Selokan Mataram in Yogyakarta as a cultural landscape: Heritage values and pressures

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Abstract. Selokan Mataram, a 31.2 km irrigation canal linking Opak and Progo Rivers in the Province of Yogyakarta, initiated and built by Sultan HB IX during the Japanese Occupation, has essential historical values and cultural heritage. It was built to provide water for agricultural activities in the area. At the moment, however, the Selokan Mataram is under the pressure of urbanization and rapid development. Such pressures are threatening its heritage values. This paper aims to examine Selokan Mataram from a cultural landscape perspective, examine the values of its cultural heritage, and document the pressures, threats, and efforts that the government has undertaken to preserve it. This research uses a case study approach, where data and information are obtained through secondary data, field observation, and interviews with multiple sources. The research argues that Selokan Mataram is a ‘cultural landscape’ that is important to Yogyakarta. It has and fulfills important values to be registered as a cultural heritage. At the same time, as one crucial cultural landscape, Selokan Mataram and the surrounding area is threatened by the rapid development of the city where the local government is not fully able to manage and control it. This research recommends that Selokan Mataram should be declared as a cultural heritage area, so that efforts can be further supported and strengthened to preserve it.

Keywords: Selokan Mataram, cultural landscape, conservation, pressure

1. Introduction

1.1. Cultural landscape and heritage values

A cultural landscape is interpreted as the process and products of the relationship between natural and cultural heritage in space and time units, and a complex phenomenon with tangible and intangible identity [1] [2]. The world cultural landscape predicate is inscribed by UNESCO (United Nations Educational and Cultural Organization) to the areas or regions around the world that can show the outstanding universal value of the relationship between nature and culture. Values related to universality, uniqueness, and representation of the particular cultural landscape. This outstanding universal value can be fulfilled if the area has authenticity and integrity values3,4. Authenticity is the originality, which is the value of the specificity of the cultural landscape form. At the same time, integrity lies in the general values of traditional values that can still withstand the various change threats.

At the locality, however, there are so many cultural landscapes that are significant and have essential values to the locals. There are perhaps do not meeting the criteria of outstanding universal value adopted by UNESCO, but important part of the history and identity of specific socio-cultural groups5. Such local cultural landscapes are then an integral part of the living culture of a given society and therefore should be conserved and
developed [6]. Because all localities have unique relations between nature and socioeconomic activities of the people, it is important to understand the specific historical values of such relations [7]. In many cases, only the locals clearly understand the history and meaning of a certain cultural landscape [5].

Cultural landscapes consist of tangible physical patterns and elements, and importantly, reflect intangible values and associations [8]. Cultural landscapes entail natural and human-made components of the environment and how they have changed over time [9]. It is essential, therefore, that studies on cultural landscape understand both elements and how they dynamically interchanges. Further, because cultural landscapes are an expression of long and complex relationships between tangible and intangible elements, the conservation and development of such cultural landscapes depends very much on the local communities' participation and management. In this context, the stewardship is therefore becoming an important issue in cultural landscape conservation—the stewardship of these landscape happens in different ways, with different models for decision-making and management [5]. Studying cultural landscape conservation should understand the existing planning and management system of a given society or administrative boundaries. Effective protection and management of living cultural landscapes require a coordinated and multilevel system to address the complexity [6].

1.2. Selokan Mataram: overview

Selokan Mataram or Mataram Canal is a 31.2 km irrigation channel built-in 1942, from the initiative of Sultan Hamengku Buwono IX (Sultan HB IX), the Sultan of Yogyakarta Hadiningrat Kingdom. Selokan Mataram was built based on two primary considerations. First, consideration of usability or functional, namely that sewer will be able to irrigate thousands of hectares of land in the Yogyakarta area. This will guarantee food production and the welfare of many farmers in this province. Second, socio-political reasons, namely as a tactic of Sultan HB IX, so that his people were not asked by the Japanese colonial Government to serve as ‘the forced labor’ program that was initiated by the Japanese colonial Government to serve as ‘the forced labor’ program that was initiated by the Japanese colonial Government at that time.

The two ideas and objectives of Selokan Mataram development initiated by Sultan HB IX are important to know and understand, because it is an integral part of the history of Yogyakarta region, which later gained status as the Special Region or Province of Yogyakarta. In 2012, the specific historical position and role of such region or province finally gained a Special Region status. This is strengthened by Law No. 13 of 2012, on the Special Region of Yogyakarta. This law specifically provides several special affairs in DIY, namely: 1) procedures for filling positions, duties, and authority of governors and vice governors; 2) structure of local government institutions; 3) culture; 4) land; and 5) spatial planning. These five aspects are undoubtedly exciting and important because it is seen as an essential factor in realizing DIY as a region with its cultural peculiarities.

Concerning Selokan Mataram, the specialty of this region is relevant, because with its history and function, Selokan Mataram can be a ‘leverage’ and an important factor to realize this region’s ideals as a distinctive, unique, and prosperous area. From this perspective, Selokan Mataram should be viewed and treated as a ‘cultural landscape’ with significant historical value for the region and its people. Selokan Mataram is a cultural landscape because it is a unity of natural and cultural elements that dynamically interact with each other [8] [9].
1.3. Yogyakarta City: historic city under transformation

As the center of the development of Yogyakarta, and an education and tourism city, the city of Yogyakarta is growing very rapidly and physically has crossed the boundaries of the administrative area of Yogyakarta, which is narrow, only an area of 46 Km2. Currently, the development of the Yogyakarta urban area has reached four times the size. This urban area of Yogyakarta, or referred to as Yogyakarta Urban Area (KPY), covers areas in the Sleman Regency on the Northside and Bantul Regency on the Southside. Within KPY itself, there are still exist some rural areas and ‘desa-kota’-a combination of urban and rural elements. In terms of population, KPY is an urban agglomeration area with a population of 1 million people, double the number in the administrative area of the city Yogyakarta.

With the rapidly increasing level of urbanization and the rapid growth of KPY, the pressures and threats to the environment and agricultural activities in the KPY area of Yogyakarta as well as the Sleman Regency are increasing. Directly and indirectly, the pressures and threats of urban development also occur along Selokan Mataram, which does cross the KPY area; some areas are even experiencing rapid growth acceleration. More importantly, accelerating the development of KPY is also triggered by various government policies and programs, which are often at odds with environmental and agricultural policies and programs. On the other hand, development control systems and mechanisms in Sleman, especially those related to land use control, have also not been fully effective. This led to efforts to preserve Mataram Sewer as a cultural landscape also experienced obstacles [10] [11] [12] [13].

1.4. Objective of the paper

The paper aims to examine Selokan Mataram from a cultural landscape perspective, the values of its cultural heritage, and document the pressures, threats, and efforts that the government has undertaken to preserve it. It is hoped that the paper would then be able to provide some practical recommendations for ensuring the conservation of Selokan Mataram as a historic cultural landscape of the region.

2. Methods

This paper is based on a case study research that explores Selokan Mataram, from cultural heritage perspectives. Selokan Mataram was chosen as a case study as it is a unique case, from its historical development and the present condition. It represents a unique cultural landscape commonly neglected because of its changing roles in present-day situation. This research is also a reminder for the policymakers and community on how important is such a historic cultural landscape which now is becoming everyday people’s activities.

Primary data was collected from the field observation, focus group discussion (FGD), and in-depth interviews. Field observation was conducted several times from March to August 2020, to get an understanding and collect data on the condition of land use, farmers’ activity in agriculture, and area development progress. Taking photos and notes was taken during the field survey. Based on the result of the field observation and the in-depth interviews was also done to get more understanding and information on the problems and management of Selokan Mataram.

Qualitative analysis was used by explanation building, constructing and evaluating the organized data and information into a narration. Narrative explanation based on the information from field observation is used to interpret the meaning and roles of Selokan Mataram for the local community. Whereas the result of field observation and in-depth interviews was analyzed by using explanation building to understand the pressures faced by the rice terrace, and the management system implemented in the area.
3. Result and discussion

3.1. Selokan Mataram: brief history
Selokan Mataram, initiated by Sultan HB XI during the Japanese colonial era, was based on the argument of the importance of optimizing existing land for agriculture, especially rice. Inspired by the early idea of Sultan Agung (the Sultan of Yogyakarta Kingdom in 16 century), Sultan HB IX believes that if the abundant water source of the Progo River on the West side of Yogyakarta region can be taken and used to irrigate dry land in the region of Yogyakarta, then it will be very useful for the people of Yogyakarta, especially the farmers. Technically, efforts to utilize the water source of the Progo River were then implemented by the construction of the canal, which connects the Progo river and the Opak River on the Eastern side of Yogyakarta. This 31.2 Km irrigation channel or sewer becomes an irrigation channel that flows or supplies water on its Southside.

Behind these very practical and rational reasons, the idea of Selokan Mataram construction has another political reason that is no less important, namely to avoid the demand of the Japanese Occupation which is requiring thousands of volunteers to be forcibly employed in various regions of Indonesia for the benefit of the Japanese invaders. By submitting the proposed construction of Mataram sewers, Sultan HB XI could argue with the Japanese colonial Government not to send its citizens as forced laborers in commercial areas of Japan. This reason is important to note because it describes the political nuances of the struggle at that time.

From the technical side, Selokan Mataram is a regular irrigation channel, with a length of 31.2 Km, with a width ranging from 2 meters to 8 meters, depending on the area and its topography. This canal flowed the water from the Progo river to the East and was poured into the Opak River in Prambanan region on the Eastside. Along this channel, there are floodgates and dividing channels to its Southside. Such a canal is so crucial as it serves irrigation for at least 10,000 hectares of land in this region.

3.2. Present condition and function
Today, Selokan Mataram is still fully functioning, although the water debit tends to decrease or fluctuate. Based on data from the Sleman Local Government, the area of land served by Selokan Mataram covers at least 10,000 hectares of agricultural land, especially rice fields. The area of agricultural land, especially the rice fields that can be served but the water supply from this irrigation channel allows farmers to grow rice three times a year with good results. Besides, the canal also supplay water for domestic uses to the Southern part of the region.

Another development that occurs in the Mataram sewer area is the use of water that develops, not only for agriculture but also for fisheries. The development of this fishery activity began exist since the early 1990s and until now continues to grow to about 1,000 hectares. In some cases and locations, there has been a conflict of water benefit between agriculture and fisheries. In some locations, this conflict was tried to be resolved by developing a model of ‘minapadi’ which is a combination of rice farming and fisheries that is quite successful.

3.3. Pressures and changes
With the growing population in Yogyakarta province and the urban area of Yogyakarta, economic activities and housing development and other functions along with the Mataram sewers. Housing and urban development also changed the system of regional infrastructure that also affected the Mataram sewer.
The representation of pressure and change was realized in the change of spatial/land use, which generally changed from natural rural land to urban form. This pattern of land use along Selokan Mataram can be categorized into three classifications, namely: natural/rural (30%); 2) semi-urban (30%); and 3) urban (40%). Each has characters like in Table 1 below.

Table 1 Classification of land use in Selokan Mataram (2020)

| No. | Classification | Characteristics | Pictures |
|-----|----------------|-----------------|----------|
| 1   | Natural/Rural (30%) | Built-up area: 10-20%; Building density: 10-20%; Population density: 10-50 jiwa/Ha; Number of building floor: 1; Architecture: Traditional/rural style; Dominant occupation: farmers | ![Picture](natural_rural.jpg) |
| 2   | Sub-urban (30%) | Built up area: 20-50%; Building density: 20-50%; Population density: 50-100 jiwa/Ha; Number of building floor: 1-2 Architecture: mixed between traditional and modern; Dominant occupation: farmers and labor | ![Picture](sub_urban.jpg) |
| 3   | Urban (40%) | Built up area: 50-90%; Building density: 60-90%; Population density: 100-200 jiwa/Ha; Number of building floor: 2-6 Architecture: modern Dominant occupation: Office staffs | ![Picture](urban.jpg) |

Source: Field observation and analysis, 2020

In terms of development and change, there has been a significant change in land use classification in Selokan Mataram. As seen in Table 2 below, the classification of rural natural areas that in the 1940s dominated the entire Selokan Mataram area currently only reaches 30% of them. In contrast, the development of urban land classification reached 40% of 0% at the beginning of the construction of this sewer. This development will continue to occur given that the area is in a rapid urban development area, including the planned construction of toll roads that will pass through about 20% of the entire length of this sewer.
Figure 1 Map of Sleman Regency and Selokan Mataram

Table 2 Land use change along Selokan Mataram

| No | Klasifikasi   | 1942-1950an | 1960an | 1980an | 2000an | 2020 |
|----|---------------|-------------|--------|--------|--------|------|
| 1  | Natural/Rural | 90-100%     | 80-90% | 60-80% | 40-60% | 30%  |
| 2  | Sub-urban     | 10%         | 10-20% | 20-30% | 30-40% | 30%  |
| 3  | Urban         | 0%          | 10%    | 10-20% | 20-30% | 40%  |

Source: Analysis, 2020

3.4. Selokan Mataram as a cultural landscape
More than just its physical characteristics, the Mataram sewer area is a unity of cultural landscape, namely dynamic interaction between natural settings and the social and economic system of its inhabitants. According to Rahmi, as a cultural landscape, the Selokan Mataram sewer can be seen from its six forms described in Table 3 below.

Table 3 Selokan Mataram as a cultural landscape: Forms

| No | Forms       | Characteristics in Selokan Mataram                                      | Photo |
|----|-------------|-------------------------------------------------------------------------|-------|
| 1  | Natural forms | Two large rivers and a stretch of the plain that is part of Mount Merapi |       |
The dominance of agricultural/rural activities and began to interact with urban activities.

The dominance of agricultural/rural activities and began to interact with urban.

Rural/traditional living ordinances that are beginning to affect the ordinances of urban life.

Typical canal structures and technical irrigation buildings are built with western/modern technology.

Source: Field observation and analysis, 2020

Furthermore, as a cultural landscape, Selokan Mataram can also be classified as a Cultural Reserve Area (Kawasan Cagar Budaya) based on the Cultural Heritage Act (UUCB) No.11 of 2010. As in Table 4 below, based on UUCB, there are six criteria to be defined as Cagar Budaya, which are: 1) Consists of two or more heritage sites; 2) A result of the cultural landscape with minimum 50 years old; 3) Has a clear spatial pattern with a minimum of 50 years old; 4) Shows previous human influences in the form of land use in a large scale; 5) Showing evidence of cultural landscape, and; 6) Having a soil structure which contains evidence of human activities.

| No | Forms | Characteristics in Selokan Mataram | Photo |
|----|-------|-----------------------------------|-------|
| 2  | Land utilization and land use | The dominance of agricultural/rural activities and began to interact with urban activities. | ![Photo](image1) |
| 3  | Settlement Architectures | The dominance of agricultural/rural activities and began to interact with urban. | ![Photo](image2) |
| 4  | Living tradition/practices | Rural/traditional living ordinances that are beginning to affect the ordinances of urban life. | ![Photo](image3) |
| 5  | Artefacts | Typical canal structures and technical irrigation buildings are built with western/modern technology. | ![Photo](image4) |

Table 4 Heritage values of Selokan Mataram (Based on UUCB)

| No | Criteria | Description | Notes |
|----|----------|-------------|-------|
| 1  | Consists of two or more heritage sites | Dam and 31.2 Km of canal | Although many pressures and threats, in general, the whole landscape of the Selokan Mataram meeting the criterias of authenticity, integrity, and relatively protection/conservation. Some areas are changing into urban landscapes. |
| No | Criteria                                                                 | Description                                                                                                                                  | Notes                                                                                       |
|----|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| 2  | A result of the cultural landscape with minimum of 50 years old          | Built in 1942-1944, so already more than 50 years old                                                                                         | could be regarded as dynamic cultural landscape, as well as the dominant function is still agricultural area. However, this trend should be carefully managed. |
| 3  | Has a clear spatial pattern with minimum of 50 years old                 | Traditional rural pattern along the canal                                                                                                    |                                                                                            |
| 4  | Shows previous human influences in the form of land use on a large scale  | Human interventions in the forms of agricultural landscapes and traditional villages                                                          |                                                                                            |
| 5  | Showing evidence of the cultural landscape; and                          | Dynamic interaction between people and the natural environment in the form of traditional rural-agricultural activities                      |                                                                                            |
| 6  | Having soil structure which contains evidence of human activities or fossil.| There exist some temples in the eastern parts of the Selokan Mataram.                                                                       |                                                                                            |

Source: Analysis, 2020

In terms of its rating, Selokan Mataram can meet the provincial *Cagar Budaya* rating following UUCB No. 11 of 2010. As shown in Table 5 below, the province's ranking means Mataram Sewer has a cross-region value, namely the entire region and community of the Special Region of Yogyakarta. This fact will certainly further support the region’s specific values currently continuously developed after the Implementation of Law No. 13 of 2002, on the Special Region of Yogyakarta.

Table 5 Ranking of *Cagar Budaya* Selokan Mataram based on UUCB No. 11 Th. 2020

| No | Criteria                                                                 | Assessments                                                                                                                                  | Notes                                                                                       |
|----|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| 1  | Represent heritage conservation cross-border regions                     | Yes, Selokan Mataram is located in two administrative boundaries; Sleman and Yogyakarta                                                   | Essential to support ‘keistimewaan’ or the special status of the region                      |
| 2  | Represent creative product of the province                               | Yes, the reactive ideas of the Sultan HB I                                                                                                  | Parts of the special status of the province                                                 |
| 3  | Rare and unique in the province                                          | Yes, only one in the province                                                                                                               | Part of the history of the region                                                           |
| 4  | Evidence of living human civilization in the province                   | Yes, until now is still utilize and maintenance as it is part of the people living tradition (farmers)                                      | Under changes and pressures                                                                 |
| 5  | Has associated with the existing tradition                               | Yes, Selokan Mataram is still used by many people in the province, as a source of water                                                        | Under pressures.                                                                           |

Source: Analysis, 2020

3.5. Conservation issues and government interventions
As outlined above, Selokan Mataram as a cultural landscape, needs to be conserved. While in various urban developments, increasingly the existence of this historic channel. Conservation efforts must be carried out so that the values of Selokan Mataram as a heritage cultural landscape can be maintained. As stated in the UUCB, these conservation efforts include: 1) protection, 2) development, and 3) utilization, and Table 6 shows conservation efforts for Selokan Mataram that have been done by the Government of Sleman Regency. In terms of protection, the main thing to note is how to ensure the design of Selokan Mataram as an irrigation channel that guarantee the conservation of agricultural land, especially existing rice fields. Data obtained from the Provincial Statistical Bureau office in 2017 stated that Sleman Regency has the most extensive...
agricultural land of 21.84 thousand hectares or about 39.5% of the total agricultural land in the Special Region of Yogyakarta (Table 7). However, from 2010 to 2016, the land conversion rate in Sleman was the highest than other regencies, around 945 hectares (78.82%), or on average 160 hectares. Study by Kusumawati et al\textsuperscript{15} documents that the water quality in this Selokan Mataram is deteriorating.

### Table 6 Conservation issues and government efforts

| No | Conservation aspects | Issues | Government efforts/Present status | Notes |
|----|---------------------|--------|-----------------------------------|-------|
| 1  | Protection          | Landuse change; Loss of sawah; Farmer tradition; Food security Visual landscape | LP2B (Perda..) RTRW; Incentives for farmers; Subsidy for farmers; Dana Desa Bundes | Should be more effective |
| 2  | Development         | Urban growth Tourism Agro-industry Services Infrastructures | Infrastructure development along Selokan Mataram; land use changes | Should be better controlled |
| 3  | Utilization         | Tourism Education Leisures Local economy Cultural festivals | Developing and supporting tourism villages; supporting the local economy | Should be more innovations in utilizing Selokan Mataram for local economic development |

*Source: Field observation and analysis, 2020*

### Table 7 Agricultural land by regency/city in the Special Region of Yogyakarta 2010-2015 (ha)

| Regency/City | Rice field | Dry field |
|--------------|------------|-----------|
|              | 2012       | 2016      | 2012 | 2016 |
| Kulon Progo  | 10,304     | 10,366    | 35,027 | 34,933 |
| Bantul       | 15,453     | 15,150    | 13,42 | 12,9923 |
| Gunung Kidul | 7,865      | 7,875     | 147,834 | 147,332 |
| Sleman       | 22,786     | 21,841    | 16,624 | 20,617 |
| Yogyakarta   | 83         | 60        | 187   | 16 |
| S.R.of Yogyakarta | 55,491 | 55,292 | 183,114 | 185,821 |

*Source: Statistical information analysis on the development at the Special Region of Yogyakarta Province, 2017\textsuperscript{16}*

### 4. Conclusion

This paper ended with four points. First, it argues that Selokan Mataram is a 'cultural landscape ' that is important to Yogyakarta. It has and fulfills essential values to be registered a cultural heritage. Based on Culturel Heritage Law (UUCLB) Number 11, 2010, Selokan Mataram meeting six criteria as a cultural landscape as follow: 1) Consists of two or more heritage sites; 2) A result of the cultural landscape with minimum 50 years old; 3) Has a clear spatial pattern with a minimum of 50 years old; 4) Shows previous human influences in the form of land use in a large scale; 5) Showing evidence of cultural landscape, and; 6) Having a soil structure which contains evidence of human activities. As a heritage cultural landscape, Selokan Mataram could be regarded as Provincial Cultural Landscape because it accordance to five criteria: 1) Represent heritage conservation cross-border regions; 2) Represent creative product of the province; 3) Rare and unique in the province; 4) Evidence of living human civilization in the province, and; 5) Has associated with the existing tradition.
Second, as one crucial cultural landscape, Selokan Mataram and the surrounding area are threatened by the rapid development of the city. This is mainly in forms of urban development. Urban development in the area has manifested in several threats or pressures to the SM. Such pressures including: 1) land use change; 2) Loss of sawah; 3) Farmer tradition; 4) Food security; and 5) Visual landscape. Third, the local government is not fully able to manage and control it. Several effort that already initiated has able to maintain and protect SM from destruction. However, there is a clear tendency that some fundamental values of Selokan Mataram has deteriorated, particularly the rural/farming practice which is becoming so important even in this changing global world.

Lastly, it is recommended that more effective efforts should be done to conserve Selokan Mataram as an important heritage cultural landscape in the region. This includes: 1) sawah conservation through many schemes; 2) rural living which can become potentials experienced economic; 3) rural visual landscapes; 4) environmental protection, particularly water catchment and reservation; and 5) open and green spaces as important source of CO2 for the growing city.

References

[1] Plachter H and Rossler M 1995 Cultural Landscapes: Reconnecting Culture and Nature, in von Droste B, Plachter H and Rossler M Cultural Landscapes of Universal Value, Gustav Fisher Verlag, New York
[2] Piagam Pelestarian Pusaka Indonesia 2003 Jaringan Pelestarian Pusaka Indonesia
[3] UNESCO World Heritage 2003 Cultural Landscapes: The Challenges of Conservation World Heritage Papers 7
[4] UNESCO World Heritage, 2009, World Heritage Cultural Landscapes: A Handbook for Conservation and Management, World Heritage Papers 26
[5] Brown J 2015 Stewardship of Protected Landscapes by Communities: Diverse Landscapes, Diverse Governance Models in Taylor et al (ed) Conserving Cultural Landscapes. Challenges and New Directions, Routledge: New York
[6] Taylor K 2012 Landscape and Meaning: context for a global discourse on cultural landscape values, in Taylor K and Lennon 2012 Managing Cultural Landscapes, Routledge: New York
[7] Amin J J A 2012 Cultural Landscape of Java, in Taylor et al. (ed). Conserving Cultural Landscapes. Challenges and New Directions, Routledge: New York
[8] Taylor K 2015 Introduction: Cultural Landscape. The First Century Conservation Opportunities and Challenges, in Taylor et al. (ed) Conserving Cultural Landscapes. Challenges and New Directions, Routledge: New York
[9] Longstreeth R 2008 Introduction: The Challenges of Cultural Landscape for Preservation, in Longstreeth R Balancing Nature and Heritage in Preservation Practice. Cultural Landscapes 2008 London: University of Minnesota Press
[10] Irawati H and Ragil H 2015 Perubahan Fungsi Lahan Koridor Jalan Selokan Mataram Kabupaten Sleman, in Jurnal Teknik PWK Volume 4 Number 2, 2015
[11] Ratih G S 2011 Penataan Ruang Jalan Pada Jalan Inspeksi Selokan Mataram Ruas Seturan-Jalan Wahid Hasyim, Final Project Undergraduate Program in Planning, Department of Architecture and Planning
[12] Hadianti A 2010 Pola Penggunaan Ruang pada Kawasan Sempadan Selokan Mataram Yogyakarta, Final Project Undergraduate Program in Planning, Department of Architecture and Planning
[13] Muzaki A 2010 Perubahan Guna Lahan dan Fungsi Bangunan setelah Peningkatan Sttus Jalan Indpeksi Selokan Mataram, Final Project Undergraduate Program in Planning, Department of Architecture and Planning
[14] Rahmi D H 2015 The Cultural Landscape of Borobudur: Borobudur Villages – continuity and changes, in Kanki K, Adishakti L, Fatimah T (editors) Borobudur as Cultural Landscape: Local Community Initiatives for the Evolutive Conservation of Pusaka Sayjana Borobudur, Kyoto University Press, Kyoto
[15] Kusumawati P, Achmad A R and Eko S 2019 Potensi Selokan Mataram: Ulasan Keadaan Fisik dan Kualitas Airnya, in Jurnal Pendidikan Geografi Tahun 24 Nomor 2 2019
[16] Statistical information analysis on the development at the Special Region of Yogyakarta Province 2017