EMPOWERING THE ENVIRONMENT THROUGH BIOPORE AS A NATURAL ABSORPTION HOLE AND COMPOST MAKER CASE STUDY: NOLOGATEN, CATUR TUNGGAL, SLEMAN REGENCY

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Abstract - *Nologaten Village is one of the villages (padukuhan) in Sleman Regency, a densely populated area. Population growth increases the need for housing and other necessary infrastructure and causes a reduction in water catchment areas, so alternative solutions are needed. As the researcher, thematic KKN (Kuliah Kerja Nyata/Field Study and Community Service) 114 UIN Sunan Kalijaga provided an intervention to empower the Padukuhan Nologaten environment through bio-pore absorption holes. The Community-based Participatory Action method included workshops containing socialization and planting biopores with the Padukuhan Nologaten community. Observations, interviews and FGDs are conducted flexibly in the community to determine the impact of activities. Researchers used descriptive analysis techniques during the planning, implementation, monitoring, and evaluation. Through this activity, the community understands more about biopores, waste sorting, and its positive environmental impact; some have committed to utilizing it optimally.*

Keywords: *Population, Water Absorption, Biopore, Environmental Empowerment, Community*

1. INTRODUCTION

Urban areas are areas with certain boundaries whose people have main activities in the fields of industry, services, trade, or non-agriculture (Government Regulation Number 59, 2022). Urban areas are synonymous with population density. In 2022, the urban population in Indonesia will reach more than 155 million people. Extracted from *Badan Pusat Statistik/*BPS (Central Statistics on Agency) (2022), rural areas have more than 120 million people. This data indicates that most of Indonesia's population occupies urban areas with a percentage of 56.4%. This percentage is projected to increase to 66.6% in 2035 (Safitri & Pradipta, 2023).

Population growth increases the need for housing and other necessary infrastructure. As in Sleman Regency, population density in 2023 will reach 2013 people per square kilometer (Bappeda, 2024). One of the villages in Sleman Regency is Nologaten Village *(Padukuhan),* which is located in Catur Tunggal Urban Village *(Kalurahan)*, Depok District *(Kapanewon)*. The residents of Padukuhan Nologaten number 2433 people with an area of 48.5 hectares consisting of 4 neighborhoods *(Rukun Warga/RW)* and ten neighborhoods *(Rukun Tetangga/RT)*.

The Padukuhan Nologaten is primarily paved roads. Most residents' yards have also undergone the process of casting and installing paving blocks or other similar materials. This condition causes a reduction in water absorption in Padukuhan Nologaten. The lack of catchment areas risks hurting the environment, such as increased surface water flow, which can trigger flooding during heavy rains, reduced groundwater potential, and the formation of puddles of water which can become nests for mosquitoes (Elsie et al., 2017; Gani & Ikhsan, 2020; Pradani et al., 2017; Suhardjono, 2015).

In the Family Welfare Programme *(Pendidikan Kesejahteraan Keluarga/PKK)* forum, which is regularly held by the community at both the padukuhan and RT scales, women in Padukuhan Nologaten discussed overcoming the breeding of mosquitoes that cause dengue fever. This discussion was motivated by several residents of Padukuhan Nologaten who were infected with the dengue virus some time ago before the researchers entered the community. The condition of dengue fever survivors has recovered.

However, a solution is still needed to overcome this problem, by channeling or helping to absorb rainwater. One method that can be used is creating biopores or absorption holes in the soil. To make this mission successful, Thematic KKN 114 UIN Sunan Kalijaga Yogyakarta conducted bio-pore outreach to Padukuhan Nologaten community. This activity continued with creating biopore absorption holes, which KKN members and the community also carried out. The aim of this activity is to provide education to the public regarding bio-pore absorption holes, starting from how to make them to their benefits in preventing flooding. The emergence of puddles due to rainwater not seeping into the ground, which can potentially become a nest for mosquitoes that cause dengue fever, can also be prevented. This bio-pore absorption hole can fertilize the soil in Padukuhan Nologaten with natural compost from organic waste disposed of in the bio-pore pipe.

2. METHOD

This research uses a descriptive qualitative method with a case study approach. Descriptive qualitative methods attempt to explain the meaning of data rationally (Doyle et al., 2020; Sandelowski, 2010; Vaismoradi & Snelgrove, 2019). A case study is an intensive study of a person, group of people or a unit to generalize several units (Gustafsson, 2017; Heale & Twycross, 2018). Through this method, researchers explain how case studies can examine environmental problems to increase the public's understanding of these problems (Hamel et al., 1993; Heale & Twycross, 2018; Yin, 2009).

A. Population and Sampling

Participants in this research were residents of Padukuhan Nologaten, Kalurahan Catur Tunggal, Kapanewon Depok, and Sleman Regency, Special Region of Yogyakarta. Around 2433 residents are divided into 4 RWs, divided into 10 RTs. Activities are carried out in rotation between RTs through community service activities, which are attended by 5-15 residents in each RT. This community service is held every day from May 25th to June 3rd 2024. In the process of research activities with residents, supervision is carried out by the Head of Padukuhan Nologaten, called Mr. and Mrs. Dukuh in the community.

B. Data collection technique

The instrument used in this research is community-based participatory action, which is part of participatory action research (PAR). In this method, researchers involve themselves with participants to work together to understand problems and change them for the better (Macdonald, 2012). The PAR method has the potential to produce readily accepted and sustainable innovation due to the involvement of all stakeholders (Agus et al., 2019; Mubuuke et al., 2013). PAR is also a data collection method used in community empowerment studies (Rahmat & Mirnawati, 2020). The stages of communitybased participatory action are planning, implementation, monitoring, and evaluation.

In the process, observations, interviews and focus group discussions (FGD) were carried out. The observation is participatory observation, where the researcher is immersed in the environment or group, observing the participants' behavior, interactions, and practices (Wekke, 2020). Researchers observed community activities such as PKK Padukuhan, PKK RT, and community service. As a KKN group, researchers reveal their identity so that the participatory observation is overt.

Mr. and Mrs. Dukuh were interviewed semi-structured regarding the condition of Padukuhan Nologaten in terms of the area and the community. In a semi-structured interview, the interviewer has a question guide, which is openended and very likely to be developed during the interview (Wekke, 2020).

Meanwhile, focus group discussions were conducted flexibly with residents in several associations involving Mr. and Mrs. Dukuh and residents and researchers. These gatherings were the opening ceremony for the Thematic KKN 114 Nologaten, PKK padukuhan three times, PKK RT twice, and community service activities. FGD is a data collection method that is widely used in social

research in the form of group discussions on a specific topic. Due to its in-depth nature, FGD is called an exploratory method. Exploratory means exploring and studying new variables that are important and have high relevance to the issue or topic being discussed (Sugarda, 2020; Swadayaningsih, 2020). Collecting qualitative data through FGD also makes it easier for researchers to establish openness and trust and understand the perceptions, attitudes and experiences of respondents or participants (Swadayaningsih, 2020).

C. Data analysis

The data was analyzed using descriptive qualitative analysis techniques, which allow researchers to see the entire data and explain it descriptively without losing its essence in the analysis process (Torrente-Sánchez et al., 2021). With this technique, researchers can find details of the problems studied in Padukuhan Nologaten and the people's experiences there. This analysis technique also describes a topic as information for developing interventions (Kim et al., 2016; Prosen, 2022).

Researchers recorded the results of observations, interviews, and FGDs and then analyzed them together in a particular forum. This analysis produced several case points or problems, then formulated to create an intervention. This intervention will later be carried out to empower, which in this study utilizes biopore absorption holes. Researchers used similar techniques during the intervention process.

3. RESULTS AND DISCUSSION

The planning, implementation, monitoring, and evaluation carried out by researchers are described. Some documentation is included to provide an overview of activities. Illustrations, tables, and flow prisms are also given to clarify the activities in this study. Several statements from residents were quoted by providing coding in the form of a serial number of participants (e.g. P1 means participant number 1) and a number indicating RT (e.g. 1 means RT 1). This code is separated by a hyphen (-).

A. Planning

The first observations were carried out in the Padukuhan Nologaten area. The scope of observations carried out is about the environment and regional conditions. Additionally, interviews with the Dukuh were conducted to deepen the observation results. The information obtained is:

1) Most of the Padukuhan Nologaten area has undergone asphalting and casting, as well as installing paving blocks or other similar materials for residents' yards.
2) Some residents have no difficulty processing organic waste because they keep fish in ponds, and some raise chickens. However, this is a problem for some others. Besides causing an unpleasant odor, the flies and mosquitoes in the area also disrupt daily activities.
3) Padukuhan Nologaten has an Independent Waste Management Group (*Kelompok Pengelolaan Sampah Mandiri*/KPSM) called KPSM Jasmine

Berseri. Unfortunately, this group has become passive, so it needs reempowerment.

4) Apart from KPSM Jasmine Berseri, Padukuhan Nologaten has another community group, the Women Farmers Group (*Kelompok Wanita Tani*/KWT). As the name suggests, this group contains women from Padukuhan Nologaten whose main activity is farming or gardening. KWT aims to empower residents to be productive and able to own their agricultural products. KWT members plant seeds and practice cultivating planting media because the land is not naturally fertile.

Based on these observations and interviews, the Thematic KKN 114 group discussed and proposed holding a biopore workshop containing information about biopore absorption holes and their planting. This proposal was approved by the Head of the Hamlet, who then determined the target number of biopores to be planted. This activity plan was also presented at the opening of Thematic KKN 114 in Padukuhan Nologaten on May 4th 2024, which the Dukuh and several community representatives attended. Apart from that, plans for biopic workshop activities were also presented at the PKK Padukuhan on May 13th 2024, which is located at Nologaten Ecotourism.

Considering regional conditions and equality for each RT, this activity will provide 100 biopores and five drill tools for planting biopores. Procurement of biopores and drilling tools is being attempted by submitting a proposal for assistance to the Sleman Regency Environmental Service (*Dinas Lingkungan Hidup*/DLH) on behalf of KPSM Jasmine Berseri. The proposal was prepared by researchers and discussed with Mr. and Mrs. Dukuh. The proposal was submitted to the DLH Sleman Regency frontliners on May 13th 2024.

On May 22nd 2024, researchers were contacted by DLH regarding approval to assist. The 100 biopores are divided into two types, namely PVC pipe biopores and hexagonal paver blocks, each with 50. Representatives of researchers met with DLH to receive assistance from biopores and drilling tools, which were placed in the Nologaten Multipurpose Building. This handover is marked with minutes and documentation, as in Picture 1 below. The technical implementation of the biopore workshop activities was discussed further by the researchers together with the field supervisor lecturer (*Dosen Pembimbing Lapangan*/DPL) and Mr and Mrs Dukuh.

Picture 1. Acceptance of biopores from DLH

B. Implementation

a) Procurement of Biopores

One hundred biopores from DLH consist of 50 hexagonal paver block biopores and 50 PVC pipe biopores. Hexagonal paver block biopores are biopores shaped exactly like hexagonal paver blocks, which have four holes and can be opened and closed. Hexagonal paver block biopores are accompanied by PVC pipe with 10 centimeters in diameter and 20 centimeters in length. Meanwhile, the PVC pipe biopores have a diameter of 10 centimeters with a height of 50 centimeters, perforated on all sides. Like hexagonal paver block biopores, PVC pipe biopores have a cover with an appropriate diameter. The PVC pipe biopores cover also has holes like pores. The difference between these two types of biopores can be seen in Picture 2.

Picture 2. PVC pipe biopore (left) and hexagonal paver block biopore (right)

The biopore allocation for each RT is divided equally, namely, ten biopores with five of each type. Likewise, five drilling tools were distributed to four RWs, each with one drilling tool. Meanwhile, the remaining one will be placed in the multipurpose building as a support inventory that can be used anytime.

b) Activity Process

The biopore workshop was conducted with community service work in each RT. Starting on May 23rd, researchers took part in community service work with residents. The schedule for implementing community service work is adjusted to the agreement of residents in each RT, as listed in Table 1 below.

Table 1. The time for carrying out community service work in each RT is also used for socialization and planting biopore absorption holes

RT	Implementation date
1	May 25th 2024
2	May 26th 2024
3	May 27th 2024

4	May 28th 2024
5	May 29th 2024
6	May 30th 2024
7	May 31st 2024
8	June 1st 2024
9	June 2nd 2024
10	June 3rd 2024

Like community service work in general, this community service work involves cleaning the environment. It also involves preparing planting media for residents to plant one hundred chili plants in each RT. This activity was motivated by the "Wajah Padukuhan" (Padukuhan face) competition, which Padukuhan Nologaten will participate in in August.

Therefore, members of Thematic KKN 114 helped residents prepare planting media. The soil is mixed with organic and chemical fertilizers and then put into unused gallons. This use is a form of reuse from gallons into pots. Through this activity, researchers also observed the soil condition, which tends to be dry only in a few RT areas where worms are still a sign of better soil fertility. At this stage, researchers are increasingly convinced that the biopore workshop can benefit the community because long-term use of biopore absorption holes can also increase soil fertility.

After the planting media had been prepared, the researchers carried out socialization on biopores, starting with an introduction to biopores in general, the types, how to plant them, and their benefits. Researchers also opened short discussion sessions, which were occasionally held while planting biopores. Figure 1 visualizes the series of community service activities.

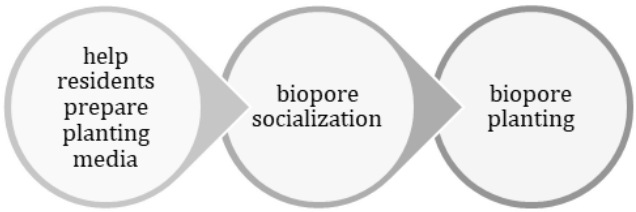

Figure 1. A series of community service activities

c) Biopore Infiltration Hole Planting Process

Apart from preparing planting media, drilling or excavating the soil with a drill to plant biopores also allows researchers to understand the soil structure in Padukuhan Nologaten in general. There is soil that is loose, hard but still moist, hard, dry, and loose but often encounters rocks.

"This was filled up before. In the past, people used to fill up demolished buildings here, so there were many broken stones. Bricks, cement, concrete," (P1–8)

Some areas with very minimal land even required the research team to dismantle paving blocks to plant paragon biopores. Picture 3 visualizes land conditions in the Padukuhan Nologaten area.

"In RT 9, there is no land, Ma'am. So, it's usually here."
(*P1*–9)

Picture 3. Biopore planted directly in the ground (left), and biopore planted that requires dismantling the bricks (right)

The biopic planting process can be understood through the following steps:

1) Have the necessary tools and media ready, namely PVC pipe biopores and paver block biopores, soil drill tools, hoes or mini shovels, usually used for gardening, and the land planted with biopores.
2) To plant PVC pipe biopores, dig up the soil with a drill. Hold the iron crosswise on the earth drill tool and rotate it to grind the soil. When it has eroded, lift the drill tool. Ideally, the soil will be lifted out as well. If not, you can use a hoe or mini shovel to scoop the soil out of the hole. This step is carried out repeatedly until the hole is 50 centimeters deep, according to the length of the PVC pipe biopore. The same steps are taken when planting paver block biopores after prying off one of the paver blocks. The depth of the hole in the ground is adjusted to the length of the concrete slab specifically for paver block biopores.
3) The next step in planting PVC pipe biopore is to insert the PVC pipe biopore into the hole that has been dug. Attach the biopore lid without pressing too hard because this lid will be opened and closed again to add organic waste. It is necessary to compact the soil around the biopore so that it can be completely embedded. PVC pipe biopores must be completely embedded in the ground so that their position is level with the ground so that flowing water can be directly absorbed into the biopore.
4) Meanwhile, to plant the paver block biopore, a 20-centimetre-long PVC pipe is inserted into the hole in the ground. On top of it, place the paver block biopore by adjusting the paver blocks around it. The paver block biopores have been planted.

Few areas in Padukuhan Nologaten can be planted with PVC pipe biopores because they have undergone a casting process, where paver

blocks in shapes other than hexagons or similar materials were installed. Therefore, not every RT uses the biopore allocation according to the amount provided. For example, RT 1 does not take PVC pipe biopores because its location is close to ecotourism.

Nologaten Ecotourism is a park with several gazebos above a large fish pond. Across from it, there is a fairly wide river, which is also used for raising fish. Therefore, household waste in the form of food scraps can be used as fish food, so a biopore is optional.

Instead, RT 8 takes more PVC pipe biopores. RT 8 residents are enthusiastic about using bio pure. They also have adequate land to use as a biopore planting area.

C. Evaluation

The biopore workshop in ten RTs ran smoothly. Researchers received positive responses from the public. Some people specifically requested that biopores be planted in their homeland if they are still available, in coordination with the head of the neighborhood *(RT)*. The community's enthusiasm can also be seen through the questions asked during socialization and the biopore planting process.

Several questions were asked, such as the difference between a PVC pipe biopore and a paver block biopore, how deep the soil must be dug, what types of waste can be thrown into a PVC pipe biopore, how long compost fertilizer can be harvested, how to harvest compost from a PVC pipe biopore, and so on. Residents of RT 9 even asked for further socialization regarding biopores by researchers at the PKK RT.

Public understanding of biopores and the differences between organic and inorganic waste has also increased, as seen during the Thematic KKN 114 UIN Sunan Kalijaga withdrawal event. In the quiz session with door prizes, several residents were able to answer questions related to biopores and classifying types of waste correctly.

Biopore absorption holes are not only an alternative to increasing water absorption areas but are also being reduced due to increasing population density. An illustration of biopore absorption holes in the soil can be seen in Figure 2. Here are some other benefits of biopores (Angguniko, 2010; Elsie et al., 2017; Gani & Ikhsan, 2020; Pratiwi et al., 2023; Wijaya et al., 2019):

1) Provides groundwater obtained due to the absorption of rainwater. In longterm use and maintenance, water absorption will be more optimal. With biopore absorption holes, soil fauna will be active by creating cavities in the soil. This cavity will become a channel for water to seep into the soil. The role of fauna and plant roots will continue to maintain the formation of cavities in the soil naturally.
2) Reduces the risk of flooding in the rainy season
3) Reduce standing water, which can become a nest for mosquitoes
4) PVC pipe biopores can store organic waste and turn it into compost through the activity of soil organisms that decompose organic waste in the biopore holes.

Waste becomes a source of energy for these organisms. Decomposed waste will become compost and can be used for cultivating plants. This organic waste can consist of dry leaves, grass, or household waste, such as food scraps.

5) Improving the quality of soil and groundwater through the activities of organisms or fauna. Decomposing fauna plays a role in the decomposition (decomposition) of waste in biopore holes so that it can turn into minerals that dissolve in water. Therefore, the quality of groundwater will improve because it contains minerals.
6) It helps prevent global warming. Organic waste in the PVC pipe biopore will decompose into humus, preventing it from being quickly emitted into the atmosphere as greenhouse gases.

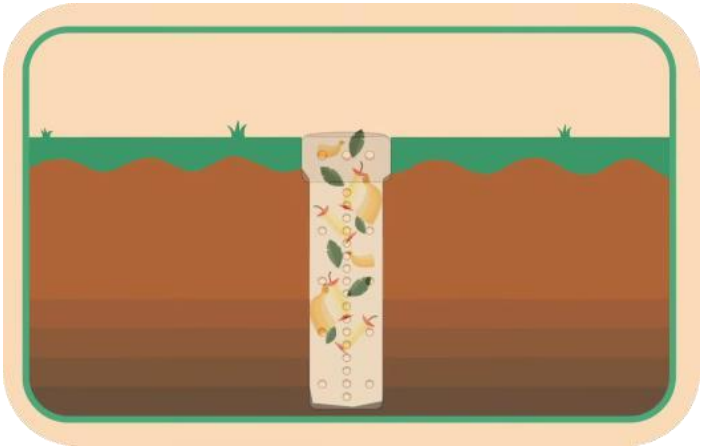

Figure 2. (Kementerian LHK, 2020)

The soil fertility level can be measured with certainty using a soil pH tester meter or soil pH measuring device. However, several visible criteria indicate the level of soil fertility, including (1) lots of grass growing, (2) loose and lumpy soil, (3) the presence of active soil organisms such as fungi, worms, and termites (Junus, 2017; Universitas Medan Area, 2023). Based on these criteria, the condition of the land in Padukuhan Nologaten needs to be fertile enough. From observations made when processing planting media during community service activities, only a few RTs had earthworms in their soil; it was loose, lumpy, or damp. In others, the soil tends to be dry, does not clot, or is loose, but no organisms, such as worms, are found.

Steps are needed to maintain bio-pore absorption holes to obtain long-term benefits. The maintenance steps always add organic material to the PVC pipe biopore. The addition of organic waste needs to be done so that soil carried by water does not enter the hole because it will be filtered by organic waste (Qadri & Gau, 2023; Sine et al., 2021). Organic waste in the form of household waste or kitchen waste, such as food scraps, can be harvested as compost after approximately two weeks, while garden waste takes around two months (Amrizal et al., 2021).

4. CONCLUSION

Padukuhan Nologaten has the potential in the form of adequate human resources. These resources are sufficient to create a healthy and clean environment. As one of the efforts that can be made to achieve this goal, it is hoped that biopore absorption holes can be used as an alternative for the community. Through

workshops conducted by researchers with some of the residents present, members of thematic KKN 114 Nologaten as researchers hope that information about biopore absorption holes can be disseminated to other residents who are unable to attend.

The activities carried out by researchers certainly still need to improve. The information provided to the public is still in the form of oral and practical explanations, not yet touching on other methods such as media that can be read repeatedly, for example, infographics or posters. In the mid-term evaluation, researchers conducted surveys in only some locations planted with biopores.

However, in every short-term planning, implementation and evaluation process, researchers always ensure community understanding, answer all questions, and practice the biopore planting process in front of the community.

In future research on environmental empowerment, researchers hope that evaluations can be carried out optimally, even within a certain period. We also hope that the educational process can be provided through various forms of media. Researchers are also very open to development research aimed at continuing this empowerment.

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