarta are situated in the riverine area. These villages experience the effects of urbanization. One of the most significant negative effects of urbanization in the riverine area of Kali Pepe is the environmental degradation of its ecosystem. This problem raises many issues, physical as well as social and economic. Therefore, urban villages need high levels of community resilience, which refers to the capacity of a community to resist various risks through specific management and adoption of good practices. This study focuses on community initiatives. These initiatives symbolize the endeavor to perceive, interact, or even adapt to the river’s condition. In Surakarta, there are various community initiatives such as Forum Solo Hijau, Ngerekso Lapen, SIBAT (which refers to Community-Based Disaster Preparedness) at the neighborhood scale in the urban villages of Sewu and Sangkrah. This research aims to identify the communities’ initiatives in the riverine area of Kali Pepe, Surakarta and understand how the local communities interact with the river. This research used the field research approach for data collection comprising in-depth interviews with local leaders and community representatives. This research used a qualitative-typological approach by analyzing the (1) formation process, (2) the role of actors, and (3) the aims of each community’s endeavor. The findings of this research provide a new perspective for understanding how communities experience the rivers and provide a guideline on how community initiatives can contribute to the sustainability of the river.

1. Introduction
The world is becoming increasingly urbanized - demographers estimate that 54 percent of the world’s population now lives in urban areas. By 2050, the world’s urban population is projected to increase to 66% [1]. Without proper planning, urbanization will affect cities and increase pressure on its environmental quality. In 2015, UN-HABITAT elaborated on several environmental issues faced by cities around the world that cause disturbances in existing ecosystems and increase the vulnerability of the human population. At the same time, climate change exacerbates these conditions. Not only does this increase pressure on the environment; it also increases the risks faced by the human populations in several key areas, such as riverine areas. Many disasters are exacerbated by climate change. Disasters also impede sustainable development, sometimes reversing years of advances in a single event. Evidence indicates that the rate of exposure of persons and assets in all countries is higher than vulnerability reduction efforts, which has significant economic, social, health, cultural and environmental impacts, especially at the local and community level [2].
Environmental problems affecting the riverine area are a big issue in Indonesia. From the perspective of infrastructure, there is a lack of adequate wastewater treatment and sanitation facilities in urban centers leading to the depositing of untreated wastewater directly into rivers and canals. This urban population causes environmental degradation which directly affects the river. Moreover, flooding which is exacerbated by climate change has affected many Indonesian cities [3].

The crucial point is how this issue affects the human populations living in the riverine areas, most of whom are slum inhabitants. Riverbank communities in Indonesia are physically vulnerable – the increasing volume of rainfall and shorter, more intense rainy seasons mean that flooding is becoming more frequent and severe [4]. In this case, the human capacity for dealing with the problems is crucial. Nevertheless, increasing the capacity of human resources requires active participation and collaboration from various stakeholders, from the government as well as society [5].

Surakarta is an Indonesian City that is traversed by many rivers. One of them is the infamous Bengawan Solo. While the rivers themselves have been an integral part of the city’s historic development for almost four centuries, the current situation is becoming increasingly complex. Notably, improperly treated wastewater coming from industries and households has polluted Surakarta’s rivers for many years [6]. Climate change also affected the city by causing frequent flooding in many riverbank areas.

One area that experiences frequent flooding is situated along the riverbanks of the Kali Pepe which passes through more than twenty kelurahan (urban villages) in the city. Many of the communities that reside on the riverbanks of Kali Pepe are vulnerable to frequent flooding [7]. On the other side, this situation often stimulates the formation of environmentally-oriented community organizations along the Kali Pepe riverbanks for adaptation purposes. This underlines the importance of understanding the community dynamics along the Kali Pepe riverbanks in managing such conditions. This paper will contribute to literature relating to environmental-related community initiatives, especially in the riverbank context.

1.1 Research objectives
This research aims to understand the dynamics of community initiatives relating to environmental issues in the riverbank area of Kali Pepe. The steps towards reaching the research goal are (1) identifying the formation process (historical background) of the existing communities, (2) identifying the activity patterns of the existing communities, and (3) identifying the collaboration pattern. The result of this research will be useful for understanding the typology of Surakarta’s environmentally-oriented communities and disaster risk management, and their dynamics, and strategies to ensure the sustainability of riverine areas. The lessons will be useful for providing recommendations on sustainability strategies for other communities.

2. Methodology
The approach in this study is a deductive method. Deductive research is a process of explanation that begins from a theory/hypothesis to the observation of systematic empirical conditions which will lead to a conclusion [8]. This study focuses not only on the downstream part of the river but also on the community initiatives on the Surakarta City scale for two reasons. Firstly, the communities living in the surrounding of the river are the ones who interact most with the river. Secondly, they are also most affected by the changes that occur in the river and, therefore, have more efforts to adapt to the changes they experience. This study viewed the empirical conditions of community organization management in the riverine area of Kali Pepe, namely Ngrekso Lepen Mangku Keprabon, Forum Solo Hijau, SIBAT Sewu, and SIBAT Sangkrah.

In the research, data and information are obtained from interviews with related stakeholders and questionnaires to the community living in the downstream area of the Kali Pepe River Basin. The respondents in this study were selected using purposive sampling. This technique is used in situations where the researcher selects cases (samples) with a specific purpose/consideration [9].

Data collection is conducted via (1) in-depth interviews with four leaders of the community organizations in the riverbank area of Kali Pepe, i.e., Ngrekso Lepen Mangku Keprabon, Forum Solo Hijau, SIBAT Sewu, and SIBAT Sangkrah; (2) questionnaires which were conducted to identify the
community’s understanding of the SIBAT program and activities, as well as its effectiveness in flood risk management. The questions in the questionnaires given to the respondents were open-ended. The respondents were all members of the community in the Sangkrah and Sewu Sub-districts. These communities were represented by their community leaders (Chairman of RW/RT). However, these figures are not the managers of the SIBAT Program, so their data and information are expected to be objective.

As for the analysis, this research uses a typological approach in describing the dynamics of the communities based on four main aspects. These aspects are used for comparison. The purpose of this approach is to understand the dynamic of the city’s environmental-oriented communities on the Kali Pepe’s riverbanks.

3. Formation process of existing environmental-oriented communities in the riverine area of Kali Pepe
In Surakarta City, various community initiatives have flourished over the years. Those communities are not only concerned with flood-risk management but also with environmental issues. Some of these issues have been explained above.

3.1. Forum Solo Hijau - Solo Green Forum
Forum Solo Hijau (FSH) was established in 2012. It was a result of the initiatives of the Ministry of Public Works, Department of Spatial Planning and the Department of Environment of Surakarta City (Dinas Lingkungan Hidup Kota Solo – DLH). The Green City Development Program (Program Pengembangan Kota Hijau - P2KH) is a thematic national-level program for cities or regencies all over Indonesia which was initiated by the Ministry of Public Works, Department of Spatial Planning of Indonesia. The goal of this program is to establish a sustainable green city. This program is expected to stimulate an Urban Green Movement (Green Forum). The aim of this community is to disseminate information and establish a green community from the Green City Development Program. Coinciding with July 5th, 2012 (as the environment day), all stakeholders (institutions/communities/institutions/individuals) agreed to create a forum of communication and education (Forum Solo Hijau) in order to realize the city of Solo as a Green City. This is with the intention of a long-term vision of Solo City as an Eco-Cultural City.

In early 2011 the embryo of FSH was already formed. At the start, the community was called Wedangan Hijau Solo (Wedhus). In October 2011, the Solo green activists gathered to help make the Indonesia Prime Farming Conference a success; some of Solo’s green activists successfully initiated a green activity communication forum they called Wedhus.

The founders of FSH come from several different environmental-oriented communities, such as Green Map Community, Republik of Ang-Ang Solo, and Green Future Community. The vision and mission of FSH are to facilitate the efforts of various stakeholders to realize the city of Solo as a sustainable green city. Therefore, the activities of FSH involve disseminating information, ideas and programs related to the realization of the Green City of Solo to each participant (institution/community/institution/individual) and expand its network in the hope of further cooperation. For financial sustainability, this community is mainly self-funded by various green communities; in addition, it receives funding from the government (see Figure 1).

Some of the documented green actions activities conducted by FSH since 2012- until now are Solo Green Mart (Pre-Declaration of Indonesia Gardening 2011), Earth Hour 2012, cleaning the pond of Taman Sriwedari (to commemorate environment day 2012), giving out plants at public transport shelters (Solo Green Forum Declaration), and clean free day action of Solo City (to commemorate the 15th anniversary of Solo Post) which was combined with river cleaning activities. This event included broader stakeholders’ involvement.

Another incentive program executed by the management of FKH is the organization of a green map workshop. This involved 3-5 meetings (discussion and data collection in the field). The final stages were action-oriented (e.g. collecting information on Solo Green City) to support the realization of Solo Green City. Other green action activities relate to a green lifestyle. These include cycling together, a culture of electricity-saving, throwing garbage in the right place, and gardening in school or at home. It is evident
that the realization of the vision of Solo Eco-Cultural City is a shared desire by all elements of society, not just from the government or private parties. The various activities of Forum Solo Hijau are categorized as non-physical incidental activities (see Figure 2).

**Figure 1.** Organizational structure of Forum Solo Hijau (FSH)

**Figure 2.** Activities of Forum Solo Hijau
3.2. Ngerekso Lepen Mangku Keprabon (NLMK)

Ngerekso Lepen Mangku Keprabon is a community formed in 2013 targeting members from 27 *kelurahan* (urban villages) along the Kali Pepe River. This community was formed based on the initiative of *PNPM Mandiri Perkotaan*—a national development funding program to promote clean rivers and its surrounding environment. The main aim of this community is to become a place for communities to learn to find solutions to environmental issues around the river. During the formation process, this community was facilitated by Balai Besar Bengawan Solo (Bengawan Solo River Basin Association), the Indonesian Ministry of Public Works, the City Government of Surakarta, and the World Bank.

This community has three key figures, i.e., Eko Setyo, Rochmadin, and Parwoto. Nevertheless, the implementation of the programs in this community was supported by various stakeholders. From the academic sector, Universitas Sebelas Maret and Forum Solo Hijau collaborated within the program. Meanwhile, national-level government bodies such as Balai Besar Bengawan Solo (BBWS), the Ministry of Environment and Forestry, the Ministry of Public Works (Cipta Karya division), and the Ministry of Social Affairs also supported the implementation of the programs. City-level government bodies such as *kelurahan* (urban village) offices, *kecamatan* (sub-districts) offices, and the city government (related agencies, and mayor of Surakarta) played a large role in supporting this community, not only by supporting the programs but also by giving technical assistance and funding.

This community relies on funding from donors from various stakeholders. Its main source of financing is from the *kelurahan*’s allocated development funding managed by the Community Empowerment Institute (LPMK) in each *kelurahan* offices. Other contributing donors are from the business sector; Bank Jawa Tengah via its corporate social responsibility scheme; BBWS Bengawan Solo; and grants from the city government. Moreover, this community also collected funding from its 450 members in 27 *kelurahan* (Figure 3).

![Figure 3. Organizational structure of Ngerekso Lepen Mangunkeprabon (NLMK)](image-url)
Some of NLMK’s activities that have been documented are information dissemination, advocacy, and monitoring, and site visits. Those various activities of NLMK are categorized as non-physical incidental activities. Most of the activities of NLMK are related to local government activities. Therefore, the activities of NLMK are less independent (see Figure 4).

Figure 4. NLMK activities

3.3. SIBAT Sewu and SIBAT Sangkrah
The Indonesian Red Cross (Palang Merah Indonesia - PMI) has several main tasks, such as disaster relief and disaster preparedness. The main task of disaster preparedness requires community participation to help smooth delivery. Therefore, PMI encourages the community to be actively involved in various disaster risk management efforts. After the tsunami disaster in Aceh in 2004, PMI initiated a program involving community representatives to develop disaster risk reduction programs. This program was later referred to as Community-Based Disaster Preparedness.

Community-Based Disaster Preparedness or Siaga Bencana Berbasis Masyarakat (SIBAT) is a non-profit organization. SIBAT is one of the disaster risk management programs that combine a top-down and a bottom-up approach. The Indonesian Red Cross, as a national institution, initiated this program and seeks to stimulate the active participation of communities in disaster risk management of their region. Currently, the SIBAT Program is focused on flood disaster management.

In Java, PMI focuses on flood disaster management efforts, thus, the following watersheds and river basins are selected, namely Ciliwung Watershed, Citarum Watershed, and Bengawan Solo River Basin as pilot programs for the development of SIBAT for flood risk management. Wonogiri Regency, Surakarta City, and Bojonegoro Regency are home to the pilot projects for the Bengawan Solo River Basin. For Surakarta City, SIBAT was formed in three urban villages (kelurahan), namely Sewu, Sangkrah, and Semanggi. This is because these areas are most vulnerable and often flooded. Kelurahan Sangkrah and Sewu are located in the Bengawan Solo River Basin and downstream of Pepe River, where the Bengawan Solo River and Pepe River meet. This location gives the riverine area a high risk of flooding. In this research, the focus is solely on the community initiative of the SIBAT of Kelurahan Sewu and Kelurahan Sangkrah.

During their formative phase, both SIBAT Sewu and Sangkrah received support from various stakeholders ranging from international to the city level. The International Federation of Red Cross and Zurich Insurance are international stakeholders that financed SIBAT in the formative phase. While the
Badan Penanggulangan Bencana Daerah Surakarta (Surakarta’s Department of Disaster Mitigation) and the government of Central Java (governor office) supported in the form of program collaboration. So far, both SIBAT Sewu and Sangkrah have formed partnerships with various stakeholders. From the academic sector, academics from Universitas Sebelas Maret helped with technical assistance during project implementation. The programs were also in line with the Surakarta government’s Sekolah Sungai program. Therefore various programs were merged with a goal to educate and raise awareness of river sustainability. From the non-governmental body, the communities also received support from Solo Raya Volunteer Community. From the national level stakeholders, the communities received program support from government bodies such as BBWS Bengawan Solo, the Ministry of Public Works, Red Cross, and the Regional Disaster Management Agency (BPBD). From the local government, both communities received support from Surakarta BPBD, Surakarta Red Cross, City Government (mayor), and kelurahan offices in the form of training, knowledge transfer, and funding. For financial sustainability, SIBAT Sewu and Sangkrah also mainly rely on donors, such as Zurich Insurance that often funds Red Cross programs in Indonesia, and grants from Surakarta City Government. Nevertheless, both communities also collect funds from their members in the form of voluntary donations (Figure 5).

![Organizational structure of SIBAT Sewu and SIBAT Sangkrah](image)

Figure 5. Organizational structure of SIBAT Sewu and SIBAT Sangkrah

a) Identification of flood risk in the lower area of the Pepe river basin
Disaster risks can be determined from the level of vulnerability of the people in combination with the level of vulnerability of a region. Vulnerability is assessed from the factors that cause disasters in a region. The higher the frequency of disaster occurrence in a region then the higher the vulnerability of the region from disaster. The more intense the activity and the higher the density of the population and the buildings in an area, the higher the vulnerability will be since the disaster impacts will be significantly felt by the people living in the area. The sum of the levels of regional and human will result in the categorization of disaster risk levels of a region. The linkage between regions and humans is linear. When human vulnerability and the vulnerability of a region is high it will generate a high level of risk and vice versa.
The downstream area of the Kali Pepe River Basin has a long history of flood events. The position of Sangkrah and Sewu Urban Villages, which is right at the meeting point of Kali Pepe and Sungai Bengawan Solo, leads to frequent flooding in these two areas. This is due to the overflow of the Pepe River that cannot enter the Solo River which has a higher water level (Figure 3). In the early 1990s, the government constructed a dike to protect the downstream region of the Pepe River Basin from flooding. These government efforts aimed to reduce the impact of floods in the city. However, since the area is the estuary of the drainage channel (system) of the surrounding area, this results in the frequent flooding of this region.

One of the last major flood events in the downstream area of the Kali Pepe River Basin occurred in 2007. In that event, almost 90% of the areas were waterlogged with a height ranging from 1 to 4 meters. Flood events are increasingly frequent in this region, especially in the area where the Pepe River estuary borders the Bengawan Solo River. There are still some residential areas in this region, although, the city government has tried to relocate the settlements and improve the function of the riverbank areas.

In the span of three months in 2017, at least five floods have occurred. The downstream area of the Kali Pepe River Basin at the urban villages of Sewu and Sangkrah is a high-density residential area. The population density is also in line with the dominance of built-up land, which reduces the extent of open spaces that offer water infiltration. Open space that serves as a water recharge area can only be found in public facilities with relatively limited space. In addition, in the lower region, there are settlements located on the embankments causing them to often experience flooding when rain with high intensity occurs for more than an hour.

b) Identification of SIBAT program implementation

The activities undertaken by SIBAT Sewu and SIBAT Sangkrah are the result of the initiation by PMI. The flood risk management training conducted by PMI stimulates the Sewu and Sangkrah community to implement environmental rehabilitation programs in each kelurahan. Programs or activities undertaken come from the community’s own initiative, which is then facilitated or supervised by PMI. These programs are adjusted to the problems and character of each region. Nevertheless, Sewu and Sangkrah as urban kampongs have similar territorial characteristics i.e., low-lying plains located at the river edge that face similar flood-related disasters. Therefore, the main flood risk mitigation programs conducted by each SIBAT is similar.

The first part of the SIBAT program involves mapping areas and points which are at flood risk via a participatory mapping method and prepared by the community itself. The mapping results are used to enhance flood mitigation and carry out risk-reduction activities to reduce flood disaster risks or impacts. The preventive effort to reduce flood risk is with the introduction and application of evacuation routes and early warning systems. SIBAT Sewu and SIBAT Sangkrah built evacuation routes and socialized it to the community of each kelurahan. Meanwhile, during the flood event, SIBAT is tasked to assist the residents in the evacuation process together with the kelurahan, e.g., members of Family Welfare Development (PKK), and the Community Health Center (Puskesmas). Figure 6 below shows some of the activities of Sibat Sewu and Sibat Sangkrah. The activities are identified as non-physical incidental and physical permanent activities, whereas, both activities are routinely done.

SIBAT Sewu’s programs appear to be more active and the organization has a broader network. SIBAT Sewu’s activities always involve other stakeholders on the kelurahan level which will directly affect preparedness for flooding. The external stakeholders that have been collaborating with SIBAT Sewu include volunteers, BBWS Bengawan Solo, Perum Jasa Tirta, BPBD Kota Surakarta, and UNS academicians. Many partnership programs are conducted aimed to increase the community’s flood resilience.
Beside SIBAT’s routine events, there are small initiatives coming from the communities. The initiatives engage a larger network. The idea for the initiative could originate from inside or outside of the organization. These activities include cleaning the river, monthly trash collection, urban farming, and planting vetiver’s vegetation along the riverbank (see Figure 7).

**Figure 6:** The Sibat Sewu and Sibat Sangkrah activities

In the process of evaluating the effectiveness of the continuity of the SIBAT program as stated in the research results, it can be deduced that the community in Kelurahan Sewu can better identify SIBAT activities than the community in Sangkrah. Its effectiveness can also be seen from the questionnaire results from the respondents. Specifically, 53% of respondents in Sangkrah Urban Village said that the activities undertaken by SIBAT Sangkrah are still ineffective. The most frequently given reason by the community is related to the delayed response in the evacuation process. In addition, program implementation still minimally involves the general public. Consequently, the programs are not well-known nor are the benefits felt by the community.

In Sewu Urban Village, more than 90% of the community stated that the programs conducted by SIBAT Sewu have been effective. The people can feel the direct benefits during the evacuation process conducted by SIBAT Sewu. The community appreciated the performance of the SIBAT board during flood disaster; even before the flood occurred, the managers were on standby in the community settlements. Extension programs and simulations conducted by SIBAT Sewu also provided benefits to
the community regarding knowledge on flood preparedness. The SIBAT program is also closely linked to its integration to the disaster risk management programs implemented by the government. Miladan et al. (2017) also stated that the effectiveness of the SIBAT program relies heavily on the active role of key social figures (social agents).

4. The Community’s Initiative Symbolizes its Efforts to Perceive, Interact, or Even Adapt to The River’s Condition

This section discusses various community initiatives in flood risk and environmental issues by the communities of Forum Solo Hijau; Ngerekso Lapen; and the SIBAT program in two urban villages of Surakarta (Kelurahan Sewu and Kelurahan Sangkrah). The discussion is divided into sub-sections that address the initiation of developments, stakeholders, and the effectiveness and sustainability of each community.

4.1. Process of initiatives formation and stakeholders

The initiatives’ formation process and the stakeholders involved in each of the communities are dynamic and unique. Most community initiatives were established less than a decade ago, around 2011-2014. Forum Solo Hijau (FSH) was formed in 2011, NLMK in 2013, and, most recently, SIBAT was formed in 2014. However, green communities have existed long before the formation of FSH, ever since 2008. This was the era of Mayor Joko Widodo. The political will and the dynamic atmosphere were conducive for forming such organizations. The Surakarta City government encouraged community initiatives for maintaining their environment. Further, in 2014, the National Government encouraged a national thematic policy for green cities which requires a consortium of green communities as a forum. The same type of scheme resulted in the formation of the Ngerekso Lapen (NLMK) and SIBAT initiatives. Both initiatives are the result of a national scheme for sustainable environmental management and risk disaster management for every city in Indonesia. Figure 8 below shows that the process of initiation and stakeholder involvement relies on intermediate partnerships.

**PROCESS OF INITIATION AND STAKE HOLDERS**

![Figure 8. Process of initiatives formation and stakeholders](image)

4.2. Identification of sustainable program implementation

The study uncovered that the SIBAT initiative is the most dynamic and sustainable initiative when compared to other community initiatives. Notably, the annual and incidental SIBAT activities are all performed routinely. The SIBAT’s initiative formation process demonstrates that many initiatives are also empowering people to build resilience not only at the time of flooding (disaster risk management) but by building the communities’ long-term social and economic vitality. Therefore, the activities more diverse and could engage more community members.
Forum Solo Hijau (FSH) and Ngrekso Lapen Mangun Keprabon (NLMK) focus only on advocating environmental issues. Most of their activities are initiated or based on an invitation from the local and national governments. The programs of FSH and NLMK are rarely based on the communities’ own initiative. This demonstrates that the key actors should not consist of only one person but should be a group of community members who share the same common goals. Thus, community organizations must be groups that initiate their own actions.

The efforts to build partnerships for riverine management are important. Especially for building partnership capacity for collaborative riverine management of Kali Pepe. Local partnerships between different actors can be effective for achieving strategic management objectives as shown from the SIBAT initiative (Figure 9).

**EFFORTS TO BUILD PARTNERSHIP WITHIN RIVERINE MANAGEMENT**

4.3. Effectiveness and sustainability of communities initiative in riverine area

Three community initiatives, namely FSH, NLMK, SIBAT Sewu, and SIBAT Sangkarah were initiated as top-down programs with interventions from both the national and local governments. In addition, community initiatives in disaster risk management (SIBAT Kelurahan Sewu and SIBAT Kelurahan Sangkarah) are largely determined by the effectiveness of the role of key stakeholders (social agents) who are also members of the community. While in FSH and NLMK, the key stakeholders of the initiative were appointed by the local government. The key stakeholders (social agents) are not from within the community.

SIBAT Kelurahan Sewu and SIBAT Kelurahan Sangkarah not only focus on environmental advocacy but also on environmental restoration. The SIBAT activities grew organically from relatively formal activities for disaster risk management activities into small initiatives (see Figure 10). Their regular community activities include monthly trash collection in several localities along the river. This SIBAT community effort for restoring the Pepe River has also resulted in wider cooperation with various stakeholders (NGOs, academicians, and community initiatives). For instance, the SIBAT annual meeting with other areas in October 2017 has resulted in several community initiatives to conduct various events for exchanging knowledge and experiences.

![Figure 9. Efforts to build partnerships in riverine management](image-url)
5. Conclusion
The top-down approach for environmental issues and disaster risk management initiatives should be supported by a bottom-up approach. This is because community engagement as subjects of the environmental issues and disaster risk management will greatly support the effectiveness and sustainability of the programs. In addition, community initiatives for disaster risk management are largely determined by the effectiveness of the key stakeholders’ role (social agents). Key social agents who are also members of the community will be able to easily engage different stakeholders such as the NGOs, academicians, and professionals to collaborate towards the common goals of environmental issues and disaster risk management.

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