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Is local wisdom able to build sustainable communities in informal flood-prone settlements? Evidence from Glintung Kampong, Malang City, Indonesia

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Abstract

Keywords:

Climate change; Flood resilience; Informal settlement; Stormwater management; Urban drainage

This study aims to highlight innovative and sustainable measures in adaptation to climate change and the Covid-19 pandemic through integration into flood control efforts based on empirical data in Glintung Kampong, an informal flood-prone settlement in Indonesia and to explore what local wisdom values influence the success of the measures undertaken. This study was designed to use a mixed method combining qualitative and quantitative data. Qualitative data consists of in-depth interviews, observations, and desk studies. Quantitative data is used for the generalization of some qualitative data across a wider field. The study results show that the existence of drainage channel facilities from the government can trigger creative ideas and innovative measures in the community. Community involvement with their “guyub rukun” and “gotong royong” values is the most influential factor in determining the success of the program, followed by community leaders, the ability to adapt to flood risk, and the ability to establish good interactions with external parties.

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1. Introduction

Sustainable Development Goals (SDGs) agreed upon by world leaders represent a challenge for countries to end poverty, reduce inequality and protect the environment, which is expected to be achieved by 2030. One of the targets is to create sustainable cities and communities through increasing inclusive and sustainable urbanization and the capacity for participatory, integrated and sustainable human settlement planning and management. However, realizing it all is not easy. This requires real, effective, and smart solutions that are not built through a consensus but through broad differences according to the characteristics of each community (Kaika, 2017). Today, more than half of the world's population lives in urban areas. More than 90% of this urban growth is occurring in countries with lower-mid level development. Governments often ignore the rights of the

urban poor and incorporating them into urban planning, thus contributing to the growth of informal settlements (Cities Alliance - UNOPS, 2020). Low-income settlements generally develop on illegal lands such as areas along the edge of canals or rivers. Most of the people in these areas do not have adequate access to health services, sanitation, water and waste disposal, which can hinder sustainable development in urban areas (Uddin, 2018). Inadequate infrastructure facilities have an impact on excessive groundwater use, soil pollution, and a decrease in surface water quality (Surya, Syafri, et al., 2020). A model has been developed to provide clues about the possibility of low-income settlements in the future (Shekhar, 2020), so that it can become a reference for city management. Government investment in public infrastructure and implementation of land status policies should be based on reasonable projections of inhabitants, including residents on land that are currently residing informally (Turok & McGranahan, 2013). Several studies have been developed to improve low-income areas in an integrated manner towards sustainable settlements, including using a zero waste management strategy (Elgizawy et al., 2016)(Elgizawy et al., 2016), disaster management and climate change considerations. Technology adaptation to climate change should be applied to reduce vulnerability, including in poor informal settlements, even though its application affects government budgets both directly and indirectly (Bachner et al., 2019). However, currently, many governments are concentrating budgets on dealing with the Covid-19 pandemic, demanding a high level of funding. Priorities of responses to Covid-19 should especially focus on people in informal settlements because of their vulnerability, such as through insufficient access to water and sanitation for washing hands properly, inadequate space for social distancing, etc. (Wilkinson et al., 2020). Therefore, supplementary fundraising innovations are needed to help overcome the impacts of climate change on life, one of which is participatory budgeting. Unfortunately, the participatory budgeting idea, which has already made a significant contribution, has not received a response on the international agenda (Cabannes, 2021).

Indonesia, the country with the fourth largest population in the world, also has serious low-income informal settlement problems. The problems are widely developed in riverbank areas. Surprisingly, some of these settlements have successfully transformed into habitable settlements with better environmental quality (Sedyowati et al., 2019; Wahyuni et al., 2021). Some areas have even developed into tourist destinations with assistance from local governments and partner funding (Wikantiyoso et al., 2021). People in low-income areas also have business motivations, human resource capacity, active roles, and businesses that have a significant effect on economic empowerment (Surya, Saleh, et al., 2020). However, not all communities are able to maintain the sustainability of programs initiated by the government or partners. In some cases, strong intervention, adequate governance, and top-down development are still needed for low-income improvement to be successful in the long term (Hasanawi et al., 2019). On the other hand, poor city governance and policies that fail to meet the needs of low-income communities have made the conditions for low-income settlements become worse (Olajide et al., 2018), although some low-income settlements also have different social and physical characteristics that provide different impacts. Community involvement is a key factor in the success and sustainability of environmental improvement programs, especially in the program planning and control process (Križnik et al., 2019). Government and partner investment also provides direct and indirect financial benefits (Araral & Holmemo, 2007; Sedyowati et al., 2020; van der Pol et al., 2017). However, there are several important points that need to be considered, including the decrease in partner commitment to provide matching funds in subsequent investment

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20 rounds, as well as the sensitivity of a 20% increase in costs and a 20% reduction in benefits due to the existence of some sub-projects that are more sensitive than others (Araral & Holmemo, 2007). The values of local wisdom that have been deeply embedded in the community are also potential assets for maintaining commitment when realizing better urban planning (Wikantiyoso & Tutuko, 2014).

In this paper, the experience of a kampong community in Indonesia, namely Glintung Kampong, an informal flood-prone area in Malang City, in adaptation to climate change in the current new normal era will be discussed thoroughly. A kampong is a group of houses that are part of the city usually inhabited by low-income people. The first objective is to highlight the innovative measures used in transforming a kampong based on three pillars of sustainability by optimizing existing infrastructure and local resources. The second objective is to explore what local wisdom values influence the success of the efforts undertaken, so that they can be adapted to other kampongs and even to a wider scope.

2. Methods

Study Area

14 The study area is located in East Java Province, which is the province with the second largest population in Indonesia. The research object is Glintung Kampong, which is a flood-prone area in Malang City, the second largest city in East Java Province. Glintung Kampong is also known as Glintung Water Street (GWS). The name GWS was inspired by the function of the roads in this kampong which turn into channels during heavy rain, especially on roads that are within a radius of ± 100 m from the main drainage channel. Since the beginning of 2000, almost 50% of the area has been flooded every rainy season with an average flood height of 0.7 meters and a maximum of 1.5 meters. The kampong is bordered by a main city drainage channel, known as Kali Lahar, about 12 meters wide in the south. In the west it is bordered by a highway connecting two major cities in East Java Province, Malang and Surabaya. In the northern part, the kampong is bordered by a neighbouring kampong which is densely populated and at a higher elevation. In the eastern part there is a railroad with a higher position than the kampong. Therefore, the GWS kampong is like a pond during stormwater events. The condition worsens due to a backwater flow when the water level in the Kali Lahar increases and water overflows into the kampong. The location map of Glintung Kampong and the kampong condition during stormwater event are as shown in Figure 1 and Photo 1.



Figure 1. The Situation map of Glintung Kampong location, bordered by the main road (at the west), higher density neighboring kampong (at the north), railroad (at the east), and Kali Lahar (at the East)

(Source: Own Elaboration, adopted from CADMAPPER, accessed on January 04, 2022)



Photo 1. Inundation height during and 30 minutes after stormwater event.

(Source: A Wijayakusuma, research contributor, photo taken on January 5, 2021)

The GWS kampong is led by a Chairman of the Rukun Warga (RW). The RW is an administrative structure under the village head. One RW is in charge of several Rukun Tetangga (RTs). The RW of the GWS kampong is in charge of five RTs. In January 2021, for the third time, the current kampong chairman was elected by the community to continue to lead the kampong. With an area of 8.2 ha and a population of 810 people, this area is classified as a high-density settlement, which is around 9,900 people/km². About 60 percent of the population is female and 40 percent male. The population of productive age is around 60 percent, teenagers and children are 30 percent, and 10 percent are the elderly. Based on the highest education, nearly 70 percent of the population are high school graduates, 20 percent undergraduates, 5 percent postgraduates, and 5 percent junior high school graduates. Based on occupation, 50 percent are employees, 20 percent are within the state civil apparatus, 10 percent are teachers, 10 percent are traders, 5 percent are self-employed, and the rest are unemployed.

Existing drainage infrastructure

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To reduce the inundation height that occurs in the kampong, in 2018 the **Malang City Government**, through the **Public Works and Spatial Planning (PUPR) Agency**, constructed a drainage channel with a total length of 40 meters. The channel consists of two canal sections, the northern section along 24 meters and the western section along 16 meters. On the initiative and collective action of the local community, the drainage channel was modified so that it can also be used for fish and vegetable cultivation following a concept of urban farming. Modifications were made by retrofitting a vertical filter partition on several segments, which is used to filter water and keep fish from drifting away. The drainage channel modification is shown in Photo 2.



Photo 2. Retrofitting the drainage channel for fish cultivation, and water reuse for vegetable cultivation

(Source: Author, photo taken on March 26, 2022)

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Initially, the channel was only used for the cultivation of catfish and vegetables such as eggplant, chili and tomato. Catfish seeds were obtained through collaboration with a research team of the Civil Engineering Study Program, University of Merdeka Malang, while the vegetable seeds were donated by the Public Works and Spatial Planning Agency. Currently, the types of fish that are cultivated are increasingly diverse and include tilapia, tombro and catfish, in addition to the variety of vegetables, now including mustard greens, pumpkin, lettuce, kale and spinach. The types of fish and vegetables chosen are those which are usually consumed by the community on a daily basis, because it is hoped that the results of fish and vegetable cultivation can meet the nutritional needs of the community.

Data collection and analysis

According to the research objectives, this study was designed to use a mixed method combining qualitative and quantitative data. Qualitative data collection was carried out through in-depth interviews, observations and desk studies. There were 10 research informants composed of a key informant (head of the RW), main informants (environmental executives, food security executives, urban agriculture executives, local woman organization chief, youth leader), and companion informants (kampong chief, sub-kampong leaders, religious leaders, elders, and local government officers). The observation used is a type of participant observation, which is a type of observation in which researchers observe the behaviour of participants while they are involved in activities (Creswell & Creswell, 2017). In this observation, the researcher is involved in the daily activities of the person being observed or who is used as a source of research data. Observation results provided data on the existing community flood resilience system, community interaction with the local government and partners, as well as creative community ideas and local community skills in optimizing the function of drainage channels. To explore data on flooding, flood losses, local wisdom values and kampong conditions from the past to the present, a memoir-type document data review was also carried out (Gentles et al., 2015). All qualitative data obtained from interviews, observations and literature studies were analysed using the interactive qualitative analysis technique which includes four steps, namely data collection, condensation of data, data presentation, conclusion and verification (Miles & Huberman, 2014).

The collection of quantitative data was done through the distribution of questionnaires. Respondents were selected using a purposive sampling technique, i.e., people who truly understand the conditions of the kampong and its management were selected. For this reason, the interviewees are kampong administrators, housewives and civil servants who actively participate in government programs in the study areas. The questionnaire includes five categories of questions as follows: 1) creative ideas and innovative measures towards community sustainability; 2) community leader; 3) participation in kampong improvement activities; and 4) Community interaction with external parties- government and non-government partners. Responses to the questionnaire were recorded according to the four possible options of a Likert scale. The four options are: always (4); often (3); rarely (2); never (1). The data is then analysed using reliability and validity tests. The questionnaire is filled in through direct interviews with the respondents and the answers are filled in directly in the appropriate column. The questionnaire data was then analysed using a correlation test, determination, and regression analysis.

Sustainability Indicators

Based on SDGs indicators for Indonesia (Bappenas, 2017), some goals and indicators are selected to evaluate the transformation process in Glintung Kampong, as follows: (1) the existence of equal rights to access economic resources, basic services, property rights and tenure over land, natural resources, appropriate new technologies, and financial inclusion, with indicators: percentage of households that have access to adequate and sustainable drinking water sources. (2) Build resilience of the poor and those in vulnerable conditions, and reduce their vulnerability to climate-related extreme events and economic, social, environmental and disaster disturbances, with indicators: the number of locations for strengthening regional disaster risk reduction, meeting the basic needs of victims of social disasters, the number of natural disaster/social disaster areas that received special service education, the existence of a disaster risk reduction strategy (DRR) document at the national and regional levels. (3) Ensure sustainable food production systems and implement resilient agricultural practices that increase production and productivity, help protect ecosystems, strengthen adaptive capacity to climate change, extreme weather, droughts, floods, and other disasters, and progressively improve soil and land quality, with indicators: determination as a sustainable food agriculture area. (4) Achieve access to adequate and equitable sanitation and hygiene for all, and stop the practice of open defecation, paying special attention to the needs of women, as well as vulnerable groups of people, with indicators: the proportion of the population using safely managed sanitation services, including hand washing facilities with soap and water. National indicator: percentage of households that have access to proper sanitation services. (5) Substantially increase the share of renewable energy in the global energy mix, with indicators: the using of hybrid energy.

3. Results and Discussion

Sustainability Drivers

Based on the results of the documentation study, it is known that since 2018, the GWS kampong has successfully transformed into a village developed according to the concept of sustainability and using local wisdom values, namely harmony and mutual cooperation (Sedyowati et al., 2019). Creative and innovative ideas lead the community to modify the drainage channel built by the PUPR Agency in GWS so that it can be used for the development of urban farming, namely fish and vegetable cultivation. Drainage channels built as part of the flood control system have succeeded in reducing inundation heights by up to 30%, and created additional socio-economic benefits between 70-90% (Sedyowati et al., 2020). However, the Covid-19 pandemic, which has had a significant impact on the national economic and social sectors (Fikri, 2021), has also had an impact on reducing the revenue of GWS by up to 50%. The pandemic has also brought about a negative impact on the infrastructure development budget of the PUPR Agency by up to 37.5% (Novika, 2020), so that funds are no longer available for maintenance and repair of channels in GWS.

Therefore, the community then is making various efforts to ensure the sustainability of the program in support of the realization of the three pillars of sustainable development namely economic growth, social equality, and environmental preservation, in situations of the uncertain impact of climate change and the Covid-19 pandemic. The efforts made include structural and non-structural measures. Structural steps are in the form of developing appropriate alternative energy technology for independent energy supply in supporting urban farming. Whereas non-structural measures include raising funds to

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finance channel operations and maintenance, and charity programs for the un-wealthy community so that they can survive under current conditions.

Achievement of Sustainability Indicators

The following are some of the findings that are also indicators of the SDGs as mentioned above, describing the success of the efforts undertaken: (1) 6% of residents get access to drinking water from Municipal Office of Drinking Water Supply, and the rest from water sources in the kampong that are feasible and continuous. (2) Glintung Kampong is involved in strengthening the programs of several institutions, including: the East Java Regional Police through the Self-Resilient Kampong Program in adaptation to the Covid-19 pandemic; the Department of Agriculture through the Food Security Village Program; the Tourism Office through the Tourism Awareness Group; the Public Works Department through the Flood Resilience Kampong Program; and the Environmental Service through the Communal Septic Tank Program. (3) Glintung Kampong develops its urban farming by reusing water in drainage channels for fish and vegetable cultivation. Energy supply for urban farming operations is obtained from hybrid energy sources, namely electrical energy and solar energy. The solar cells to generate energy for circulating water as seen in Photo 3. Furthermore, the use of water turbines will also be developed as an alternative energy supply (Photo 4). (4) Almost 100% of houses have toilets, but 50% are without septic tanks. However, through the Environmental Service Strengthening Program, communal septic tanks have been built.



Photo 3. The installation of solar cell to supply energy for circulating water from the drainage channel

(Source: Author, photo taken on March 26, 2022)

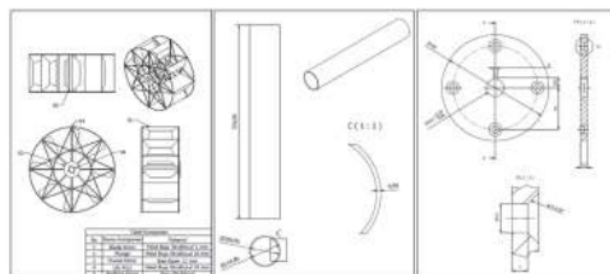


Figure 2. The design of water turbines as an alternative energy supply

(Source: Own Elaboration, adopted from Autodesk Inventor Pro 2021, accessed on April 15, 2022)

Towards Sustainable Community in Adaptation to Climate Change

To date, Glintung Kampong is also known as a place for comparative studies against other communities in the Malang City area, outside Malang City, and even from outside East Java Province. This success cannot be separated from the following factors: (1) the values of local wisdom that always present in every step of people's lives, namely living in harmony ("guyub rukun") and cooperation ("gotong royong") which have been used to solve all problems in the kampong, especially during the Covid-19 pandemic. (2) The spirit of the community that always tries to improve the achievement targets for the next stage. This means that the community unconsciously has implemented continuous improvement and program sustainability. (3) The ability to interact with external parties, such as businesses, and build good relationships. (4) The ability to raise funds and other resources from external parties to achieve the increased target; the community collects funds from third parties such as businesses. For example, the provision of solar cells that are used for hybrid energy were obtained from sympathizers. This finding supports the research results of Cabannes (2021) on participatory budgeting (PB). (5) The assistance from academics in developing adaptation technology to climate change, such as simple flood early warning and flood proofing to minimize flood risk, appropriate technology for generating renewable energy, and urban farming technology using drainage channel water reuse and renewable energy. (6) The chairman of Glintung Kampong can carry out their duties properly and they have obtained a high level of trust from the community, as indicated by their being chosen again as the chairman for the third time. Almost 75 percent of residents want the incumbent to continue leading the kampong. (7) The role of women who take care of the household in their daily lives, interact with neighbours, and are involved in kampong management, and who directly or indirectly disseminate all kampong programs.

Most Influence Factors

According to in-depth interviews, some parameters were identified that build creative ideas and innovative measures towards community sustainability. Those parameters are the community leader, adaptation to flood risk, interaction with external parties, and community participation in kampong improvement activities. Based on those parameters, a set of statements were then made which are compiled in a questionnaire as an instrument for collecting quantitative data. Analysis using correlation and regression methods were then undertaken to know the relationship between each parameter, and how each parameter independently and simultaneously affects the building of creative ideas and innovative measures by the community. The analysis results show that the parameter that has the most significant influence is community participation, at 78%. This finding supports the research results of Križnik, Im Sik, and Su (2019). Meanwhile, the community leader, adaptation to flood risk and interaction with external parties have almost the same effect, 46%, 46% and 41%, respectively, as shown in Table 1 below.

Table 1. Results of Regression Analysis

| Code | Parameters | Statistics values | | |
|----------------|--|-------------------|---------|--------------|
| | | r | P-value | Significance |
| Y | Creative ideas and innovative measures towards sustainability | | | |
| X ₁ | Community leader | 0.46 | 0.000 | valid |
| X ₂ | Adaptation to flood risk | 0.48 | 0.000 | valid |
| X ₃ | Interaction with external parties | 0.41 | 0.000 | valid |

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| Code | Parameters | Statistics values | | |
|----------------|---|-------------------|---------|--------------|
| | | r | P-value | Significance |
| X ₄ | Community participation in kampong improvement activities | 0.78 | 0.000 | valid |

The regression analysis also formulates a model for the building of creative and innovative ideas for the Glintung Kampong community, described below:

$$Y = -2.11 + 0.41X_1 + 0.33X_2 + 0.16 X_3 + 0.79 X_4 \quad (\text{Equation 1})$$

The model above describes that if there are no community leader factors, adaptation to flood risk, interaction with external parties, and community participation in Glintung Kampong, then there will be no creative ideas that appear, in fact a negative value with a coefficient of 2.11 is demonstrated. If the factors of community leader, adaptation to flood risk, and interaction with external parties are assumed to be 1, then an increase in the value of participation will cause an increase in creative and innovative ideas by 0.79. In the same way, it can be determined that the increase of each parameter according to the model coefficients for community leader, adaptation to flood risk, and interaction with external parties, would be 0.41, 0.31 and 0.16 respectively.

This result is in accordance with the values that already exist in GWS society, namely living in harmony and mutual cooperation, which means that all problems may be easily solved together. This encourages almost all people to be actively involved. They understand that they are forced to live on informal land because they have no other option to live in the city on a limited budget. Initially, residents did not realize that they live in a flood-prone area, the border area of the city's drainage channel. However, along with the increase in urbanization in the area, the previously empty land has become filled with increasingly dense buildings. The residents, however, do not surrender and dissolve into adversity because of the condition of their residence which is in a flood-prone area. They are constantly trying to improve their lives. All the efforts they make are not based on certain obligations or regulations, but are driven by a desire to change. They try to survive by helping each other. The negative stigma of informal settlements that are often accused of violating unreasonable city regulations should gradually be changed. This statement supports the research results of (Wilkinson et al., 2020).

However, the active involvement of the community will not come about as a strong force without a true community leader. The chairman of Glintung Kampong has a good education with a bachelor's degree in Economics. He is also friendly, humble, nurturing of all people without distinction, and hardworking as well. These characteristics drive people to respect and appreciate him. Residents always try to follow all his invitations and appeals to jointly improve their kampong. External parties are also sympathetic and voluntarily contribute to participatory budgeting to support the financing of kampong programs. Currently, it seems this kind of leadership is acceptable and can drive the community and other parties.

This study recommends that the success and sustainability of government programs are considerably determined by the characteristics of the community itself, which cannot be generalized. Each community will have its own excellences and uniqueness, so that it will produce different proposed programs which cannot be set according to national or international standards. This recommendation is in accordance with Cabannes (2021). However, there is one essential thing that may be adopted for other regions, that is the

existence of a very important driving actor to mobilize the community and external parties. Therefore, in implementing a program in an area, it is important to deepen study of the characteristics of the community covering social, economic, and environmental aspects. This statement supports the research results of Kaika (2017). It is also necessary to initially identify whether there are community leaders who can give full support so that the program's goals and objectives can be achieved. However, the most important thing is the willingness of the government to provide public services facilities to the community like other city residents. This study found that the facilities, even just a little, can trigger the community to do every effort in improving their kampong or environment. Through the good interaction between the city government and the community, a sustainable city as the SDGs target can be realized.

4. Conclusion

This paper attempts to highlight innovative measures in transforming the kampong based on three pillars of sustainability by optimizing existing infrastructure and local resources based on empirical data in Glintung Kampong, an informal flood-prone settlement in Indonesia, and to explore what local wisdom values influence the success of the measures so that they can be adapted to other kampongs, as well as to a wider scope.

The flood control program implemented by the Malang City Government in response to the impact of climate change in Glintung Kampong has succeeded in encouraging the community to come up with creative ideas and innovative steps to maintain the sustainability of the program and the kampong's economic growth in the current Covid-19 pandemic situation. Almost the entire community is actively involved without coercion, driven by the desire to obtain social equality, improve well-being, and obtain a clean and healthy environment, even though it is located in an informal flood-prone settlement. With the involvement of all community members, it will provide greater opportunities for the emergence of creative and innovative ideas. Therefore, the results of the study show that active community participation and their values, namely "guyub rukun" and "gotong royong" is the most influential factor. The following factor is the community leader. The success in mobilizing the entire community to be actively involved so that creative and innovative ideas emerge is strongly influenced by the figure of the kampong leader. His leadership style that has been applied so far in the GWS kampong has succeeded in embracing all community members and external parties. The next factor is the community's capability in adaptation to flood risk as the impacts of climate change continue, and the ability to interact with external parties. One important consideration for the success of the program more broadly, is that no program should be the same for different locations and communities.

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