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Analysis of Climate Change Adaptation Program Implementation on Urban Riverside Low Income Communities, Indonesia
Case Study of Yogyakarta

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Abstract.
Climate change in urban areas has more aggravated focus as more and more humans are living near city centers. Climate change in the form of heavy rains with medium and high intensity makes floods often occur on the banks of urbanized rivers. This article aims to show the characteristics of slum riverside settlements within Yogyakarta city and the optimal quality improvement program for settlements in that place. Kampung Suranatan, Gemblakan Bawah, and Mrican-Giwangan located on the banks of the Winongo, Code, and Gajahwong rivers in the city of Yogyakarta are inhabited by low-income communities. This purposive sampling research was conducted using the snowballing method on eight informants to map the conditions, climate change adaptation program implementation as well as determine the most optimal program. The results showed that although they were often hit by floods, these three kampungs were able to survive because the communities in them were proactive in various environmental conservation movements, especially riverbanks. This proactiveness is the most important provision to become a climate-resilient kampungs.

Keywords: riverside slum, low-income communities, urban rivers

1. Introduction

All over the worlds' riversides experience flooding. However, within urbanized riversides, resided low-income communities (LIC) who became victims of annual floods. Regarding climate change data, increased rainfall occurred in Kalimantan, Java, Sumatra, and Papua between 1998 and 2010. Meanwhile, decreased rainfall is experienced on the west and south coasts of Sumatra, East Java, Maluku, southern Sulawesi, West Papua, and Bali (As-syakur, et al 2012). Heavy rains with high intensity with the peak of the rainy season shifting in February (Nugroho, S.P., 2008) affects the severity of floods that often occur on the banks of the three rivers.

In addition, its location downstream of rivers that originate in an active Volcano, namely Merapi, at the peak of the rainy season with 200mm of rainfall (Belizal et al., 2013) triggers a lava slide, if previously there has been a buildup of material on the slopes of the mountain. It is what happened to the three rivers that were adjacent to the low-income communities' residences. The potential for lahars from Mount Merapi in 2010 with a repeat eruption once every 100 years, may not happen shortly, but this potential is still there. The area where they live is flooded by river water at least once a year, not to mention the lahars. LIC's efforts in dealing with these risks cannot be separated from regional characteristics. Their experience in adapting to potential disasters and climate change can be a lesson for other locations with similar multi-risk contexts

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The city of Yogyakarta is adjacent to Sleman Regency in the north with one of the most active volcanoes in the world, namely Mount Merapi, also bordering the east. Bantul Regency borders the south side and is agricultural land domination. On the west, the city is bordered by Kulonprogo Regency, now the home of the Yogyakarta International Airport. The city of Yogyakarta is the smallest compared to other municipalities in the Special Region of Yogyakarta (32.5 km2), consisting of 14 Districts, 45 sub-districts, 614 RW, and 2,525 RT. Statistics state that 428,282 people live in Yogyakarta (BPS, 2021), with a density of 13,117 people/km2. Despite its small size, the city is dense and inhabited by many residents. During the five-year development era (mid-term) until 2020, population dynamics occurred in this city. The table below describes the dynamics of the population of Yogyakarta for 10-years in the last five decades.

Table 1. Population Growth of Yogyakarta City per 10 years for five decades

Year	Population	Population Growth
1980	398.192	1.72
1990	412.059	0.35
2000	497.669	1.48
2010	388.627	-0.21
2020	428.282	1.00

Table 1 explains an increase in the number of residents in Yogyakarta. In 2010 there was a decline in the Yogyakarta population, but this was due to the Yogyakarta administration border change turned into Sleman and Bantul. It means the population in Yogyakarta continues to increase and explains that rapid urbanization is also happening in this city.

This city has three main rivers; Winongo, Code, and Gajahwong. These three rivers are upstream of small rivers at Merapi. As in urban areas in Indonesia, there was uncontrolled urbanization even in the pre-independence era in these three locations (McGee, 1997). The LIC live and carry out their daily lives as part of Yogyakarta on these three riverbanks. Yogyakarta is unique since it is the only living sultanate within the Republic of Indonesia. With that in mind, there are ways of doing things such as land titling in urban kampungs, which especially only happens in Yogyakarta (Geertz, 1976).

Urbanization that occurs on these riversides is characterized by the distance between houses that are close together, the width of the narrow road dimensions, the form of slum settlements with the number of house occupants exceeding the population, and the behavior of the community is not yet aware of the environment (Sadali, et al., 2018). There is a fusion that unites villages and cities in urban areas. Here social relations created in villages are brought to cities; there are no boundaries as in the Eurocentric view where villages and cities are separated (Arie Setyaningrum Pamungkas, 2016: 1-5.). McGee referred to this as the 'desakota' phenomenon or urban village, also called as kampung.

Talking about the area, of course, cannot be separated from the character that formed it. The characteristics of settlements are explained in ekistics as a science by Doxiadis (1967). It explains that they can be seen based on the five constituent characters; humans, nature, shelter, society, and their networks. These five characteristics are summarized for the LIC settlements; the physical dimension and the accompanying infrastructure/infrastructure, the

social dimension and the involvement of relevant stakeholders, and the financial dimension for the funding scheme used.

Research conducted by Srinivas (2005) and Bredenoord, J. (2016) also divides the conditions of LIC settlements into three characteristics are related to Doxiadis theory, namely physical characteristics, namely the environment and shelter, non-physical characteristics; social community (humans, society, and its network), and the legal side. Judging from the spatial arrangement that makes this area a place for humans (Carmona, 2003), the physical form of LIC settlements consists of a network of physical and social infrastructure such as clean water, sanitation, electricity, roads, and drainage; schools, health centers, markets (Bredenoord, J., 2016). The condition of the social character of the community is seen from the income and origin of the people living in the area (Srinivas 2005), while the legal characteristics are the lack or absence of legal ownership of the plots of land they occupy (Srinivas 2005).

Based on the previous research, the novelty of this paper is the fact that the riverside is located within active volcanic lahar flow, situated within a unique cultural setting of kampungs in the only active kingdom of Indonesia, namely the Yogyakarta Sultanate of Yogyakarta Special Region.

1.1. Characteristics of Implemented Programs

LIC settlements in Yogyakarta are grouped based on their characteristics or type using the basic understanding of ekistics; to achieve order between humans as residents of the settlements with the physical and social environment (Doxiadis, 1967). Many forms of this LIC settlement are found from the ekistics point of view. The international discussion panel on clean water and sanitation for urban poverty (Water and Sanitation for Urban Poor-WSUP) describes several criteria for determining the location of LIC settlements in an urban context, such as accuracy of infrastructure needs, land ownership and rent, population density, level of demand for services, and technical and financial feasibility. Determining this technical and financial feasibility can support interventions, for example, LICs are close to their interconnected neighbors, or exclude low-water pressure environments. Local understanding and consensus or agreement on intervention areas and 'known' LIC settlements with easily identifiable boundaries need an official definition of urban poverty. In summary, several studies from the World Bank (Srinivas 2005; Bredenoord, J., 2016) divide LIC settlements into three characteristics; based on their physical form, the social character of the community, and their legality.

Some experts suggest the similarities in the physical characteristics and services of LIC settlements. Both of these are usually limited or inappropriate (Srinivas 2005; Bredenoord, J., 2016). Physical and social infrastructure networks such as clean water, sanitation, electricity, roads, and drainage; schools, health centers, and markets exist, but their services are limited/incomplete/not supportive. Clean water supply already exists but is limited from the city network, or they are using wells with a pump system distribution. Likewise, drainage and toilet facilities also exist, but the LICs are still highly dependent on public authorities or rely heavily on the city's distribution network. Usually, these facilities are communal, such as community sanitation or often known as 'Sanimas'.

The social characteristics of the LIC settlements are divided based on the income and origin of the people living in the area (Srinivas 2005). First, most LIC settlement households have livelihoods in various informal sector companies. On average, most earn wages at or near the minimum wage level. Second, regarding their origin, the residents of the LIC settlements are mostly immigrants (migrants) and not natives, both rural-urban and inter-city. Second or third-generation migrants inhabited these LIC settlements. These two things cause the social position in the LIC settlements to be weak and helpless.

In general, the status of LIC settlements is unclear and even illegal. The most visible legal characteristic of these settlements is the lack or absence of legal ownership of the plots of land they occupy (Srinivas 2005). Many LICs live on vacant government or public lands, or marginal land parcels such as railway and river boundaries, or former swamplands that are difficult to build. When land is not used "productively" by the owners, the LIC took it to build their houses. In many countries in Asia, many landowners "lease" their land for a nominal fee to LIC with informal arrangements that are not legal under the law.

The three characteristics above indicate that the position of LIC settlements in urban settings is very weak with all the limitations it has. All limitations in services and physical infrastructure, weakness in social condition, and unclear legality must be strived to improve the settlement's quality, by positioning its status more in favor of the LIC. The discussion below describes various efforts to improve these qualities. Based on these characteristics of implemented programs, the analysis of the case will be proposed.

This article aims to answer research questions regarding "How the Climate Change Adaptation Program on Urban Riverside Low-Income Communities is implemented?" This article describes the condition of LIC settlements in Yogyakarta. Additionally, it analyzes the types of implemented climate change adaptation programs. Later on, it explains which program works best to improve the climate change resilience settlements in that place.

Efforts to adapt and mitigate climate change at ProKlim locations can be in the form of:
Control of droughts, floods, and landslides;
- Increasing food security;
- Control of climate-related diseases;
- Handling or anticipating sea level rise, rob, sea water intrusion, abrasion, ablation or erosion due to wind, high waves.
- Management of waste, solid and liquid waste;
- Treatment and utilization of wastewater;
- The use of new renewable energy, energy conservation and saving;
- Agricultural cultivation;
- Increased vegetation cover; and
- Prevention and control of forest and land fires.
(Ministry of Environment and Forestry, 2017)

2. Methods

The method used for this study is case study comparisons. This method is used to find patterns for the entire city's implementations. The method used is qualitative with purposive sampling in the form of snowballing for primary data sampling, with a final result of eight informants. At the beginning of the study, the researcher took two informants based on the clustering of stakeholders, one from the bureaucrats and one from the community. It developed into four informants, one from bureaucrats and three from community members. These informants refer to the more informants. In each case study, five informants are added to represent conditions of LICs and the type of programs implemented. In total 30 informants' data were collected and analyzed. Moreover, during direct observations, the researcher also obtained photos and documentation in the field. We also use secondary data, such as policy documents, statistics of the LIC population, and maps. Relevant policymakers or personnel they refer to provide these data.

There is also a mapping method using google maps, by providing notation on the location of river border areas, LIC settlements, regional functions, and photos of observations. Spatial correlation analysis used mapping tools to make sense of the LIC's settlement location and

characteristics based on the typology explained in the introduction. This analysis helps to show the patterns of implementation.

3. Discussion

Doxiadis explained the area characteristics in general, which is sharpened by the study of Srinivas (2005) and Bredenoord (2016) specializing in the LIC settlements' characteristics. These characteristics are physical and non-physical: social community and legality. In Yogyakarta, there are several Kampungs located on the riverbanks (Wicaksono and Ariyanti, 2017). The location is shown as a mapping analysis in Figure 2. Case studies are located in three urban river areas: Code, Winongo, and Gajahwong which are densely populated areas of LIC in Yogyakarta. In each river a representative location was chosen, namely Kampung Suranata, Gemblakan Bawah and Mrican-Giwangan. Previous research shows that these kampungs have several programs implemented (Wicaksono, 2020).

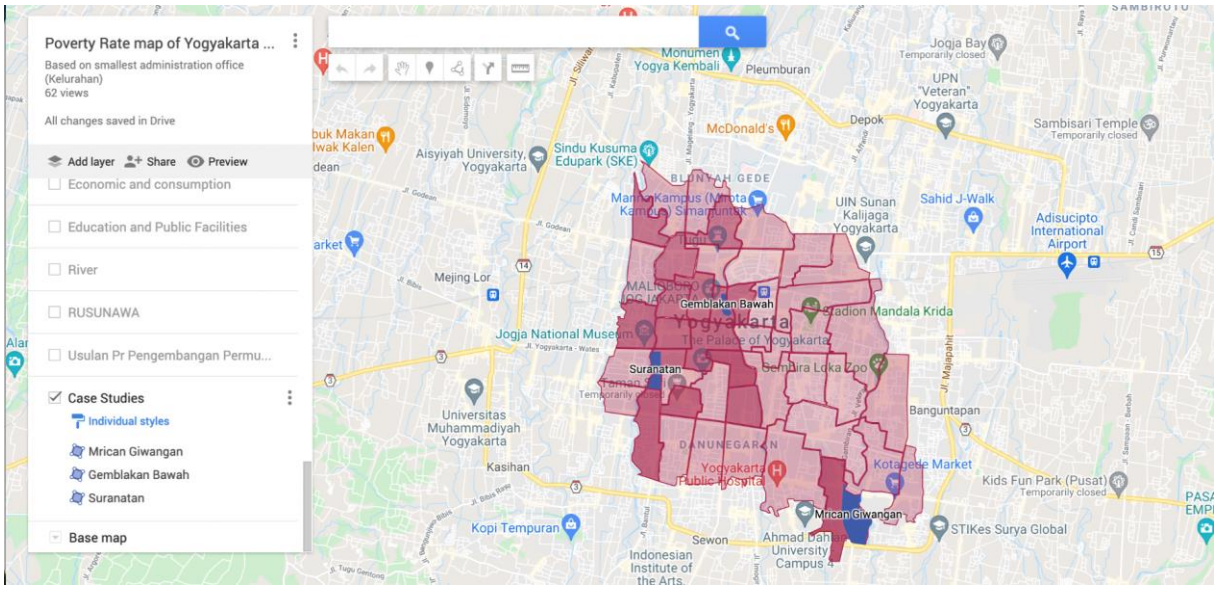

Figure 2.1. Map of Slum Areas in Yogyakarta (Author, 2022)

3.1. Kampung Suranatan

Suranatan is a densely populated kampung located in Notoprajan Sub-district, along the banks of the Winongo river at two indentations on the south side (downstream) (Figure 3). The topography of this kampung area varies with gentle and steep slopes. Suranatan is a Javanese term 'sura-nata' which means 'to arrange a surau/mosque'. The shape of the buildings in this kampung is generally in the form of traditional Javanese buildings with kampung-styled roofs or saddles of clay/tile materials, most of which have brick walls, although houses are still found with wooden walls. There is a cultural heritage site in this kampung called Ndalem Notoprajan, which used to be the residence of Prince Notoprajan, a relative of Sultan HB V who was known as a religious person and a 'rebel' who always fought against the Dutch colonials. This building is now used as the Ministry of Education and Culture's art office.

Figure 3.1. Map of Kampung Suranatan (red) and the Winongo River
(Source: Ministry of Public Works, 2021)

Although it looks a little 'not updated,' almost all the streets in Notoprajan alley are neatly arranged from paving block paving materials from the Islamic Mataram era, complete with road shading. The banks of rivers in the flood boundary area are equipped with embankments and safety fences (Figure 4). The completed infrastructure and topography on the two sides of the river make the Suranatan area, including its riverbanks, rarely flooded.

However, it is necessary to pay attention to the security side of the infrastructure because it is getting old. In 2020, during the rainy season, the embankment collapsed in this kampung and caused damage to five houses. As it turned out, many of the locals were also courtiers of the palace. Many of them are courtiers of Suranata, who are in charge of arranging the surau or mosque as a place of worship. Apart from being soldiers, their tasks are preparing Islamic religious rituals for the Sultan, his families, and relatives, such as prayer mats, prayer beads for dhikr, and articles for prayer (Bekti, 2019).

Figure 3.2. The condition of the embankment and LIC settlements in Kampung Suranatan
(Author Observation, 2022)

Kampung Suranatan has a Winongo River Community that is proactive in community empowerment through M3K, 'Mundur, Munggah, Madep Kali' translated as 'retreating, raising, and facing the river' movement. This community is called FKWA, Winongo Asri Communication Forum. The informant explained that from 2010 to 2020, the stakeholders (both bureaucrats and the community) implemented their vision of protecting the environment through the M3K river management program. The community initiates this program. The informant conveyed that the community contributed through several initiative programs in the field. It is a form of autonomy for change to adapt to the impacts of climate change.

Apart from M3K, other programs related to adaptation initiated by the community are also carried out based on the stages of river elevation, namely water conservation upstream, M3K movement in the middle, and 'biotilik' downstream. The municipal government recognized the program as the river protection movement. It shows that the community is aware of the problems that exist at each stage, and can provide specific solutions through the implementation of collaboration between stakeholders.

The informant explained that in 2018 a combination of officials from several government agencies together with residents in Suranatan had evaluated the support components in the kampung settlements for environmentally friendly things through the Kampung Proklim program at the Yogyakarta City level. The people in Suranatan are generally LIC. The people of this kampung have a steady income, even though they live in or below the poverty line. However, Suranatan has the 'privilege' in urban planning projects. Whatever the program, this kampung always gets top priority from the regional and municipal governments.

Kampung Suranatan is close to Kauman Yogyakarta, the residence of Muslim merchants of Arab descent who are generally traders. Kauman Yogyakarta is also known as Muhammadiyah's basecamp. It was where KH Ahmad Dahlan first preached and developed

his organization. Although today Kampung Suranatan is no longer a special settlement for courtiers of the palace but has mixed with the general public, its unique character as an area where 'worship experts' live and its closeness to Kauman Yogyakarta is maintained. Every day, when prayer time arrives the majority of residents (Muslim) rush to the nearest mosque and surau. Although located in small alleys, this kampung the crime rate is low. There are almost no incidents of theft and brawls/fights between residents. There is even an alley in this kampung called 'Gang Guyub Rukun.' The nickname is because the population is known to be diligent and obedient in carrying out the commands and teachings of Islam.

Rohijani: “As a community, we often work voluntarily, sometimes there are programs, but not always (there are)”

In Kampung Suranatan, the community is active in environmentally friendly activities. The community with the municipal government initiates a productive green kampung in Suranatan (Mutiara, 2018). The ‘Proklim’ program from the Environment Agency empowered the community through the waste bank program (Figure 5).

Figure 3.3 Organic waste processing into fertilizer carried out by Surolaras Waste Bank, in Kampung Suronatan using Eco Enzymes (Raharja, 2016)

Meanwhile, the legality of land status in this kampung is the Sultan Ground, especially on the banks of the Winongo riverside. This status is also called ‘kekancingan’ land. In Javanese, the word ‘kancing’ means key. Therefore, the status is 'locked' by the palace in the form of a letter of agreement. The legal status of this land can be used, but cannot be traded.

3.2. Kampung Gemblakan Bawah

Kampung Gemblakan Bawah is a kampung located along the banks of the Code River in Suryatmajan Village (Figure 5). In Yogyakarta, there are two Gemblakan, the Lower Gemblakan is the kampung below (by the river), and Upper Gemblakan is on the upper side (the side of the highway).

The shape of houses in Gemblakan Bawah is generally ordinary houses with a saddle roof made of clay/tile, and almost all of them have brick walls (permanent). In contrast to Notoprajan, whose topography varies, the area of Gemblakan Bawah is generally more below the road surface in front of it, tending to be parallel in height to the riverbank (Figure 6). It makes this village area often flooded during the rainy season. According to the informant, the water level that comes out of the river's flood boundary during a flood can reach one meter or

more. The sanitation system in Gemblakan Bawah still does not meet proper health standards. Residents still do not pay attention to the rest of the kitchen and bathroom waste; all household waste is channeled directly into the river.

Figure 6. Physical conditions of settlements in Kampung Gemblakan Bawah
(Author Observation, 2022)

The informant explained that Gemblakan Bawah had been a slum area for years. Many houses were built on riverbanks with a distance of fewer than 1.5 meters, as shown in figure 6. The Kotaku (City without Slums) program implementation by the Ministry of Public Works widened the road in Gemblakan Bawah village to three meters. Houses affected by it were rebuilt in areas higher or above the flood limit. Construction of rainwater drainage channels and green open spaces, renovating several public infrastructure facilities. These facilities are shared toilets, flood monitoring posts, and the construction of local communal spaces (Ariyanti, 2019, Nugraheni and Kusmaryadi, 2019) (Picture 7).

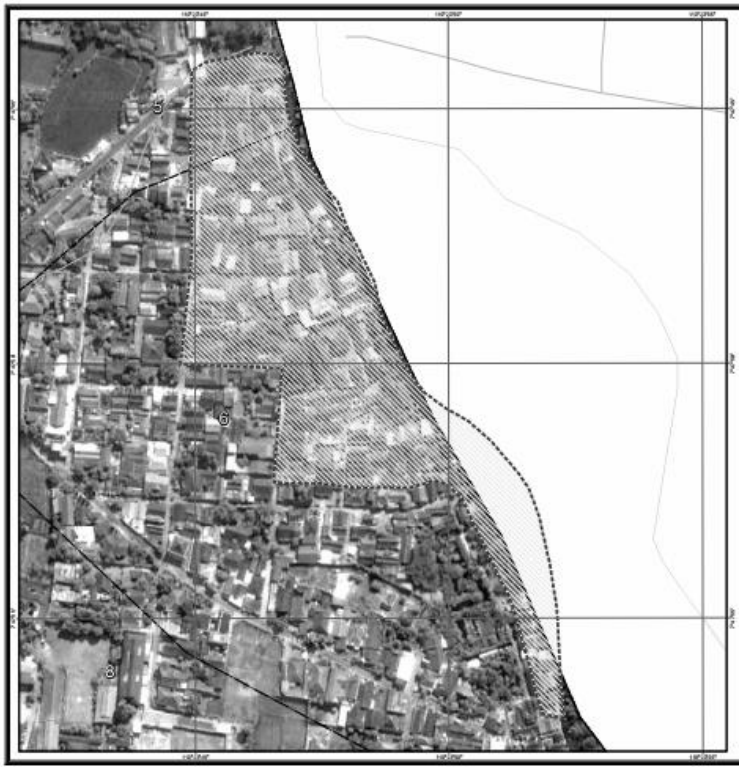

Figure 7. Concept map of potential development in Kampung Gemblakan Bawah
(Source: Ministry of Public Works, 2020)

The movement to change villages along Code River was initiated in 1984 by YB Mangunwijaya, better known as Father or Romo Mangun. However, this movement does not seem to have reached Gemblakan Bawah village yet. The informant stated that actually, the Code River has a community called Pemerti Kali Code (PKC). However, this movement only covered the Gondolayu Bridge, and the area to the south side used to be less active. The Pedestrian Code Gumreget (PCG) community was formed only in 2014 when the Kotaku program began. The community fostered by the Ministry of Public Works keeps the area of Kampung Gemblakan Bawah physically beautiful and developing through community empowerment. The ministry with the PKC and FKWA communities is seeking to continue the M3K program and develop in the Kampung Gemblakan Bawah area.

Apart from the KotaKu and M3K programs, in Gemblakan Bawah there are also flats, namely Cokrodirjan flats. The Rusunawa (social housing) condition can accommodate 72 residents but tends to be dirty and rundown. Although it was intended to relocate residents, the informant explained that in reality there were no residents who wanted to occupy the Rusunawa due to the lack of environmental facilities and infrastructure such as limited water and electricity, and the indecisiveness of the manager. This Rusunawa is mostly used by migrants, most of whom had ID cards from outside the region (West Java).

According to the Yogyakarta palace website, this village is about the same age as the founding of the Islamic Mataram Kingdom. Gemblakan (upper and down) was once the village where the courtiers of brass and silver craftsmen lived (Bekti, 2019). Gemblakan means master, blacksmith, or blacksmith. Many blacksmiths in this area made various household equipment and weapons for the palace in the past. The remains are found at Gemblakan Atas, now a center for trophy craftsmen, including spear weapons artifacts that are on display in several people's homes. In contrast to Suranatan, which tends to be more religious, Gemblakan Bawah has a more 'abangan' (Syncretic Muslim) population or non-devout followers of Islam.

Even though there is a mosque in this village, the residents of this village seem to like various competitions and dexterity games. Empty land is used as a training field or a pigeon race at the entrance. The community's majority works as hawkers/small traders (Figure 8).

Figure 8. Social Characteristics of the people in Kampung Gemblakan Bawah
(Author Observation, 2022)

In this village, cultural acculturation took place very quickly. Many indigenous people have moved to locations that are more 'southern' to Yogyakarta city, to Bantul, either because they received relocation assistance from the government, their land was bought by investors, or for other reasons. In addition to the natives, in Gemblakan Bawah many migrants live in the temporary houses of the natives. Most of them still have DIY ID cards, with jobs as employees or shop workers, and some are people from West Java who have jobs as traders. Kampung Gemblakan Bawah is bordered by big shops and is still a sub-district with the eastern side of the Malioboro commercial area, the Inna Garuda row to Kepatihan (DIY Governor's Office).

Nunik: “There are many people who live here, but most of them are not natives. They work in the shops in the upper area (Kampung Gemblakan Atas)”

Characteristics of the Legality of Kampung Gemblakan Bawah

In general, the status of the land in Kampung Gemblakan Bawah is the same as Kampung Suranatan, namely the Sultan Ground. This area was also previously reserved for courtiers of the palace. The Rusunawa building looks dirty and shabby because of the lack of a sense of ownership and concern for the environment of the residents coupled with the manager's indecisiveness.

3.3. Kampung Mrican Giwangan

Mrican Giwangan is located on the banks of the Gajah Wong River, Yogyakarta city. In DIY Province, there are two Mrican villages, the first is in Gejayan (on the edge of Jl. Affandi), Sleman Regency, and the second is Mrican-Giwangan Village located in Umbulharjo District, Yogyakarta City. The case study in this study is in the second location (Figure 9).

Figure 9. Map of the Mrican-Giwangan Kampung Village Area
(Source: Ministry of Public Works, 2020)

In the era of Islamic Mataram, the area along the Gajah Wong river was not as busy as it is now. This area was not inside the first ring of the kingdom. Previously, Gajah Wong was a transit point. On one fateful afternoon or evening, a palace caretaker used the river to bathe the elephants and horses belonging to the palace. In the dry season, the flow of water in the Gajah Wong River is small, because its upstream comes from small rivers on Mount Merapi from many springs, but flash-floods often occur in the Gajah Wong River in the rainy season. The name Gajah Wong, which in Javanese means elephant and people, is taken from the story of the elephant caretaker and his elephant being swept away by the flood. It is said that the elephant's caretaker disobeyed Sultan Agung's order not to bathe the elephants in the downstream area. The flood swept them away and their bodies were found in the South Java Sea. Therefore this river was named Gajah Wong.

Kampung Mrican-Giwangan became famous after the community in the area optimized the river into a tourist area by cultivating thousands of tilapia. This riverside area was formerly a slum and often flooded, especially because this village is located on the downstream side of the indentation of the Gajah Wong River. Plenty of garbage on the riverbanks and bodies, both domestic household waste and industrial waste from an (illegal) pig farm at the riverbank. It was later demolished and spatially managed (Figure 10).

Figure 10. A former pig farm location by the riverside in Kampung Mrican-Giwangan
(Author Observation, 2022)

This kampung has been cleared up since January 2019. The community has become more proactive and made the river a public space enjoyed by all groups by initiating the 'Weir of Lepen Mrican Youth.' As mentioned by the informant, the youth of Karang Taruna in the village invited the residents of Mrican who lived on the outskirts of the irrigation canal area. They discuss and align the vision and mission with the activities plan. In March 2019, residents and youth began to take to the field, moving the location of the pig farm, closing the 'illegal' garbage dumps, and dredging the bottom of the irrigation canal.

Surani: “If we don't care about the environment, who will?”

In addition, the support of the city government in the City Without Slum area planning program was also present to bring changes with a stimulus of 19 billion rupiahs from the City Budget in 2019 was carried out in three kampungs by the Gadjah Wong Riverside (Rusqiyati, 2019).

This community eventually joined the M3K movement initiated by the Gadjah Wong Watershed Communication Forum (Forsidas). They removed the pig pens/farms from the riverbanks, cleaned up the rubbish, and dredged the river to a depth of 60 cm to raise thousands of fish. With the Kotaku program, this village area has improved primarily and rejuvenated by using paving and rehabilitating embankments (Figure 11). The riverbank area is now viral and visited by hundreds of visitors every day.

Figure 11. River Arrangement in Mrican-Giwangan Village (Author Observation, 2022)

This status is in line with the program carried out by the local government. Deputy Mayor of Yogyakarta, Heroe Poerwadi explained that the Yogyakarta Government sought tourism empowerment in the Kali Gajah Wong area. In addition, to support the residents' economy, they will also develop culinary and tourist attractions such as the vegetable village and the fruit village (Nurhadi, 2020). Not quickly satisfied, residents and youths expanded the fish pond area from 100 meters to 1 kilometer long, extending south to the end of Mrican Village before entering the ring road (Damarjati, 2020). As observed in the picture, current irrigation from the intake to the channel is used as fish ponds.

4. Conclusion

The result must clearly answer the objectives of the work. The results should summarize (scientific) findings rather than provide data in great detail. The findings should be in dialogue with the theory or the results of previous research or publication, so as to continue to develop science.

The three villages located on the banks of rivers in Yogyakarta have several differences and similarities. The differences are two kampungs developed since the time of the Islamic Mataram, namely the Suranatan and Gemblakan Bawah villages. Meanwhile, the Kampung Mrican-Giwangan only developed after the bus terminal was established nearby. All three are located on the riverbanks and are inhabited by LIC. Kampung Gemblakan Bawah has a high level of slums, next is Suranatan Village with a moderate level of slums. Of all these three kampungs only Mrican-Giwangan has low to moderate slums. The characteristics, similarities, differences, and forms of programs implemented in these three kampungs, can be seen in table 2.

Table 2. Characteristics of the three kampongs

Characteristic	**Kampung Suranatan**	**Kampung Gemblakan Bawah**	**Kampung Mrican Giwangan**
Physical	● Location: on the riverside ● High density ● Flood: rare event	● Location: on the riverside ● High density ● Flood: often	● Location: on the riverside ● High density ● Flood: rare event
Social	● Low income ● Slum: Medium ● Communality ● Homogeneous, mostly natives ● Religious	● Low income ● High slum ● Communality ● Heterogenous, some migrant ● Syncretic Muslim	● Low income ● Slum: Low to medium ● Communality ● Heterogenous, some migrant ● Religious and Syncretic Muslim
Legal	● Sultanate/Sultan ground ● Did not have certificate	● Kekancing/Tanah Keraton ● Did not have certificate	● Private own ● Has certificate
Type of Adaptation Program	M3K program Proklim	Kotaku	Kotaku

In the surrounding environment, these people make the varied intensity of the floods. Although inhabited by many LIC, these three villages differ in the intensity of slums. It differs because of the behavior of the people. The character of a homogeneous or heterogeneous society, religious and Syncretic Muslim, also brought the intensity of this slum different. The slums occurring in LIC settlements are not seen from the status of the land. In general, the LIC live in illegal plots or without property rights; it turns out that in Kampung Mrican-Giwangan, many low-income residents who own land live on legal land. These physical, social, and legal characteristics give color to the development of the three villages in the case study.

However, the climate adaptation program, it is more lenient than infrastructure programs. When the location has been touched by some upgrade for its infrastructure, the condition of the kampung is improved for the better. These three villages used to have frequent floods, but with the implementation of spatial programs such as Kotaku and M3K, the incidence of flooding in these kampungs has decreased. This explanation shows successful programs are not only top-down but also bottom-up. However, only Suronatan is also equipped with the Proklim program, which entitles it to access not only adaptation but also mitigation readiness. Most of these programs come from community initiatives. All three kampungs also have communities that are proactive in preserving the riverbank environment and making the village more resilient in the face of climate change.

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