Landscape design of Ciliwung Riverbank based on ecological aspect in Pejaten Timur Settlement Area, South Jakarta

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Abstract. Jakarta is a city that has a reasonably dense population and continues to grow every year. The rapid increase in the number of residents has caused a lack of harmony between the need of land for housing and existing land availability. This condition has led to a change in the function of riverbank in the area of settlements which happened in Pejaten Timur, South Jakarta. The existing settlements are on the riverbank caused environmental problems such as river width change and pollution. These conditions caused this area is often flooded every rainy season. Therefore, this research was conducted to design the Ciliwung Riverbank and restoring the function of its riverbank which was supposed to be a green open space. Green open space is designed in the form of an urban community park that can be used as a water catchment area, improving the ecological function of the riverbanks, and as a place to relax for the citizens around the site. The design of the park is carried out by the design process method, these design process included preparation, inventory, analysis, synthesis, and site design. In the analysis section, the writer determines the potential and site constraints, and then some appropriate site development plans can be produced. The applied concept is called "Eco-relaxing riverside park", which is an urban park on the riverbank that is environmentally friendly and has the primary function of a place to relax for visitors. The result of the urban community park design is expected to increase the aesthetic and functional value of the Ciliwung Riverbank in Pejaten Timur, South Jakarta. The final result of this research is the site plan, overall perspective, spot perspective, visible section images, detailed drawings, and explanations of the images. Keywords: Ciliwung Riverbank, riverbank settlement, urban green space

1. Introduction
The increase in population in Jakarta every year causes the problem of decreasing land for settlements. Based on Statistics Indonesia (BPS) [1], the total population of Greater Jakarta in 2016 was 10.28 million people and increased to 10.37 million people in 2017. The lack of land for settlements area creates other problems in the form of land use that is not supposed to be used as residential lands, such as the emergence of settlements built on riverbanks. Based on Statistics Indonesia (BPS) [2], there are 267 settlements located along the riverbanks in Greater Jakarta. The riverbanks are ideally used as conservation areas that can prevent, maintain and protect river bodies from landslides and erosion due to natural disasters or human behavior, and as water catchment areas when water flows exceed normal [3].

The river is one of the environmental components which is very influential for human life. The river has an essential function as a water source, fisheries, livestock, agriculture, and business in urban areas. Ciliwung River is one of the 13 rivers flowing in Jakarta. This river has the most significant impact because it passes through the middle of Greater Jakarta...
and crosses many settlement areas, dense housing, and slum areas. Pejaten Timur is one of the sub-districts whose settlements are crossed by the Ciliwung River. One of the consequences of settlements along the river is causing river pollution. The Ciliwung River is entirely polluted due to the garbage and household waste dumped into the river and drainage around the site. This problem is also one of the triggers for flood when the existing waste has clogged the drainage and caused water to overflow when the rainfall is high.

Pejaten Timur, South Jakarta, is one of the areas that was flooded in February 2018. One of the government's efforts to prevent the flood was doing the Ciliwung River normalization project. This project aims to restore the condition of the river width by expecting the river water holding capacity. The riverbanks of the Ciliwung River in the residential area of Pejaten Timur, which is used as the location of this research, has been acquired by the Jakarta National Land Agency for the implementation of the Ciliwung River normalization project since 2016.

Meanwhile, the area of green open space in Greater Jakarta only amounts to 9.98% of the total area. Based on Jakarta's Department of Parks and Cemeteries [4], this number is still far from the 30% owned by the Greater Jakarta. Therefore, the implementation of the Ciliwung River normalization project needs to be balanced with some efforts to increase green open space by building some parks. The park, which will be built in the settlement area of Pejaten Timur, proposes to restore the function of the riverbanks as green open space is such a kind of an ecological-based community park. This community park is expected to create a sense of togetherness, bonding between residents, restore the buffer area between the river and land ecosystems, so that river functions and human activities are not disturbed, and improve environmental sustainability.

The objectives of this study are as follows:
1. identifying and analyzing the characteristics of the landscape and use of the riverbank of the Ciliwung River in the settlement area of Pejaten Timur, South Jakarta,
2. analyzing the opportunities and constraints on the riverbank of the Ciliwung River in the settlement area of Pejaten Timur, South Jakarta,
3. designing an ecological-based urban community park on the riverbank of the Ciliwung River in the settlement area of Pejaten Timur, South Jakarta.

2. Methods

2.1. Research location and time
This research was conducted on the Ciliwung River riverbank, it is located in residents of community unit number 03, Pejaten Timur settlement area, South Jakarta (Figure 1). This research took place from July to October 2019.

2.2. Research methods
This research was conducted with a design process, according to Booth [5], including preparation, site inventory, analysis, synthesis, and site design

2.2.1. Preparation
At this stage, the problem formulation is carried out. To determine the objectives for landscape design, conducting literature studies, compiling research proposals, arranging permits for related parties, and gathering initial information from various sources or related agencies.
2.2.2. Site inventory
Data collection activities were carried out by direct surveys (collecting primary data) and literature studies (collecting secondary data). Related data can be obtained through field observations, interviews and questionnaires, and literature studies.

2.2.3. Analysis
The analysis was carried out to process the data that had been obtained from the site inventory process. The collected data were analyzed in four ways, including qualitative descriptive analysis, quantitative descriptive analysis, social analysis, and spatial analysis.

2.2.4. Synthesis
Analysis results are grouped based on potential and constraints. The existing potential is maintained and developed, while the existing constraints are sought for solutions. These solutions then produce a site synthesis that is used as the basis for designing the landscape. This process results in site zoning, specifically determining the appropriate space for its utilization purposes, which is then carried out by the development of basic concepts and design concepts. The output of this synthesis process is in the form of the development concepts and a block plan.

2.2.5. Design
This stage is using design principles, which include unity, balance, rhythm, emphasis, harmony, scale, and proportion. The development concept that has been created in the synthesis process can be processed into a block plan, which is then used to make design development. The design development is carried out in various aspects under the ecological concept. This stage produces output in design drawings, site plan, section drawings, detailed engineering drawings, planting plans, overall perspectives, and spot perspectives.
3. Results and Discussions

3.1. Site inventory
The site is located in an open area on the riverbank of the Ciliwung River, which is administratively located in RW 03 and RW 09, Pejaten Timur subdistrict, Pasar Minggu, South Jakarta. The site has an area of 1.0159 ha, which is directly next to the north by the Ciliwung River, to the south by Jalan Gunuk Raya, to the east with the RW 3 settlement area, and to the west with the RW 09 settlement area. The site is an empty land along the Ciliwung river that is flooded almost every year. The densely populated settlements around the site are also the cause of the large amount of waste dumped into the Ciliwung River. Therefore, it is increasing the possibility of flooding due to overflowing river water. The area around the site is quite busy with the activities of residents who live around the riverbank. The image of the site inventory can be seen in Figure 2.

![Figure 2 Site inventory](image)

3.2. Site analysis and synthesis
This site is an empty land and large area. It is located in the middle of a settlement with no green open space, so it has the potential to be developed. Based on the Regulation of the Minister of Public Works Number 5 of 2008 [6], according to the area of land available, the public space that can be developed on the site is a sub-district community park with a minimum area of 9000 m² or 0.9 ha.

The soil condition on the site is alluvial soil with better productivity than the topsoil because of deposition. Based on the soil erodibility class, according to USDA-SCS [7], alluvial soil types are included in the soil category which has high erosion sensitivity. This condition is not possible for medium to large scale landscape construction. The park can be built by carrying out various site engineering, especially the special treatment of soil. Consideration of the landscape construction load needs to be paid attention to maintain soil stability.
The entire area has an altitude of 19-23 m asl, with a slope ranging from 8.1-22.2%. According to the Minister of Agriculture Decree number 837/Kpts/Um/11/1980 [8], the slope on the site enters the rather steep category. To create a community park with an ideal slope, site engineering needs to be done in the form of grading or cut and fill at several areas, so that the site has a flatter topographic condition and has a safe height from flooding, and does not endanger park visitors when carrying out various activities in it. Barrier vegetations are planted to add more safety in the leveled area, and bio-retaining walls are provided to support the ecological concept.

In general, the climatic conditions on the site are included in the climatic conditions of the City of South Jakarta, which is a tropical climate. According to the Meteorological, Climatological, and Geophysical Agency: BMKG [9], the climatic condition on the site has an average air temperature of 28.76°C per year. There are shady areas under the trees and also open space areas exposed to direct sunlight. The average rainfall in the last year in the research period was 134mm per year, it is related to the potential for flooding in Jakarta, which usually increases at the end of the year.

Access into the site can be reached through Jalan Gunuk Raya and Jalan Gunuk V, the main roads along the research site area. The facilities and utilities on the site are minimal, without pedestrian walk or lighting. Facilities and utilities still need to be added according to the needs of visitors and activities carried out. The choice of materials for facilities and utilities that are strong and waterproof is also critical because it is still potentially flooded. However, the materials used must also be environmentally friendly to support the ecological concept.

Designing vegetation arrangement is very important on the site to increase the aesthetic value of the area. The selection of vegetation on the site must also meet the criteria, because the site is still potentially flooded. These criteria include vegetation that is resistant to excess water conditions and has strong roots so that it is not easily wiped away when exposed to flood water flows.

The lack of public green space in this residential area is one reason why residents feel essential to build or present a community park on this site. So that residents can carry out the desired activities in this community park. Based on the questionnaire obtained, the most results regarding the activities that people want are to relax and exercise. However, other activity spaces were also added with an appropriate division of area. Based on the questionnaire, the community walked to the site by walk and rode a motorbike. That can be fulfilled by adding paths for pedestrians in the park and parking lots for motorbikes or bicycles in the welcome area. For the people’s preference for ecological design, the dominant community considers that the ecological design in the park is made with local materials and is environmentally friendly. However, the application of community preferences for an ecological design still considers site conditions. It applies various plants, conserves energy use, uses a recycling system (reduce, reuse and recycle), dominantly uses local plants, and practices stormwater management.
The main concept in this research is “Eco-Relaxing Riverside Park”. “Eco-Relaxing” refers to the initial concept of an ecology-based environmental park. This park will become a public space on the riverbank that has the primary function of relaxation for its users. The environment and activities in this park refer to the user's goal of going to the site, to relax and relieve fatigue or pressure caused by work on a busy day. These objectives can be achieved by presenting an ecological and green atmosphere to the site.

The design concept in this community park is based on the site's location on the Ciliwung River's edge and is closely related to water. The shape and color of the water itself are created in several elements of the park design. The form of flowing water like the Ciliwung River itself is transformed and connected to form circulation paths in this park. These shapes are created with modern designs and materials under the residents' preferences from filling out the questionnaire that has been done. Modern materials and designs are also applied but still combined with environmentally friendly materials that make the park still seem ecological.

The ecological-based concept applied to the site focuses on water, to support and maintain the primary function of the site as a rainwater catchment area and hold the flow of the Ciliwung River from overflowing into residential areas. The concept of hydrology by using bio-retention ponds is essential to facilitate the passage of rainwater as a run-off to the Ciliwung River and filter wastewater from the settlement area so that the water becomes cleaner.

Moreover, the concept of circulation by using permeable pavement also makes it easier for users to do activities and helps the soil absorb water properly. The permeable pavement itself is a pavement system that can flow rainwater into the soil and aggregate storage areas [10]. The overflow water is stored and absorbed to the ground or flew directly into the drainage system. The use of energy-efficient facilities and utilities also increases the ecological value of the site, the application of waste separation can make it easier to recycle waste with the implementation of 3R (Reduce, Recycle, Reuse), and the use of various
environmental friendly materials is also applied to this park to provide adequate benefits for the user and the environment.

3.4. **Block plan**
The combined results of the site analysis, development concepts, and community preferences form a block plan. The areas in this community park are expected to facilitate the community around the site to carry out various activities such as gathering, relaxing, exercising, also educating the public about the environment from the ecological concept applied to the site. The development concept that is combined into a block plan can be seen in Figure 4.

3.5. **Landscape design**
Combining primary concepts, design concepts, and development concepts produces a landscape design with a site plan drawing product. The Ciliwung Riverbank, which is designed as a green public space, is implemented after considering the Ciliwung River normalization project, which will be carried out by river widening by 10-15 m. This community park design provides a public space to relax and socialize for its users, especially residents around the site. This riverbank is designed to be a community park that provides river inspection path facilities next to the Ciliwung River, and it has three main areas such as a welcome area, recreation area, and conservation area. The site plan can be seen in Figure 5, the overall perspective can be seen in Figure 6.

![Figure 4 Block plan](image-url)
**Figure 5** Site plan

**Figure 6** Overall perspective
4. Conclusions
Pejaten Timur is currently a middle-class settlement area which is quite dense and has caused pollution problems in the Ciliwung River. The functions of the riverbank itself are currently disturbed, and the inadequate absorption of rainwater on the site causes the area to flood every rainy season frequently. One of the efforts to prevent the flood problems on the site is to restore the Ciliwung Riverbank’s function in the settlement area of Pejaten Timur to become a more organized and more optimal green open space in absorbing rainwater.

The development of this site is based on the concept of “Eco-relaxing riverside park,” which is an ecology-based community park on the riverbank that can be used to relax as its primary function. The application of these basic concepts is supported by an organic design concept because it is closely related to water and the Ciliwung River itself. The ecological concept is also applied to various environmentally-friendly facilities on the site to meet user needs and increase the ecological, aesthetic, and functional values of the riverbanks. The spatial plan applied to this park consists of two welcome areas, recreation area, and conservation area. The welcome area planted with display plants to attract visitors. The recreation area for various activities, such as relaxations, sports, and more. The conservation area used for river inspection track planted with various vegetations to prevent landslide or erosion. It is hoped that the development of this landscape design can anticipate floods on the site.

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References
[1] [BPS] Statistics Indonesia 2017 Total population and population growth rate by regency/ city in DKI Jakarta province
[2] [BPS] Statistics Indonesia 2015 Number of villages/ sub-district according to the existence of settlements on riverbanks, under extra high voltage airways (SUTET), and slum settlements
[3] Salmah S 2010 Arrangement of river banks in terms of environmental aspects (Jakarta, Indonesia: Trans Info Media)
[4] [Department of Parks and Cemeteries] Data of recap area of green open space per municipality in DKI Jakarta [internet] 2017 [cited 2018 Aug 27] Available from: https://data.jakarta.go.id/dataset/rekapluasruangterbukahijauperkotamadyadidikijakarta
[5] Booth N K 1983 Basic element of landscape architectural design. (Illinois, US: Waveland Press, Inc)
[6] Regulation of the Minister of Public Works 2008 Number 5 of 2008 about Guidelines for the Provision and Utilization of Green Open Space (RTH) in Urban Areas
[7] El-Swaify and Dangler D W 1976 Erodibilities of selected tropical soils in relation to structural and hydrologic parameters in soil erosion: prediction and control. (Iowa, US: Soil Conservation Society of America)
[8] Decree of the Minister of Agriculture 1980 Number 837/Kpts/Um/11/1980 about Criteria and Procedures for Designating Protected Forest Area
[9] [BMKG] Meteorological, Climatological, and Geophysical Agency 2019 Climate Data for South Jakarta City, 2018-2019
[10] [UTTIPEC] 2009 Pedestrian design guidelines (New Delhi: Delhi Development Authority)