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## The Benefits of Infiltration Wells for Enhancing Groundwater Availability in Cikarawang Village, Dramaga District, Bogor West Java

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### Abstract

Cikarawang Village, located in Dramaga District, Bogor, West Java, covers an area of 226.56 hectares and had a population of 8,227 in 2012. The majority of the residents work in agriculture, livestock farming, and small-scale industries. Despite the village's significant potential in the agrarian sector, the education level of its residents remains low, with only 61% having ever received formal education, and 52% of them only being elementary school graduates. One of the main problems facing the village is an increasingly severe groundwater crisis, especially during the dry season, where the 270 dug wells in the village often experience significant drops in water levels. This situation impacts the availability of clean water, which is crucial for daily needs and agriculture. The purpose of this Community Service (PkM) activity is to enhance the understanding and awareness of the community regarding the importance of infiltration wells as a solution to the groundwater crisis. It is hoped that infiltration wells can become an effective water storage system by utilizing rainwater that falls to the ground, so that it can help manage rainwater in a sustainable manner. The methodology used in this PkM activity includes direct counseling to village residents, question and answer sessions to explore understanding and obstacles faced by the community, as well as evaluation via questionnaires to measure changes in community understanding before and after the activity. The results of this activity show a significant increase in public understanding of the benefits of infiltration wells, from initially only 32.5% to 85.8% after implementing the program. These results indicate that the education carried out was successful in increasing public awareness and could be an effective first step in overcoming the groundwater crisis in Cikarawang Village.

**Keywords:** Cikarawang, Groundwater, Rainwater, Community Service (PkM), Infiltration wells

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### Introduction

The background of the community service in Cikarawang Village is based on a situational analysis that reflects the village's social, economic, and environmental conditions. Cikarawang Village, located in Dramaga District, Bogor Regency, West Java Province, covers an area of 226.56 hectares with a population of 8,227 as of 2012 (Karim, *et al.*, 2017) <sup>[10]</sup>. The village consists of three hamlets, seven neighborhood units (RW), and 32 community units (RT) spread across 11 sub-villages (Figure 1, Google Earth, 2023) <sup>[5]</sup>. Most of the population works in agriculture, which is the backbone of the village's economy, while the livestock and cottage industries also significantly contribute to the local economy (Heriyanto, *et al.*, 2023) <sup>[8]</sup>.

The education level of the Cikarawang Village community is relatively low, with about 52% of the population being only elementary school graduates (Karim, *et al.*, 2017) <sup>[10]</sup>. This affects their access to knowledge and technology, including sustainable water resource management practices. This low education level also limits their ability to understand and adopt technical solutions such as infiltration wells, which could actually help address the water problems in this village (Kusnaedi, 2011) <sup>[11]</sup>.

The topography of Cikarawang Village consists of lowlands and rice fields, part of the Cisadane River Valley. Its geological conditions are dominated by pumice tuff rocks, which are excellent for storing water, making it ideal for constructing infiltration wells (Google Earth, 2023) <sup>[5]</sup>. However, the village faces serious challenges in the form of an increasingly concerning groundwater crisis. With 270 generally shallow dug wells, the supply of clean water, especially during the dry season, is often disrupted. High demand for groundwater and the lack of adequate clean water sources have caused a significant drop in groundwater levels, negatively impacting the water needs for agriculture and daily community life (Effendi, *et al.*, 1998) <sup>[4]</sup>.

Additionally, climate change, which causes changes in rainfall patterns, further exacerbates the water crisis in Cikarawang Village. Rainfall is becoming increasingly unpredictable, with shorter durations but higher intensities, causing rainwater to quickly flow into rivers and be lost rather than seep into the ground. This further worsens the already depleted groundwater reserves (Smith, 2019) <sup>[16]</sup>. This situation requires effective intervention to increase water infiltration capacity, particularly through the construction of infiltration wells.

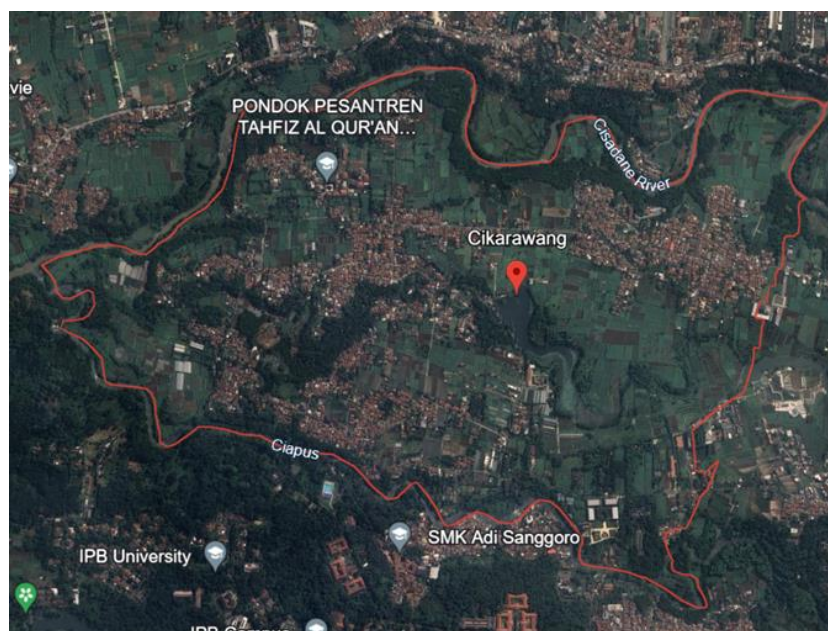
One proposed solution to address the groundwater crisis in Cikarawang Village is to utilize infiltration wells. Although this technology has great potential, its use is still limited due to a lack of understanding and awareness among the community about its benefits, as well as a lack of information and technical guidance on the construction and maintenance of infiltration wells (Kusnaedi, 2011; Smith, 2019; Jones,

2020) <sup>[11, 16, 9]</sup>.

Furthermore, reduced vegetation in residential areas decreases the soil's capacity to absorb water, ultimately reducing the effectiveness of the water infiltration process (Green, 2017) <sup>[7]</sup>.

As an initial step, awareness and education about the importance of infiltration wells need to be intensified. Active community participation in the construction and maintenance of infiltration wells is crucial to ensure the sustainability of this effort. Increasing community capacity through technical training on how to properly construct infiltration wells, and understanding the importance of maintaining surrounding vegetation as part of the water infiltration system, can help reduce the pressure on groundwater resources (White, 2016) <sup>[18]</sup>.

Infiltration wells function differently from regular water wells used for household needs. Infiltration wells are designed to channel water into the ground, whereas water wells are used to draw water from the ground (White, 2016) <sup>[18]</sup>. The basic principle applied to infiltration wells is to provide a pathway for rainwater to infiltrate into the soil, especially in impervious or hard-to-penetrate land (Black, 2021) <sup>[1]</sup>. To enhance their effectiveness, infiltration wells are usually built close to rainwater drains from rooftops, allowing water to seep directly into the ground (Grey, 2019) <sup>[7]</sup>. The construction of the well should be designed so that water can easily enter and have a sufficiently long residence time in the well, especially if made to a suitable depth, optimizing water infiltration into the ground (Red, 2020; Yellow, 2018) <sup>[15, 19]</sup>.



**Fig 1:** Cikarawang Village, Bogor (Google Earth, August 2024)

## Research Methodology

For the Community Service Program (PkM) in Desa Cikarawang, which focuses on enhancing understanding and the use of infiltration wells as a solution to address groundwater crises, here are the methodological steps that can be followed along with the flowchart in Figure 2.

### 1. Problem Identification and Needs Assessment

- Initial Survey: Conduct data collection on groundwater conditions, clean water sources, and the community's understanding of infiltration wells through field

observations and interviews. This is to comprehensively assess the existing issues and determine the community's specific needs (Effendi, *et al.*, 1998; Smith, 2019) <sup>[4, 16]</sup>.

- Data Analysis: Analyze the survey results to identify the main problems and the community's needs in groundwater management (Jones, 2020) <sup>[9]</sup>.

### 2. Program Planning

- Formulating Goals and Objectives: The program's goal is to increase community understanding and awareness

of infiltration wells and to implement this technology as a solution to the groundwater crisis (Heriyanto, *et al.*, 2023) <sup>[8]</sup>.

- **Development of Educational Materials:** Develop educational materials that include explanations of the benefits of infiltration wells, how to build them, and their maintenance. These materials are designed based on the participants' needs and level of understanding (Kusnaedi, 2011) <sup>[11]</sup>.
- **Implementation Strategy Development:**

Design effective methods for outreach, training, and evaluation, including the selection of practical and interactive methods to actively engage the community (Green, 2017) <sup>[6]</sup>.

### 3. Conducting Outreach and Training

- **Outreach and Discussion:** Hold outreach sessions and discussions to explain the concept of infiltration wells, their benefits, and the importance of groundwater management (Smith, 2019) <sup>[16]</sup>.
- **Demonstration and Technical Training:** Provide hands-on training on how to build infiltration wells, including easily understood technical steps (White, 2016) <sup>[18]</sup>.

### 4. Monitoring and Evaluation

- **Implementation Monitoring:** Conduct regular visits to

monitor the implementation of infiltration wells built by the community after the training (Effendi, *et al.*, 1998) <sup>[4]</sup>.

- **Impact Evaluation:** Assess the program's impact on increasing community understanding and the effectiveness of infiltration wells in addressing the groundwater crisis (Jones, 2020) <sup>[9]</sup>.
- **Feedback Collection:** Gather feedback from participants regarding the program for future improvements (Green, 2017) <sup>[6]</sup>.

### 5. Reporting and Publication

- **Preparation of Final Report:** Prepare Comprehensive report on all PkM activities, including data analysis before and after program implementation (Kusnaedi, 2011) <sup>[11]</sup>.
- **Publication of PkM Results:** Publish the results of the activities in related journals or seminars to share experiences and knowledge (Smith, 2019) <sup>[16]</sup>.

The above steps provide a structured approach to conducting the PkM program, ensuring that each phase is thorough and that the community is effectively engaged and educated on the benefits and implementation of infiltration wells.

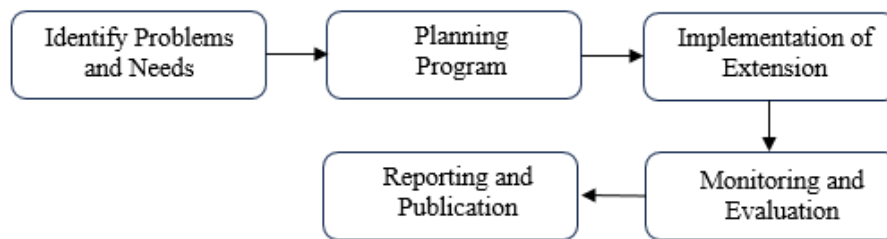


Fig 2: Methodology Flowchart of the Community Service Program (PkM)

### Research Results

The Community Service Program (PkM) in Cikarawang Village aims to address the groundwater crisis by enhancing community understanding of infiltration well technology. This initiative focuses on educating and practically applying infiltration well technology, which is expected to help mitigate the problem of clean water shortages, especially during the dry season. The program was attended by 30 village residents (Figure 3).

The results and discussion of this program will provide an in-

depth analysis of the impact of the outreach and training provided, both in quantitative and qualitative aspects. This analysis includes participants' knowledge improvement, technology implementation at the household level, and the effectiveness of infiltration well technology in increasing groundwater reserves. By considering the survey results before and after the training, participant feedback, and monitoring the technology implementation, we can evaluate how well the program has achieved its objectives and identify areas for future improvement.



Fig 3: Participants of the PkM program in Cikarawang Village after the socialization session

## 1. Qualitative Results

The qualitative analysis of the Community Service (PkM) activities in Cikarawang Village aims to evaluate the program's impact on enhancing community understanding and awareness of infiltration well technology. The main focus of the qualitative analysis is to understand changes in the participants' knowledge and attitudes towards this technological solution and explore their responses to the outreach and training sessions. Through Q&A sessions, direct observation, and participant feedback, this section will identify how well the program has educated the community, the challenges faced in applying the technology, and the success of the outreach methods used.

This analysis provides insights into how the implementation of infiltration well technology can be accepted and applied in the local context and how the community's needs and expectations can be accommodated to enhance the program's effectiveness in the future. Based on qualitative analysis, the expected results include:

### a. Increased Community understanding

#### ▪ Understanding of the Concept

After attending the outreach and training sessions, participants showed a significant improvement in understanding the function and benefits of infiltration wells. Most participants, especially those who initially had limited knowledge, were able to explain how infiltration wells can help address the groundwater crisis and how to construct them (Smith, 2019) <sup>[16]</sup>.

#### ▪ Change in Attitude

A positive change in attitude was observed among participants regarding the use of infiltration well technology. Previously, many participants were unaware of the importance of sustainable groundwater management. After the training, they showed a greater interest in applying this knowledge in their daily lives (Jones, 2020) <sup>[9]</sup>.

### b. Participants' Response to the Program

#### ▪ Participant Feedback

Participants provided positive feedback on the outreach and training sessions. They appreciated the practical and hands-on approach used, such as demonstrating how to build infiltration wells. Some participants expressed amazement at how simple yet effective this technology is (Kusnaedi, 2011) <sup>[11]</sup>.

#### ▪ Constraints and Challenges

Some participants identified challenges related to the resources and materials needed to build infiltration wells independently. Additionally, there were concerns about the future maintenance of infiltration wells, given their limited prior knowledge and experience (Green, 2017) <sup>[6]</sup>.

## 2. Quantitative Results

The quantitative analysis of the Community Service (PkM) activities in Cikarawang Village aims to systematically evaluate the program's impact through numerical and statistical data. The main focus of the quantitative analysis is to measure the increase in participants' knowledge about infiltration wells, the success of implementing this technology, and its effectiveness in addressing the groundwater crisis. Using data from surveys conducted before and after the training, as well as information on the number of participants who successfully implemented infiltration well technology in their households, this section will examine significant changes.

This analysis will also include evaluating the program's success based on quantitative metrics such as increased understanding, technology adoption rates, and initial impacts on groundwater reserves. This quantitative data provides a clear picture of the program's effectiveness and forms the basis for assessment and further improvement in sustainable groundwater management efforts. Based on quantitative analysis, the expected results are:

### a. Knowledge Enhancement

#### ▪ Pre and Post-Training Surveys

Based on the survey results, participants' understanding of the benefits of infiltration wells increased from 32.5% before training to 85.8% after training, as shown in Table 1 and Figure 4. This indicates a significant increase in community knowledge regarding infiltration well technology and the importance of sustainable groundwater management (Effendi, *et al.*, 1998) <sup>[4]</sup>.

### b. Number of Participants and Education

#### ▪ Number of Participants

The program was attended by 30 participants.

#### ▪ Educational Background

Participants came from diverse educational backgrounds, ranging from elementary to high school. Despite the varying levels of education, they showed a high willingness and enthusiasm to learn and apply infiltration well technology (Heriyanto, *et al.*, 2023) <sup>[8]</sup>.

### c. Technology Implementation

#### ▪ Post-Socialization Interest

Many participants expressed interest in implementing the construction of infiltration wells after the socialization session. This indicates the program's success in encouraging the adoption of infiltration well technology at the household level (Black, 2021) <sup>[1]</sup>.

### d. Effectiveness Evaluation

Monitoring:

Monitoring can be conducted once the infiltration wells have been constructed.

**Table 1:** Questionnaire results before and after socialization of infiltration wells

No.	Questionnaire	Respondents' Understanding (%)			
		Before		After	
		Yes	No	Yes	No
1	Initial Knowledge about Infiltration Wells	33,3	66,7	100,0	0,0
2	Participation in the PkM Program, Infiltration Well Theme	6,7	93,3	86,7	13,3
3	Understanding of Infiltration Wells	40,0	60,0	100,0	0,0
4	Implementation and Implementation of Infiltration Wells	46,7	53,3	80,0	20,0

5	Changes in Water Access and Availability	33,3	66,7	76,7	23,3
6	Environmental and Social Impact	26,7	73,3	83,3	16,7
7	Sustainability and Maintenance of Infiltration Wells	53,3	46,7	86,7	13,3
8	Suggestions and Input for PkM Activities	20,0	80,0	73,3	26,7
	Average	32,5	67,5	85,8	14,2

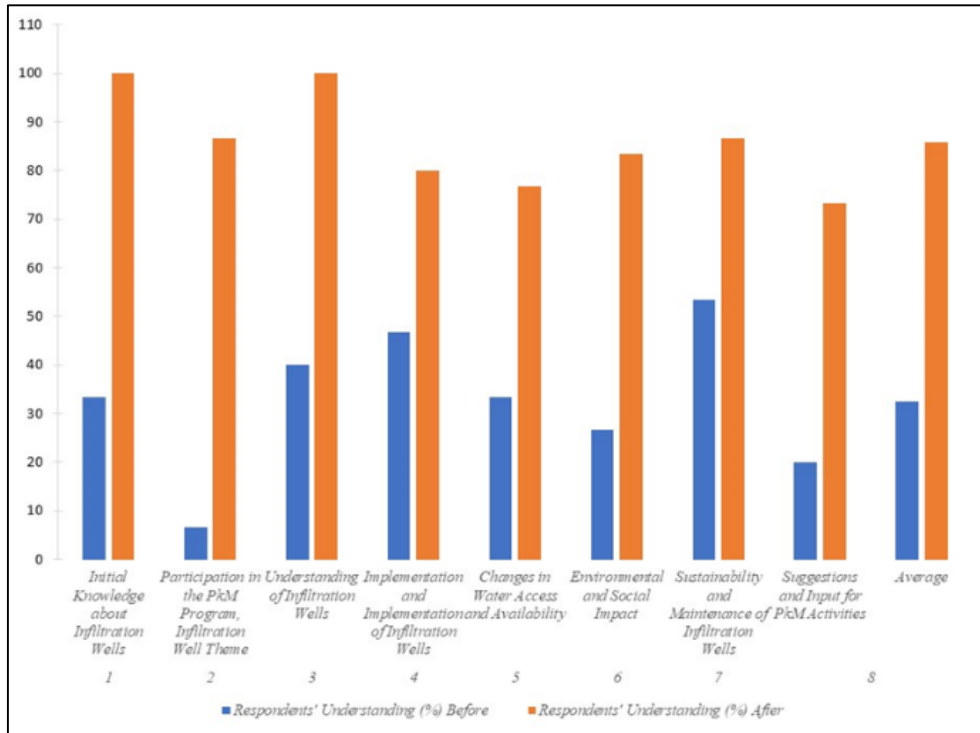


Fig 4: Questionnaire results before and after socialization of infiltration wells

**3. Analysis**

The PkM program in Cikarawang Village successfully increased community understanding and awareness of the benefits of infiltration wells significantly. The increase in knowledge from 32.5% to 85.8% shows the effectiveness of the outreach and training materials provided (Smith, 2019) [16]. The involvement of participants with diverse educational backgrounds proves that this technology can be understood and applied by the broader community, although there are challenges related to resource limitations and maintenance (Jones, 2020) [9].

Constraints identified during the program, such as the need for materials and knowledge about infiltration well maintenance, demonstrated the need for ongoing support and the provision of additional resources to ensure long-term success (Green, 2017) [6]. Feedback from participants indicated that practical approaches and direct demonstrations were effective methods in educating the public (Kusnaedi, 2011) [11].

By adopting infiltration well technology, this program shows great potential in overcoming the groundwater crisis in Cikarawang Village. This success can become a model for similar programs in other areas with similar conditions, as long as the challenges and needs of the community are carefully considered (Effendi, et al., 1998; Black, 2021) [4, 1].

**Conclusion**

1. PkM activities in Cikarawang Village have succeeded in increasing community knowledge and awareness about the benefits and functions of infiltration wells. Before the training, only 32.5% of participants understood the benefits of infiltration wells, but after the training, this

understanding increased significantly to 85.8%. Shows that the outreach and training approach carried out is effective in increasing public understanding of this water management technology.

2. There is participation and adoption of technology which indicates positive acceptance of infiltration well technology at the household level. The enthusiasm and involvement of participants shows the potential for this technology to be applied more widely in villages.
3. This program has the potential to become a model for other regions with similar problems, provided there is adequate support and ongoing efforts to improve understanding and implementation of this technology.

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