

## **Exploration of Clean Water Provision Endeavors in Residential Facilities for Construction Workers within the National Capital Development Area (IKN), Indonesia**

### **ABSTRACT**

Clean water is one of the basic needs to support human life. As the population grows, the need for clean water also increases. In the development of the National Capital area in North PenajamPaser, a lot of clean water will be needed. The study aims to find out alternative steps that will be taken to increase the fulfillment of clean water needs in the construction area of flats housing construction workers (HPK) in the National Capital Region (IKN) North PenajamPaser Regency, East Kalimantan Province, Indonesia. The study was carried out in the construction area of flats housing construction workers in the National Capital Region, North PenajamPaser Regency, East Kalimantan Province, Indonesia. The data collected is in the form of qualitative data, namely a description of the study location in general, and quantitative data: number of residents, water needs per person, number of flats for worker housing, and rain conditions in the study area. The techniques used to collect data that are appropriate to the object of study are observation, interviews, institutional visits, and literature review. The analytical methods used are: (1) a qualitative approach using descriptive analysis which describes the existing conditions of the study area, (2) analysis of population projections and (3) analysis of clean water supply. The study results in a show that efforts to provide clean water in HPK IKN can be done other than dams and reservoirs, namely by harvesting rainwater through infiltration wells, rainwater collection ponds, biopore absorption holes, rain gardens, porous paving blocks, and storage reservoirs.

Keywords: Provision of Clean Water, Residential Flats for Construction Workers, National Capital Region (IKN)

### **INTRODUCTION**

The development of residential areas is also accompanied by an increase in the need for clean water services in them. These needs tend to increase and the quality of life is increasing and activities in residential areas are also growing rapidly. Clean water is a vital need for every human being, so the availability of clean water determines the level of health and welfare of society. In reality, the limited supply of clean water is closely related to the causes of poverty, because poverty is also caused by health problems.

According to [1], water is a very important natural resource because it can satisfy the lives of many people, so it is necessary to maintain the existence of water so that it can provide benefits to all living things on earth. It is stated by [2] that clean water is water that meets the requirements of the drinking water supply system, which includes water quality requirements, including physical, chemical, biological, and radiological quality so that if you drink it, the water in pure condition does not cause side effects. The problem of providing clean water is still a concern for all parties, especially the government. This is caused by the decline in the availability of raw water for clean water, both quality and quantity, which can be influenced by various factors, such as weather, limited raw water potential, environmental conditions, industrial activities, and so on. It is stated by [3] that climate change due to increasing global temperatures, changes in rain patterns and extreme weather can affect the flow of rivers, lakes and water sources. As a result, water quality can change significantly. Along with the increase in Indonesia's population, the need for clean water increases from year to year. According to the Central Bureau of Statistics (BPS), the latest data in 2013 recorded 248,8 million people, then an increase of 264.2 million people in 2018, and then an increase of 278,8 million people in 2023[4].

Massive development of IKN has begun, especially in the central government core areas, with so much development in all fields of work, it also has an impact on the number of workers which is not small. Therefore, decent and healthy housing is needed to accommodate the entire number of construction workers, for this reason, it is realized through the construction of housing for construction workers by the Ministry of Public Works and Public Housing (PUPR).

One of the problems that often occurs in residential areas is the lack of clean water supplies. Various problems then emerged related to this, both in terms of raw water sources, in terms of management, and terms of infrastructure. The development of residential areas is also accompanied by

an increase in the need for clean water services in them so the government and private sector or the community are required to provide clean water infrastructure as well as possible.

These needs tend to increase and the quality of life is increasing and activities in residential areas are also growing rapidly. Providing water for residential area needs means, in this case, providing water for household needs, public facilities, and social facilities. Population activities can be accommodated in public and social facilities, but will not run well without being supported by adequate infrastructure services. Limited provision of adequate clean water infrastructure in residential areas can affect human life, economic productivity, and the quality of life of society as a whole. Therefore, there needs to be more serious efforts to handle the provision of clean water in the IKN environment so that the community's need for clean water can be met.

The study aims to find out alternative steps that will be taken to increase the fulfillment of clean water needs in the construction area of flats housing construction workers (HPK) in the National Capital Region (IKN) North PenajamPaser Regency, East Kalimantan Province, Indonesia.

## METHODOLOGY

### 1. Study Location

The study was carried out in the construction area of flats housing construction workers (HPK) in the National Capital Region, North PenajamPaser Regency, East Kalimantan Province, Indonesia (Figure 1).

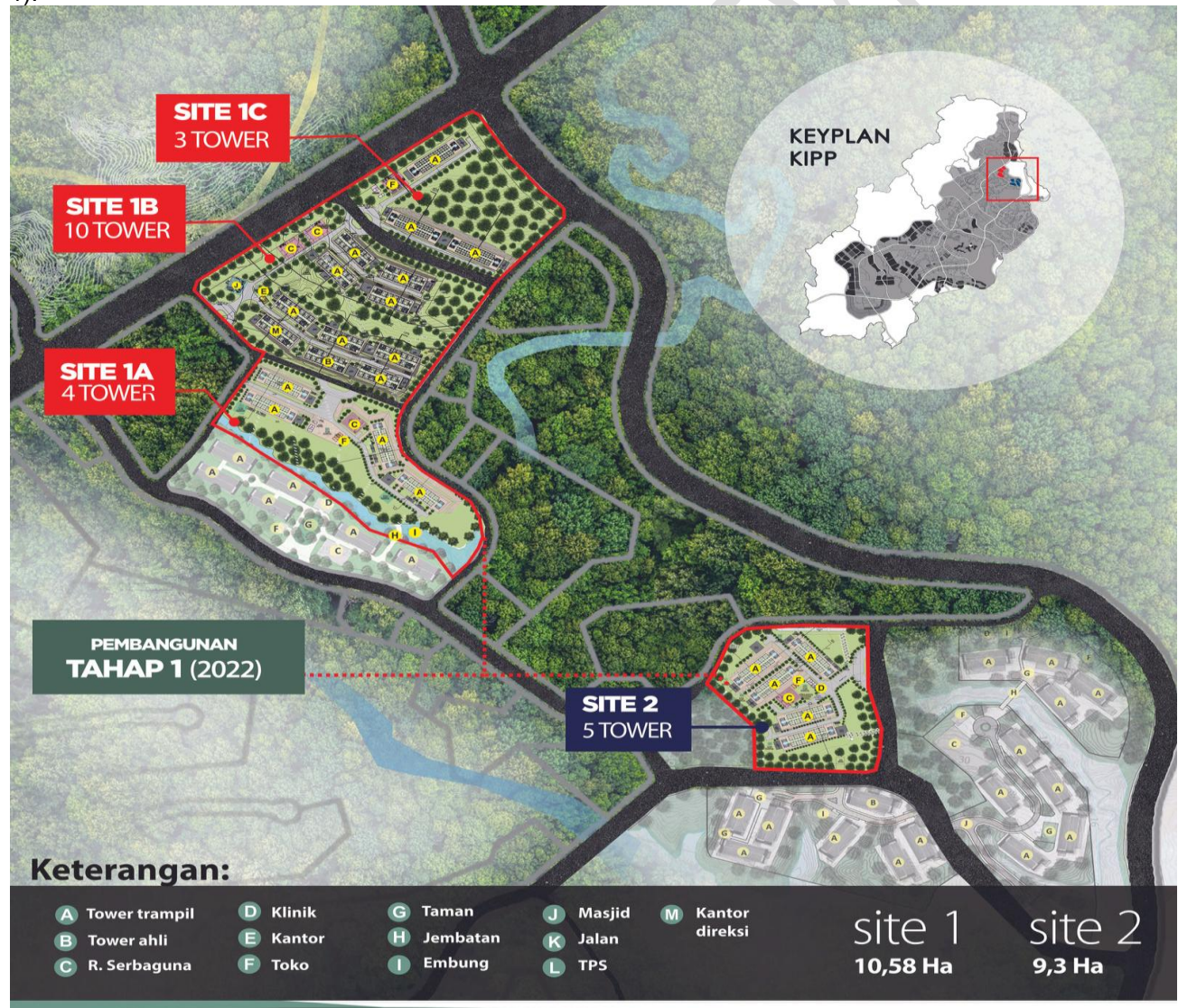


Figure 1. Residential Area for Construction Workers in National Capital Region (Source: Ministry of PUPR)

## 2. Types and Sources of Data

The data collected are qualitative data, namely a description of the study location in general, and quantitative data in the form of the number of residents, water needs per person, the number of workers' residential flats, and rain conditions in the study area.

## 3. Data Collection Method

Data collection aims to collect data and information in the study area. The techniques used to collect data that are appropriate to the object of study are observation, interviews, institutional visits, and literature review.

## RESULTS AND DISCUSSION

### 1. Description of the Condition of the Worker's Flats at HPK-IKN

Data on the condition of flats designated for construction workers in HPK-IKN with 4 floors per flat tower is presented in Table 1.

Table 1. Data on the condition of flats intended for construction workers in HPK-IKN with 4 floors per tower

| NO.      | LOKASI                   | JUMLAH TOWER | PERUNTUKKAN | JML LANTAI               | KAPASITAS PERLANTAI | TOTAL KAPASITAS | FASUM & FASOS |   |
|----------|--------------------------|--------------|-------------|--------------------------|---------------------|-----------------|---------------|---|
| 1        | Site 1A                  | 4 Tower      | Tower 11    | Tower Terampil Laki-laki | 4                   | 190             | 760           | Aula/Kantin, Klinik, Toko, Kantor Pengelola |
|          |                          |              | Tower 12    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
|          |                          |              | Tower 13    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
|          |                          |              | Tower 14    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
| 2        | Site 1B                  | 9 Tower      | Tower 1     | Tower Terampil Laki-laki | 4                   | 192             | 768           | Masjid, Aula/Kantin, Toko, Kantor Pengelola |
|          |                          |              | Tower 2     | Tower Terampil Laki-laki | 4                   | 192             |               |   |
|          |                          |              | Tower 3     | Hunian PUPR              | 4                   | 63              |               |   |
|          |                          |              | Tower 4     | Tower Khusus Wanita      | 4                   | 63              |               |   |
|          |                          |              | Tower 5     | Tower Ahli               | 4                   | 63              |               |   |
|          |                          |              |             | Ruang Terbuka Publik     |                     |                 |               |   |
|          |                          |              | Tower 7     | Tower Terampil Laki-laki | 4                   | 192             |               |   |
|          |                          |              | Tower 8     | Kantor Bersama PUPR      | 4                   |                 |               |   |
|          |                          |              | Tower 9     | Tower Terampil Laki-laki | 4                   | 192             |               |   |
| Tower 10 | Tower Terampil Laki-laki | 4            | 192         |                          |                     |                 |               |   |
| 3        | Site 1C                  | 4 Tower      | Tower 20    | Tower Terampil Laki-laki | 4                   | 190             | 760           | Aula/Kantin, Klinik, Toko                   |
|          |                          |              | Tower 21    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
|          |                          |              | Tower 22    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
|          |                          |              | Tower 6     | Tower Terampil Laki-laki | 4                   | 192             |               |   |
| 4        | Site 2                   | 5 Tower      | Tower 15    | Tower Terampil Laki-laki | 4                   | 190             | 760           | Aula/Kantin, Klinik, Toko, Kantor Pengelola |
|          |                          |              | Tower 16    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
|          |                          |              | Tower 17    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
|          |                          |              | Tower 18    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
|          |                          |              | Tower 19    | Tower Terampil Laki-laki | 4                   | 190             |               |   |
| TOTAL    |                          | 22 Tower     |             |                          |                     | 14,484          |               |   |

Source: Indonesian Ministry of Public Works and Public Housing

## 2. Rainfall Conditions in Sepaku District, PenajamPaser Utara Regency

The general condition of rainfall in 4 sub-districts in the North PenajamPaser region in 2021 and 2022 is presented in Table 2. In 2022, Sepaku District recorded the lowest rainfall, namely 144 millimeters (May) and highest, namely 364 millimeters (October)

Table 2. Average District Rainfall in North PenajamPaser Regency in 2021 and 2022

| Month     | BabuluDistrict |      | WaruDistrict |      | PenajamDistrict |      | SepakuDistrict |      |
|-----------|----------------|------|--------------|------|-----------------|------|----------------|------|
|           | 2021           | 2022 | 2021         | 2022 | 2021            | 2022 | 2021           | 2022 |
| January   | 286            | 428  | 272          | 370  | 146             | 310  | 248            | 212  |
| February  | 390            | 445  | 106          | 281  | 131             | 224  | 261            | 205  |
| March     | 299            | 280  | 214          | 199  | 182             | 190  | 155            | 351  |
| April     | 238            | 161  | 207          | 282  | 189             | 152  | 182            | 279  |
| May       | 248            | 239  | 198          | 143  | 207             | 166  | 130            | 144  |
| June      | 269            | 312  | 180          | 231  | 172             | 240  | 300            | 303  |
| July      | 130            | 138  | 161          | 215  | 197             | 230  | 40             | 206  |
| August    | 302            | 167  | 420          | 252  | 363             | 233  | 208            | 283  |
| Septembet | 228            | 142  | 370          | 270  | 360             | 235  | 162            | 347  |
| October   | 327            | 339  | 294          | 279  | 328             | 144  | 302            | 364  |
| November  | 225            | 287  | 352          | 248  | 271             | 276  | 329            | 262  |
| December  | 446            | 250  | 412          | 198  | 349             | 286  | 410            | 196  |

Source: BPS North PenajamPaser Regency 2023

### 3. Forecast for the 2022-2023 Rainy Season in 20 Season Zones (ZOM)

The estimated start of the rainy season in 2022-2023 in the year-round segment is as follows:

- MH All Year : 3 ZOM (15.0% of 20 ZOM)
- July 2022: 2 ZOM (10.00% of 20 ZOM)
- September 2022: 10 ZOM (50.00% of 20 ZOM)
- October 2022: 1 ZOM (5.00% of 20 ZOM)
- Monsunal-1 ZOM Type: 4 ZOM (20.00 from 20 ZOM)

A comparison of the initial forecast for the 2022-2023 rainy season with the average for the 1991-2022 period is as follows:

- MH All Year : 3 ZOM (15.00% of 20 ZOM)
- Ahead of the average: 11 ZOM (55.00% of 20 ZOM)
- Same as the average: 2 ZOM (10.00% of 20 ZOM)
- Retreat from the average: 0 ZOM (0.0% of 20 ZOM)
- Monsunal-1 ZOM Type: 4 ZOM (20.00 from 20 ZOM)

Meanwhile, the forecast for the nature of rain for the 2022-2023 rainy season is

- Above Normal (AN): 6 ZOM (30.00% of 20 ZOM)
- Normal (N): 14 ZOM (70% of 20 ZOM)
- Below Normal (BN) : 0 ZOM (0.0% of 20 ZOM)

The peak forecast for the 2022-2023 rainy season is

- November 2022 : 9 ZOM (45.00% of 20 ZOM)
- December 2022 : 2 ZOM (10.00% of 20 ZOM)
- January 2023: 1 ZOM (5.00% of 20 ZOM)
- February 2023: 2 ZOM (10.00% of 20 ZOM)
- April 2023: 6 ZOM (30.00% of 20 ZOM).

### 4. Estimated Clean Water Needs

The number of residents (workers) who will live in flats at the study location is estimated at 544 people, the need for clean water for each person is 60 liters [5], so the amount of clean water needed is 544 x 60 liters = 32,640 liters/day.

### 5. Efforts to Provide Clean Water

#### 5.1. Rainwater Harvesting Alternatives

Geologically, the National Capital Region is said to experience water shortages, to overcome this problem the government is building dams and reservoirs. However, various alternatives are still being pursued so that the water needs of residents of the National Capital can be well prepared. One of them is an alternative provision of rainwater or what is known as Rainwater Harvesting.

Harvesting rainwater is an alternative water source that has been practiced for centuries in various countries that often experience water shortages [6]. Harvested rainwater can be used for multi-purposes such as watering plants, washing, and bathing, and can even be used for cooking if the water quality meets health standards [7] and [8].

Three basic components must be present in a rainwater harvesting system, namely: (1) catchment, namely a rainwater catcher in the form of a roof surface; (2) delivery system, namely a system for channeling rainwater from the roof to the shelter through gutters; and (3) storage reservoir, namely a place to store rainwater in the form of a barrel, tub or pond.

Apart from these three basic components, it can be equipped with supporting components such as a water pump to pump water from a tank or holding pond.[5] and [7].

Obstacles faced in harvesting rainwater include the fluctuating frequency and quantity of rain and the quality of rainwater not meeting WHO clean water standard guidelines. There are two issues related to rainwater quality, namely: (1) bacteriological water quality issues, namely rainwater can be contaminated by dirt in the catchment area (roof) so it is recommended to keep the roof clean; (2) insect vector issue: insects can reproduce by laying their eggs in water. Therefore, it is best to close the water storage barrel tightly to prevent the entry of insects such as mosquitoes. Problems with rainwater harvesting systems, namely bad smelling water, algae growth in the reservoir, sediment at the bottom of the reservoir, sometimes rodents, birds or frogs can find their way into the aquarium and start to rot if they are no longer alive. again, and the rainwater is not clear [9]. Furthermore, [10] stated that the problems with rainwater harvesting are: (1) rainwater that falls through the atmospheric layer then dissolves large amounts of dust and solid particles suspended in the air (Aerosol) so that it becomes contaminated, (b) when it falls on the land surface, rainwater then it becomes water runoff which has the potential to be contaminated by contaminants originating from surface runoff.

There are several simple treatment methods for using rainwater, including boiling the water will kill bacteria, adding chlorine (35ml sodium hypochlorite per 1000 liters of water) will disinfect the water, sand filtration (biosand) will remove dangerous organisms [11].

[8] stated that the Solar Water Disinfection(SODIS) technique is currently being developed, namely plastic bottles that have been painted black are filled with water and dried in the sun for several hours to kill bacteria and microorganisms in rainwater. In Taiwan, traditionally the practice of harvesting rainwater is mostly carried out in areas that have limited supplies of surface or underground water sources [5].

Field observations show that although rainwater harvesting is a simple, cheap technique and does not require special skills or knowledge, it is not widely practiced in Indonesia. Even though the practice of harvesting rainwater is important as an alternative water source.

From these facts, it can be stated that the government's role is needed so that the practice of rainwater harvesting can be carried out widely. The government needs to carry out communication, information, and public education so that people can be interested, understand, be aware, and be willing to do it in their own homes. If rainwater harvesting is widely practiced, then the problem of water shortage at the household level can be avoided. The following is an example of a simple rainwater harvesting system design that people can apply at the household level.

To meet the water demand, the supply of which is increasingly limited, water conservation efforts are needed. Harvesting rainwater is one method of water conservation that can be done by people in their households. Water conservation efforts require commitment from all parties to the issue of water sustainability. If rainwater harvesting is practiced sustainably, it will help maintain water sustainability and environmental sustainability to support the lives of current and future generations.[12] stated that to encourage the use of rainwater harvesting, future steps must include a comprehensive approach. First, education and social campaigns need to be stepped up to increase public awareness of the benefits and safety of rainwater, there needs to be financial incentives to encourage communities to install rainwater harvesting systems and collaboration between government, NGOs and the private sector is essential to promote and monitor the implementation of harvesting rainwater widely.

## 5.2. Is Rainwater Drinkable

Researchers from Monash University, Melbourne, Australia conducted a study to find out the impact of using rainwater for daily needs. This research was carried out by monitoring around 300 households that used collected rainwater as a source of daily drinking water. The results of research conducted for more than a year show that the risk of developing gastroenteritis and stomach flu, which are usually triggered by viruses or bacteria, in people who consume rainwater tends to be no different

compared to people who use quality tap water as a source of drinking water. The researchers also concluded that rainwater is safe for daily consumption. Researchers say rainwater has an acidity level that is still safe for the body, namely a pH of 5.6. This figure can be considered neutral and does not have a bad effect on body health.

We can collect rainwater in containers such as tubs or buckets. If this water is to be consumed as drinking water, ensure that the containers are clean, and not filled with dirt.

Before processing it, make sure to let the rainwater sit for an hour to make heavy particles settle into the bottom of the reservoir. This can also help prevent the growth of microorganisms.

To make rainwater safer to consume, we have to filter it or boil it first. We can use a homemade water filter or a special filter tool that can make rainwater free of bacteria, dirt, dust, mold, chemicals, and various other contaminants.

It's just that it's best to still boil rainwater to kill various kinds of bacteria and make it calmer for us to drink it. Health experts say there is rainwater that is not safe for consumption. The following are the types of rainwater.

If the environment where we live has many factories or industrial areas, the air pollution problem is usually quite serious. This will affect the process of forming rain in the sky. It is feared that rainwater in this area contains high levels of chemicals, pollutants, and dangerous chemicals that are not suitable for consumption.

Rainwater that is stagnant in dirty places such as streets, plant pots, or other places is mixed with various kinds of dirt and other things that make it no longer suitable for consumption. If we don't take good care of the water storage containers, the collected rainwater will be mixed with various unhealthy dirt and contaminants.

### 5.3. Rainwater Potential in IKN

The Construction Worker Residential Center (HPK) is currently equipped with Flats for Construction Workers (TKK) with 22 four-story towers the number of beds provided is 14,484 beds and the roof area of these 22 towers is 825 square meters. The water that can be accommodated by the roof area is 825 M<sup>2</sup> x 22 Towers. The area of 22 Towers = 18,150 M<sup>2</sup> with rainfall of 120.68 mm. Using the rainfall volume formula:  $V = \text{rainfall (1 mm)} \times \text{length (1 m)} \times \text{width (1 m)}$ , then periodically in HPK IKN there will be around 2,200,585 liters of clean rainfall water. Meanwhile, the clean water requirement for 544 workers with each person's clean water requirement being 60 liters/day is 32,640 liters/day [8].

The results of manual water monitoring at the HPK tower tank in February, March, and April 2023 are presented in Tables 3, 4, and 5.

Table 3. Manual Water Monitoring Results at the HPK Tower Tank - February 2023

| No | Date      | Day       | Time      | Start | Stop  |
|----|-----------|-----------|-----------|-------|-------|
| 1  | 1/2/2023  | Wednesday | Evening   | 04:14 | 09:33 |
| 2  | 3/2/2023  | Friday    | Evening   | 21:14 | 02:31 |
| 3  | 4/2/2023  | Saturday  | Afternoon | 09:17 | 16:40 |
| 4  | 6/2/2023  | Monday    | Afternoon | 10:11 | 15:29 |
| 5  | 9/2/2023  | Thursday  | Afternoon | 12:12 | 18:23 |
| 6  | 11/2/2023 | Saturday  | Afternoon | 09:00 | 17:00 |
| 7  | 14/2/2023 | Tuesday   | Evening   | 21:21 | 04:12 |
| 8  | 21/2/2023 | Tuesday   | Evening   | 19:30 | 20:10 |
| 9  | 23/2/2023 | Thursday  | Afternoon | 12:37 | 16:22 |

Table 4. Manual Water Monitoring Results at the HPK Tower Tank - March 2023

| No | Date      | Day       | Time      | Start | Stop  |
|----|-----------|-----------|-----------|-------|-------|
| 1  | 4/3/2023  | Saturday  | Evening   | 22:11 | 01:04 |
| 2  | 6/3/2023  | Monday    | Afternoon | 11:05 | 13:06 |
| 3  | 7/3/2023  | Tuesday   | Afternoon | 09:37 | 14:00 |
| 4  | 8/3/2023  | Wednesday | Afternoon | 10:10 | 13:23 |
| 5  | 14/3/2023 | Tuesday   | Afternoon | 13:17 | 17:23 |

|    |           |           |           |       |       |
|----|-----------|-----------|-----------|-------|-------|
| 6  | 15/3/2023 | Wednesday | Afternoon | 11:03 | 13:07 |
| 7  | 20/3/2023 | Monday    | Evening   | 00:26 | 04:13 |
| 8  | 22/3/2023 | Wednesday | Afternoon | 13:11 | 14:16 |
| 9  | 25/3/2023 | Saturday  | Afternoon | 13:29 | 16:12 |
| 10 | 29/3/2023 | Wednesday | Evening   | 00:41 | 03:21 |

Table 5. Manual Water Monitoring Results at the HPK Tower Tank - April 2023

| No | Date      | Day       | Time      | Start | Stop  |
|----|-----------|-----------|-----------|-------|-------|
| 1  | 9/4/2023  | Sunday    | Afternoon | 11:11 | 13:17 |
| 2  | 10/4/2023 | Monday    | Afternoon | 14:10 | 16:39 |
| 3  | 11/4/2023 | Tuesday   | Afternoon | 13:37 | 18:20 |
| 4  | 12/4/2023 | Wednesday | Afternoon | 16:27 | 17:11 |
| 5  | 15/4/2023 | Saturday  | Afternoon | 09:00 | 12:02 |
| 6  | 17/4/2023 | Monday    | Afternoon | 11:11 | 13:38 |
| 7  | 19/4/2023 | Wednesday | Evening   | 02:30 | 04:15 |
| 8  | 22/4/2023 | Saturday  | Afternoon | 11:29 | 17:03 |
| 9  | 23/4/2023 | Sunday    | Afternoon | 10:11 | 13:29 |
| 10 | 25/4/2023 | Tuesday   | Afternoon | 08:29 | 10:17 |
| 11 | 29/4/2023 | Saturday  | Evening   | 03:24 | 09:20 |

#### 5.4. Diversity of Rainwater Harvesting Patterns

The potential for rainwater is enormous as an alternative water source. Where rainwater tends to contain relatively low levels of pollutants. Especially those that flow from the roof of the building, so they do not require a complicated management process. Rainwater as an alternative source of water in buildings can be used both as drinking water and for other needs.

Implementation of rainwater harvesting in various types of buildings has also been explored throughout the world. These include residential buildings (single-family), multi-story residential buildings, office buildings, schools, dormitories, sports facilities, hospitals, airports, and gas stations.

Rainwater harvesting is nothing new for the government. Since 2009 there have been efforts to encourage rainwater harvesting activities through the issuance of Minister of Environment Regulation Number 12 of 2009 concerning Rainwater Utilization. According to [10], rainwater utilization is done by making: (a) rainwater collection pond; (b) infiltration wells; and/or (c) biopore absorption holes. Apart from that, according to [14], other methods for harvesting rainwater are rainwater absorption ditches, infiltration areas, yard embankments, yard fences, earth excavation holes, landscape modifications, establishing groundwater conservation areas, conservation ponds, revitalization of lakes, ponds and lakes as well as plantation forests.

Apart from that, the Ministry of Public Works and Spatial Planning (PUPR) has also issued Minister of Public Works Regulation (PermenPU) Number 11/PRT/M/2014 concerning Rainwater Management in Buildings and Their Plots [15].

Some ways to harvest rainwater that can be done are:

##### 1. Infiltration Well

Infiltration wells are holes made to absorb rainwater into the soil and/or water-bearing rock layers. Currently, various types or models of infiltration wells have been developed, such as open and closed channel infiltration wells. For the general public, infiltration wells can also be built in yards, guided by SNI No.03-2453-2002 concerning technical planning procedures for rainwater infiltration wells for yards in Figure 2 and Figure 3.



Figure 2. Infiltration Well 1  
(Example of A Picture of A Shallow, Round Infiltration Well Using A Building Gutter)



Figure 3. Infiltration Well 2  
(Example of A Picture of A Shallow, Round Infiltration Well Using an Open Channel)

## 2. Rainwater Collection Pond

A rainwater collection pond is a pond or container used to collect rainwater that falls on the roof of a building (house, office, or industrial building) which is channeled through gutters. In principle, this pool is not much different from a Detention Pool, which should have a filtering and processing or soil absorption system, as referred to in Ministerial Decree 11/2014 [10]. Examples of images of rainwater collection ponds are presented in Figure 4 and Figure 5.



Figure 4. Rainwater Collection Pond 1  
(Example of a Picture of a Rainwater Collection Pond BelowGround Level)



Figure 5. Rainwater Collection Pond 2  
(Example of a Picture of a Rainwater Collection Pond AboveGround Level)

### 3. Biopore Absorption Holes

Biopore infiltration holes are holes made perpendicularly (vertically) into the ground, with a diameter of 10 – 25 cm and a depth of around 100 cm or not exceeding the depth of the groundwater table. Technically, biopore holes are similar to infiltration wells, only their diameter is much smaller. This is what the term Bioporimight be used for.



Figure 6. Biopore Absorption Holes

### 4. Rain Garden

A rain garden is a garden with vegetation designed to collect rainwater runoff. In 2018 UGM built a rainwater harvesting facility in the form of a Rain Garden, in AGS Park (short for Architectural, Geodetic, Civil Park) which was built in 2018.

Rain Garden is a type of green infrastructure that has proven effective in managing rainwater runoff in urban areas. In the 2600m<sup>2</sup> AGS Park, six rain garden basins were built in the center of the park and several elongated basins at the edges of the park. Examples of rain gardens are presented in Figure 6 and Figure 7.



Figure 7. Rain Garden 1

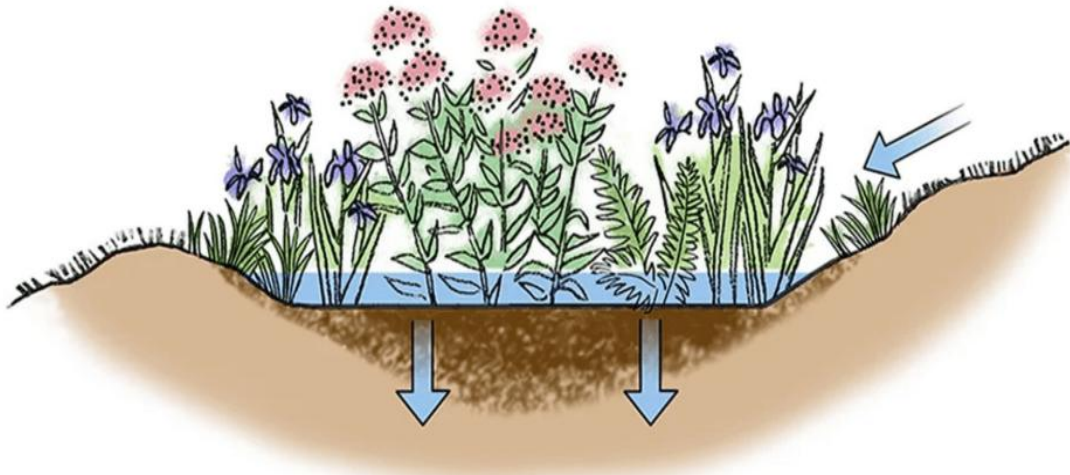


Figure 8. Rain Garden 2

### 5. Porous Paving Blocks

Paving blocks are known in Indonesia as building materials to pave land surfaces. Meanwhile, porous paving blocks are pavement materials that have pores, allowing more rainwater to seep into the ground. Image: Green porous paving blocks are visible for parking lots and non-porous paving blocks for roads [12].

### 6. Storage Tank

The simplest rainwater harvesting system is a system that has been commonly used since ancient times. Rainwater containers can be in the form of ponds, barrels, or other similar containers intended as rainwater reservoirs.

In principle, this model does not have a system for filtering or a system for absorbing water into the soil. People generally use rainwater from storage containers for washing or watering plants in their yards. However, in several areas with low rainfall, people have used rainwater as a source of drinking water.

Apart from the various rainwater harvesting models that have been presented, it is worth reminding yourself of the key role of plants. The ability of plants to absorb and release water back into the environment through the transpiration process has made plants the main players in the rainwater harvesting stage.

### **5.5. Change the Rainwater Installation Design**

In the 22 HPK Flat Towers in the Indonesian capital, there are 44 rainwater reservoirs with a capacity of 22,000 liters. Referring to the IKN Law, rainwater that is absorbed or channeled to the ground will be done through 3 methods, namely:

1. Green and blue open spaces that are widely spread, evenly distributed, and connected in one hydrological system to hold and store water and improve the quality of urban ecosystems and biodiversity, thereby creating comfortable cultural and recreational spaces
2. Design of urban facilities, such as micro-scale green roofs on buildings and structures to retain rainwater before it is absorbed by the soil or before it becomes runoff into drainage channels and rivers
3. Design of urban facilities on a macro scale, such as the application of porous roads and sidewalks, biosaves, and bioretention systems to hold or absorb rainwater quickly, thereby facilitating the smooth and safe movement of vehicles and people.

The function of reservoirs in HPK Flats needs to be optimized by rebuilding rainwater harvesting patterns. For example, by not disposing of rainwater at the HPK location which is received by the roof area and stored in a special place that meets the volume of rainwater. The water that flows through the gutter is collected in a reservoir which functions as a control tank and adds oxygen by making a protein skimmer head which will function as an air sucker to reach the underground water tank.

In the manual observation phase reservoir for 30 days in February, March, and April 2023 for 24 hours with a dynamic observation pattern, there was always a disproportionate discharge of rainwater through the drain pipe. This also refers to the IKN city target which is a sponge city which refers to cities and acts a sponge that can hold rainwater so that it does not run directly into drainage channels and which can improve the function and use of natural water so that the danger of flooding can be reduced as well as the quality and Water quantity can be increased through filtering and storage in underground water reservoirs.

### **CONCLUSION**

Based on the results of the study and discussion, it can be concluded that efforts to provide clean water in HPK IKN can be done other than dams and reservoirs, namely by harvesting rainwater through infiltration wells, rainwater collection ponds, biopore absorption holes, rain gardens, porous paving blocks, and reservoirs container.

### **References :**

- [1] Y. Kusumawardinani And W. Astuti. 2018. System Management Evaluation. Provision of Clean Water in Madiun City PDAM. Neo Teknika Journal 4 (1): 1-10.
- [2] M. Hilmi, R. Sutanto, And Y. A. Padang. 2013. Analysis. System. Regional Drinking Water Company Water Distribution in Pemongkong Village, Jerowaru District, Kab. Lomb. East. Journal of Mechanical Engineering Dynamics. 3(2):111–120.
- [3] Sucopindo. 2023. Sparing and Climate Change: Saving Water Quality in an Era of Weather Change. <https://www.sucofindo.co.id/article-1/sparing-dan-bahan-iklim-selamat-kualitas-air-di-era-bahan-cuaca/> 20 December, 2023.
- [4] BPS [https://dataindonesia.id/varia/detail/data-jumlah-penduduk-indonesia-2013\\_2023](https://dataindonesia.id/varia/detail/data-jumlah-penduduk-indonesia-2013_2023).
- [5] Director General of Human Settlements Number: 295 /Kpts/Ck/1997 Date: 1 April 1997 Concerning: Technical Guidelines for the Construction of State Buildings
- [6] Chao-Hsien Liaw And Yao-Lung Tsai, 2004, Optimum Storage Volume of Rooftop Rain Water Harvesting System For Domestic Use, Journal of the American Water Resources Association; Aug 2004; 40, 4; Proquest Agriculture Journals Pg. 901.

- [7] Sharpe, William E. And Swistock, Bryan. 2008. Household Water Conservation, College Of Agricultural Sciences, Agricultural Research And Cooperative Extension College Of Agricultural Sciences, The Pennsylvania State University.
- [8] Worm, Janette And Hattum, Tim Van. 2006. Rainwater Harvesting For Domestic Use, Agromisa Foundation And Cta: Wageningen, The Netherlands
- [9] Anonymous. 2023. What are the common problems that occur in rainwater harvesting systems? [https://www-graf-info.translate.google/en-ie/knowledge-hub/blog/what-are-the-typical-problems-with-a-rainwater-harvesting-system.html?\\_x\\_tr\\_sl=en&\\_x\\_tr\\_tl=id&\\_x\\_tr\\_hl=id&\\_x\\_tr\\_pto=tc](https://www-graf-info.translate.google/en-ie/knowledge-hub/blog/what-are-the-typical-problems-with-a-rainwater-harvesting-system.html?_x_tr_sl=en&_x_tr_tl=id&_x_tr_hl=id&_x_tr_pto=tc) (accessed 6 December 2023).
- [10] Center for Environmental Studies GadjahMadaUniversity . 2021. Exploring Rainwater Harvesting Steps. <https://pslh.ugm.ac.id/menjajaki-angkat-pemanenan-air-hujan/> (accessed, 12 December 2023).
- [11] Thomas, Terry. (2018). Rainwater Harvesting: Practical Action, School Of Engineering, University Of Warwick, Coventry Cv4 7al, UK.
- [12] Meliala, L. 2023. Rainwater Harvesting (PAH) as an Alternative Water Source for Urban Communities. <https://lcdi-indonesia.id/2023/12/06/pemanenan-air-hujan-pah-as-alternatif-source-air-untuk-community-perkotaan/> accessed 6 December 2023.
- [13] Minister of Environment Regulation Number 12 of 2009 concerning Rainwater Utilization.
- [14] Maryono, A. 2016. Harvesting Rainwater, GadjahMada University Press, Yogyakarta.
- [15] Regulation of the Minister of Public Works Number 11/Prt/M/2014 concerning Rainwater Management in Buildings and Plots.