Multifunction Wastewater Treatment Plants as Educational and Recreational Parks for the Community

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Abstract. The scarcity of land and the lack of communal sanitation in slum areas are common issues in densely populated country like Indonesia. One of them happens in Kampung Nambo, located in South Tangerang City, Banten Province. Those issues encourage some household to build their houses without an adequate sewage disposal system within a very limited land. Wastewater flows directly to the river without any treatment process and it creates negative impact to the environment and human life. Moreover, this kampung also does not have educational and recreational parks facilities, which can fulfil human’s need to socialize and health. The method used in this study is an action-based research. Addressing the problem of scarcity of land and the need for WWTP facilities, the complementary facilities offered are hydroponic farming, workshop venue, playgrounds, reading park, sports facilities that are integrated with the proposed WWTP area. Generally, the WWTP areas often placed in the backside and were not utilized optimally. Meanwhile this study accommodates the WWTP towards integrated and multifunction facility. It is not only to fulfil the needs of education and recreation parks for the community, but also to preserve the location for WWTP extension in the future.

Keywords: design, multifunction parks, wastewater treatment plant

1. Introduction

The area of Jakarta City cannot accommodate its urban activities so it spreads to the surrounding area. One of which is The South Tangerang City. The situation makes the city experiences a rapid development and city growth in terms of economy and population. The accelerated development is carried out by both the government and other private developers. The morphology of the city then becomes denser due to the massive growth of the population in the city. The number of green and open spaces are reduced significantly and replaced by man-made built environment, both for settlements, urban activities and its supports.

This massive and fast growth city is usually beyond the local government’s anticipation. Most of the people who live in South Tangerang City can choose house or settlement. Both types of residential environments have significant differences. Housing is an environment that is made with adequate design in this case either arrangement of the houses or a complete set of facilities in it. Meanwhile, settlement is a common residential environment with the addition of several other activities [1,2]. Unfortunately, the development of housings in South Tangerang City is still slower
than the plan. Moreover the design was made by the private sector and thus making those who live in the small neighborhood to experience the negative impact of this poor urban planning [3].

One of the affected neighborhood areas is Kampung Nambo in Serpong District (Figure 1). This 4 hectare area kampung is inhabited by one neighborhood association (RT) or about 120 household. There is a buffer zone in the form of a green space on the south side of the village due to its proximity to Cipeucang landfill. In addition, the west side area is adjacent to the Cisadane River. The location of Kampung Nambo which is still being surrounded by natural green open spaces has turned some sectors to use it as a landfill site.

Figure 1. Boundary area of Kampung Nambo

Limited land and lack of environmental awareness seems to be the background for some household to build their houses without planning an adequate wastewater disposal system. The land for housing in Kampung Nambo is very limited because around 60 percent of the open areas are filled with water bodies. Wastewater is disposed directly to two types of water bodies, and those are kobakan (small artificial reservoir to accommodate wastewater so that it can be absorbed into the soil) and fish pond. The way to dispose of such wastewater is not in accordance with the standard because the wastewater does not go through any treatments and it is released directly into the natural environment. In a long term, it continuously harmed the groundwater quality [4]. Poor water quality due to pollution contamination and other impurities from wastewater is mixed in those two types of water bodies.

To anticipate environmental pressure due to inadequate handling of wastewater and the need for a social place, it is necessary to revitalize the buffer zone so the function of the area will be improved [5]. We expect that with a good design that encourages activities in the buffer zone area and also with a good solution to handle the wastewater problems, the household will actively protect the area from any environmental damage. In this way it create sense of belonging by designing the area together with the community. The purpose of this paper is to propose revitalization of the buffer zone by
adding the function of communal WWTP. Additionally, more functions and purposes those are a recreation and education park in the surrounding community are attached to the area to accommodate the needs of the community.

2. Methods
This study began with a survey of existing conditions which included problem identification. The problems that were identified came from the community itself and from an external factor that is the huge pile of garbage that caused unpleasant odors around the area. The problem that comes from the community is that the absence of WWTP facility to treat household wastewater from the household in the area.

After that, the study continued with forum of group discussions with the household and involved the local government as the regulator. The research team shared the potential and problems related to this buffer zone while the household provided their responses and aspirations for how this area should be treated and how they want it to become. Keeping in mind that some of the land in that area belongs to the local government, they checked that the use of those lands to see if they are in accordance with the land use regulations that have been made before.

After reaching an agreement through discussions between the team planners from Universitas Indonesia, the users (the local community) and the regulators (the local government Agency of Building and Spatial Planning Agency, Environmental Agency and City Without Slum Program) and the community based NGO, Bina Ekonomi Sosial Terpadu. The design team then made a design for a park based on the aspirations of the household and the land use regulation. The initial design was then presented to household and the local government during the next forum group discussion. We went through several interactive workshops until all party reached common agreement. The use of a buffer zone as a wastewater treatment location as well as a recreational and educational park for this community was intended to be a long-term plan. It has to be submitted to the local government first so they could continue and legalize the construction process.

3. Findings and Discussion
Households consume water as one of natural resources; only 2.5% of the total water in the world can be used as clean water source, while the rest of 97.5% water in the world is salt water [6]. Not only they consume natural source, households also generate a huge amount of waste. Wastes that are disposed directly to the environment can impact the environment. Wastewater that flows into the river without going through any screening process is going to pollute the river. This phenomenon is happening in Kampung Nambo since years and made it turn into one of the cities that is categorized as a slum. Slums are one of the ongoing big problem in Indonesia. Based on data from Indonesian Ministry of Human and Settlement in 2014, the total area of slums in Indonesia reached 37.407 ha in total, in which 60 percent or 3286 ha of it were found in the urban space [7].

In Kampung Nambo, there are 11 houses still dispose their wastewater directly to the river without proper treatment process. The waste water comes from human wastes, laundry, taking a bath, and other sanitation and hygiene activities. It may have negative impact on the environment such as river pollution caused by the chemical substance in the wastewater that would cause several diseases, bad odor coming from the river. Kampung Nambo is currently facing these problems. Besides, Kampung Nambo also does not have any sport and recreation facilities that are accessible for the inhabitants. A city can be considered as a liveable city if it has public facilities to support their communities such as children playground, sport areas, reading park, and many more [8].

One of the solutions from government for the wastewater treatment problem is to build a communal wastewater treatment plant (WWTP). The communal septic tank in Kampung Nambo is designed to serve 50 households. WWTP is going to be placed in the lowest contour of kampung, enabling the wastewater to enter it without using any energy demand. It will need the help of gravitation to distribute the wastewater to WWTP. However, currently there are 120 households in the
area and this number certainly will increase in the future. Therefore 1 WWTP for the capacity of 50 households will not be enough.

WWTP is different from septic tanks in general because it already has its own filtration system to filter pollutants found in wastewater, lowering the number of pollutants in the waste water when it enters the city drainage and making it safe to be used to water the garden. WWTP system works in several stages. The initial stage is anoxic chamber where the decomposition of waste using microorganisms takes place. After that, the wastewater enters the anaerobic process and aerobic chamber to reduce pollutants such as Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) with the help of microorganisms [9]. Then it enters the sedimentation chamber where the water is finally clean and ready to continue to the final process called chlorination chamber. In this process, the water is mixed with a disinfectant to destroy harmful pathogens for the environment. After all stages are finished, the water that is processed then channeled to the city drainage.

Land integration or multifunction design concept is a solution to the scarcity of land in a region. WWTP construction that takes place beneath the ground creates the surface of the WWTP a potential area to be used to accommodate community activities need, such as children's playground, reading park, and hydroponic pilot project. Beside that, there would be an area for workshop, sport, and the outdoor for Pembarbaan Kesejahteraan Keluarga (PKK), the women empowerment program. The effectiveness of land use for various functions such as the provision of public space and integrated waste processing can improve the quality of a settlement.

The location of the WWTP area in Kampung Nambo (Figure 2a) will be located in the lowest contour area and will face to the north and the south side. The area of the planned WWTP is 932 m², consisting of 40 m² of an underground WWTP, a 48 m² multifunctional space for reading park and for a workshop area, futsal field with an area of 375 m². The futsal field is designed as a multifunctional sports field for badminton and volley (Figure 2b).

Additionally, to invite more interests from the visitors, especially the community as the users, when someone enters the WWTP area there will be a signage that will be a spot to take “selfie” pictures. The area is designed to be a bit further to the back side due to the consideration of the presence of wide-leaf ketupang forest as a buffer zone. In addition to that, it will allow an easier access for maintenance or desludging that will be done periodically for once a year. The WWTP inlet distance to the building will be 6 meters while the outlet distance from the WWTP to the sewer will be 8 meters. The usual material used for the surface of WWTP is a mere concrete slab with 6 air points, but in this design, the surface of the WWTP will be used as a children's playground that implements
local Indonesian game concepts such as ular tangga (snakes and ladders), engklek (hopscotch) and any similar games. The playground area will be created by painting the surface based on the predetermined pattern. This method is very economical and simple. The realization of this playground can be done with the help of the surrounding community in the form of a participation in creating and maintaining the environment. It will not stop at the provision of a playground, the surface of WWTP will be also used as a place for hydroponic planting media which will later become the responsibility of the community to maintain and harvest it.

Figure 3. Trees as the fences and the buffer zones

The provision of the reading facility is due to the public demand for a place for education as well as an area for community meetings and creativity workshops such as handicrafts. The garden areas can also be used as a workshop for waste management technology that can be implemented in the neighbourhood such as Household Sanitary Landfill (HSL) introduces by BEST NGO. The reading facility is designed as an indoor space but with an open concept that will utilize natural air conditioning. The selected material for the reading facility material is wood based on its natural ambience. The reading facility will provide books that are accessible to the surrounding community and outsiders who will come to visit the Kampung Nambo.

The trees will surround all areas. They will act as fence and buffer zone to the area (Figure 3). The trees that are going to be planted are wide-leaf ketapang tree, tanjung tree, kemuning tree, and kantil trees. Those trees were chosen based on plant categories that can reduce odor because the area is located near a landfill. For the area around the reading park, Japanese bamboo will be planted as a shade. Multifunctional futsal court as a badminton court and volley court will face the north side and the south side to avoid glare from the sun.

4. Conclusion
A study about “green open space” found that green open space gives more awareness on human health for the community and it is proven by the dominance of human health related program activities [10]. This study broke the tendency that WWTP area has normally become the less developed area and poorly maintained because WWTP is seen as a mere dumping area, deeming it unnecessary to make it visually pleasing. The location of the WWTP in the backside of a building also discourages the maintenance workers to do a periodic maintenance in the form of desludging. In the end, WWTP is unable to function and is forced to closed. Actually, a good-designed WWTP can be a potential for its surrounding area. One of the cases can be found in Kampung Nambo. A WWTP area can be proposed
as an integrated area for a various community activity in Kampung Nambo such as education and recreational center. In order to eradicate the image of poorly maintained and dirty of WWTP, it can be done by planting more trees as a buffer zone that can also function as a green space area. Utilization of the WWTP area as a green area and playground can certainly provide benefits, such as: (1) providing integrated land use solutions for areas with limited green land, (2) maximizing land use for a hydroponic space, (3) using the area around the WWTP for a reading garden as a mean of recreation and also a place for the residents to socialize, (4) turning the area above WWTP into a gathering area so it will no longer be a dirty and backward area, (5) the integrated WWTP with play areas can be an example for densely populated areas with limited land and (6) to preserve the area for future WWTP extension.

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