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The Effectiveness Of Infiltration Wells In Supporting Groundwater Resources In Pekanbaru City

Ayudya Rizky Marpaung[1], Muhammad Ridho Alfarisi[2], Niko Kristian[3], Nisa Nur Ishaq[4], Putri Rahmawati[5], Yanifa Aulia Annesia[6], Eriyati[7]

[1,2,3,4,5,6,7]Universitas Riau

Abstract

Land-use change in Pekanbaru City has reduced water recharge areas and increased pressure on groundwater sustainability. This study examines groundwater conditions, infiltration well effectiveness, economic feasibility, and the implementation of infiltration well policies. It uses a descriptive-analytical approach based on secondary data, including land-cover and runoff coefficient analysis, cost-benefit analysis using the replacement cost approach, and qualitative policy analysis. The findings indicate that forest, swamp, and shrubland areas decreased from approximately 48% of the city area in 2006 to 10% in 2014, while the runoff coefficient increased from 0.31 to 0.36. A household infiltration well with a radius of 0.5 m and a depth of 2 m can infiltrate an estimated 31.4–47.1 m³ of water annually, generating a net benefit of IDR 132,600–393,900 per year. The payback period ranges from 3.83 to 11.39 years for concrete culvert rings and 6.25 to 18.56 years for red bricks, indicating economic feasibility. However, the implementation of Pekanbaru City Regional Regulation No. 10 of 2006 remains suboptimal due to low public awareness, weak supervision, limited enforcement, and insufficient inter-agency coordination. Further field verification is needed to validate these findings.

Keywords: infiltration wells, groundwater, land-use change, replacement costs, policy effectiveness, Pekanbaru

INTRODUCTION

Water plays a vital role in both household needs and economic activities, but its availability is limited and heavily dependent on recharge from rainwater infiltration. With rapid urban development, the conversion of open land to residential areas, and the expansion of impermeable surfaces, the portion of rainwater infiltrating into the ground has decreased.

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Pekanbaru City also faces a similar situation. Land conversion in this city has been shown to affect the soil's ability to absorb water [1]. The shrinking infiltration area has two impacts simultaneously: increased surface runoff and threats to groundwater sustainability.

Infiltration wells are one of the steps taken. Research results in the Maros Tengah Sub-DAS (Central Maros Watershed) indicate that infiltration wells can suppress runoff while increasing infiltration [2], and planning in the Dramaga Cantik 2 Housing Complex in Bogor estimates a reduction in runoff of up to 56% [3]. In Pekanbaru City, research in the Vila Tani Housing Complex shows that the implementation of infiltration wells reduces flood discharge in the area by around 54% [4]. Conversely, their effectiveness is influenced by local conditions, so results in one area cannot be directly applied to other areas.

Economics views water infiltrated through infiltration wells as adding to groundwater reserves, the value of which can be approximated by replacement cost, which is the cost of obtaining water from other sources. Since December 2024, Perumda Tirta Siak's water tariff for households in Pekanbaru has ranged from IDR 9,000 to IDR 13,900 per m^3 [5], so every cubic meter of groundwater saved has a clear economic value. Meanwhile, building infiltration wells requires costs, which in studies in various regions range from around IDR 3.4 million to IDR 5.2 million per unit [6][7]. Therefore, the feasibility of infiltration wells needs to be assessed by comparing their benefits and costs, and calculating the value of the groundwater that can be saved.

From a policy perspective, the Pekanbaru City Government requires the construction of infiltration wells through Regional Regulation Number 10 of 2006, but its implementation has not been optimal. Research in Tuahmadani District concluded that the implementation of this regulation has not been effective [8].

Based on the author's research, previous research reviews generally discuss the technical aspects, economic value, or infiltration well policies separately. No studies have been found that compare the benefits and costs of infiltration wells and calculate the value of groundwater saved in Pekanbaru City. This study fills this gap by combining these three aspects in the context of Pekanbaru City. The objectives are to analyze groundwater conditions, the effectiveness of infiltration wells, a comparison of the benefits and costs of infiltration well construction, the value of groundwater saved, and the effectiveness of infiltration well policies in Pekanbaru City.

LITERATUR REVIEW

Groundwater is water found beneath the surface of the earth and stored within layers of soil and rock that can store and transmit water. Groundwater is a crucial

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component of water resources because it can be used to meet household needs, economic activities, agriculture, and various community activities.

The existence of groundwater is closely related to the hydrological cycle, particularly infiltration, the process by which water enters the ground from the Earth's surface. Some of the rainwater that falls on the Earth's surface infiltrates and moves into deeper layers of the soil, where it becomes part of the groundwater recharge.

According to the Minister of State for the Environment Regulation Number 12 of 2009 concerning Rainwater Utilization, rainwater can be used as a source of groundwater recharge. The regulation explains the importance of rainwater utilization and conservation efforts to maintain the balance of groundwater availability.

Infiltration wells are a water conservation technology that collects rainwater and channels it into the ground through a process called seepage. Infiltration wells are generally constructed as holes or wells in the ground surface that receive rainwater, either directly or through channels from the roof of a building.

Government Regulation Number 16 of 2021 contains provisions regarding rainwater retention facilities, including infiltration wells, as part of rainwater management in buildings (Government of the Republic of Indonesia, 2021).

In general, infiltration wells have several main functions, namely:

1. Increases the amount of rainwater entering the soil.
2. Helps increase groundwater reserves through the infiltration process.
3. Reduce the volume of surface runoff.
4. Reduce the potential for puddles and flooding due to rainwater runoff.
5. Supporting water resource conservation, especially in urban areas.

   Thus, infiltration wells not only function as a means of controlling rainwater runoff, but also as an effort to maintain the sustainability of groundwater resource availability.

The working mechanism of an infiltration well is related to the processes of infiltration and percolation. Infiltration is the process of water entering the ground from the surface, while percolation is the movement of water into deeper layers of the soil.

When rainwater flows into an infiltration well, it is temporarily stored and then seeps through the walls and bottom of the well. The water then moves according to the characteristics of the soil layers and local geological conditions. If soil conditions permit, the water can reach aquifers and replenish groundwater reserves.

The effectiveness of the absorption process is influenced by several factors, including:

a. Rainfall, which determines the amount of water that can potentially be stored and infiltrated.
b. Soil permeability, which determines the ability of the soil to pass water.

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c. The depth of the groundwater table, which affects the space available for water to infiltrate.
d. Geological conditions and aquifer layers, which determine the ability of underground layers to store and flow water.
e. The size of the water catchment area, which affects the volume of rainwater that can be channeled to the infiltration well.

These factors need to be considered in the use of rainwater for groundwater conservation.

Effectiveness is a measure used to determine the extent to which a program, policy, or technology is able to achieve its stated objectives. In the context of this research, infiltration well effectiveness can be defined as the degree to which an infiltration well successfully captures and infiltrates rainwater into the ground, thereby supporting the addition of groundwater reserves.

The effectiveness of infiltration wells is determined not only by the presence or number of wells built, but also by their ability to perform their intended function. Infiltration wells may not be effective if the soil conditions do not support infiltration, the well capacity does not match the volume of rainwater, or the construction is not properly maintained.

Therefore, the effectiveness of infiltration wells can be analyzed through the following indicators:

a. The ability to absorb water, namely the ability of the well to channel rainwater into the ground.
b. Storage capacity, namely the ability of the well to accommodate the volume of incoming rainwater.
c. Reduction of surface runoff, namely the amount of rainwater that flows on the ground surface.
d. Support for groundwater recharge, namely the potential for water to be infiltrated to become additional groundwater reserves.
e. Well condition and maintenance, namely the well's ability to function sustainably.

Gan (2023), in a study on the implementation of infiltration wells at the Hang Tuah Cipta Residence housing complex in Pekanbaru, reported the highest runoff reduction effectiveness of 87.321% for the well conditions analyzed. These findings indicate that the dimensions and technical condition of the infiltration wells influence their ability to reduce rainwater runoff. These figures are based on the results of the study site and cannot be directly generalized to the entire city of Pekanbaru.

Urban areas generally experience increased infrastructure development, housing, roads, and commercial buildings. These changes in land use can reduce the open land surface that serves as water catchment areas. As a result, more rainwater becomes surface runoff rather than naturally infiltrating the ground.

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Infiltration wells are an alternative method for groundwater conservation in urban areas because they can help return some rainwater to the ground. Implementing this technology can also support sustainable rainwater management by reducing surface runoff and increasing the potential for groundwater recharge.

Juandi, Manelsa, and Syech (2017), in their study of the distribution of groundwater infiltration levels in Bukit Raya District, Pekanbaru City, found differences in infiltration levels between regions. The study showed that open land area and soil lithology are factors influencing groundwater infiltration levels. These findings emphasize that the implementation of infiltration wells requires consideration of the environmental characteristics of each region.

Therefore, the implementation of infiltration wells in Pekanbaru City needs to be adjusted to geological conditions, soil permeability, and groundwater depth. The soil's ability to absorb water varies from location to location. Infiltration well management is based on policies that support water resource conservation in Pekanbaru City. One such policy is Pekanbaru City Regional Regulation Number 10 of 2006 concerning Water Resources and Infiltration Wells.

Hendri, Ardiansah, and Fahmi's study on the implementation of infiltration well construction in Pekanbaru City discusses the provisions of the Regional Regulation, including the obligation to provide infiltration wells in buildings under conditions stipulated by the regulation. Walihuddin's (2019) research on water resource management and infiltration wells in Pekanbaru City identified that policy implementation still faces obstacles, including buildings not yet equipped with infiltration wells and suboptimal supervision and implementation of sanctions. This indicates that the success of groundwater conservation is not only determined by the technical capabilities of infiltration wells, but is also influenced by policy implementation, community compliance, and construction supervision.

The construction of infiltration wells must adhere to technical standards to ensure proper water infiltration. One technical reference in Indonesia is SNI 8456:2017 concerning Rainwater Infiltration Wells and Trenches. Furthermore, Government Regulation No. 16 of 2021 contains provisions regarding rainwater retention facilities.

Technical requirements that must be considered include groundwater depth, soil permeability, safe distance from buildings, and well dimensions adapted to soil conditions and the volume of rainwater to be collected. Requirements should be determined directly by applicable standards and regulations, as technical requirements can vary depending on the type of facility and site conditions.

Therefore, infiltration well construction cannot be done haphazardly. Soil condition testing and groundwater level measurements are necessary to ensure the selected location allows for proper infiltration.

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Based on previous theory and research, infiltration wells are a water conservation alternative that has the potential to support the sustainability of groundwater resources in Pekanbaru City. Their effectiveness is influenced by the physical conditions of the environment, the soil's ability to absorb water, the well's capacity, and policy implementation and facility maintenance.

RESEARCH METHODS

This study uses a descriptive-analytical approach with a combination of simple qualitative and quantitative methods in Pekanbaru City, Riau Province. The data used are entirely secondary data collected through documentation studies from scientific journals, theses, local government publications, and data from the Central Statistics Agency. While components for which data is not yet available for Pekanbaru City, such as the cost of infiltration well construction, use data from other regions as a comparison. Groundwater conditions are analyzed indirectly through changes in land cover area and combined runoff coefficient, while the effectiveness of infiltration wells is analyzed descriptively-comparatively based on the well capacity, soil infiltration rate, and the results of previous studies. The comparison of benefits and costs is analyzed using a replacement cost approach, namely the volume of infiltrated water multiplied by the clean water tariff of Perumda Tirta Siak as a shadow price to obtain gross benefits, which are reduced by maintenance costs to obtain net benefits, then investment costs are divided by net benefits to determine the break-even point period compared to the technical life of the material. The effectiveness of the policy is analyzed descriptively-qualitatively by comparing the provisions of Pekanbaru City Regional Regulation Number 10 of 2006 with its implementation based on previous studies.

RESULTS AND DISCUSSION

(Rizki Rianda Putra, Manyuk Fauzi, 2014)mapping urban land in 2006, 2012, and 2014 using a geographic information system. The three land classes with the best water retention and infiltration capacity—forests, swamps, and shrubs—shrunk significantly, as shown in Table 1.

Table 1. Changes in Land Area in Pekanbaru City, 2006–2014

Land type	2006 (ha)	2014 (ha)	Change
Forest	5,618	619	−89%
Swamp	1,664	17	−99%
Shrubs	23,345	5,593	−76%
Plantation	18,132	37,765	+108%
Settlement	11,033	15,443	+40%

Source: processed from Putra et al. (2016)

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Total forest, swamp, and scrubland in 2006 was approximately 30,600 hectares, or 48% of the city's area (63,304 hectares). By 2014, this figure had fallen to approximately 6,200 hectares, or 10%. Within eight years, almost all natural and semi-natural cover had been replaced by cultivated and built-up areas. The largest portion of the change was in the form of plantation expansion, not residential development.

Plantations are often considered “green,” so their impact is considered small. The runoff coefficient value according to the SNI used(Rizki Rianda Putra, Manyuk Fauzi, 2014)shows the opposite that forests and swamps have C = 0.15, while plantations C = 0.30. Replacing forests or swamps with plantations doubles the proportion of rainfall that becomes runoff on each hectare. The contribution of plantations to total runoff (area × C) increased from 28% in 2006 to 51% in 2012. Sandhyavitri (2014) that oil palm plantations have the lowest infiltration rate among vegetation types. Plantation expansion is thus not a neutral change for groundwater.

At the city level, the runoff coefficient increased from 0.31 (2006) to 0.35 (2012) and 0.36 (2014), or about 16% (author's calculations).(Rizki Rianda Putra, Manyuk Fauzi, 2014)showed that C would reach 0.49 by 2034 if land use patterns remained unchanged. In the Sail Sub-watershed, Bukit Raya District, Sulistio (2021) found a similar pattern: C increased from 0.4691 (2007) to 0.4759 (2012) and 0.4899 (2017), as settlements increased (from 1,320 ha to 1,500 ha) and plantations decreased (from 490 ha to 160 ha). In 2017, almost half of the rainfall in the area became surface runoff.

The pressure on the infiltration is uneven.(Rizki Rianda Putra, Manyuk Fauzi, 2014)shows that the runoff coefficient of WP I, the old city center, is stable at 0.55 because it was built early, while WP V increased the most, from 0.36 (2006) to 0.44 (2014). WP V includes sub-districts such as Tampan and Marpoyan Damai, which according to(Andry, 2025)becoming a new center of economic growth with a population growth of around 3.9%. Water absorption is lost most rapidly at the edges of growing cities, as water absorption in the city center has long been exhausted.

From the demand side, population growth increases the need for water, including groundwater. Regional Regulation No. 10 of 2006 itself regulates the obligations of deep well users and groundwater users.(MAHARANI, 2025)Groundwater in Pekanbaru is likely facing dual pressures, with recharge declining due to loss of infiltration, while withdrawals increase due to population growth. If both continue, the discrepancy will lead to a decline in groundwater reserves and levels.

Pekanbaru's groundwater resources are under pressure. Indirect indicators are consistent: the city's absorbing land has shrunk from 48% to 10% of the city's area, runoff coefficients have increased at the city and sub-district levels, and flooding is recurring in developing areas. Further research is needed using monitoring well data to test whether groundwater reserves are truly declining.

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As described in the first problem formulation, the area of natural land cover in Pekanbaru City shrank drastically from 48% to only 10% in the period 2006–2014, accompanied by an increase in the runoff coefficient from 0.31 to 0.36 at the city level (Rizki Rianda Putra, Manyuk Fauzi, 2014). This condition indicates that the natural ability of the area to absorb rainwater into the ground has experienced significant degradation. Forests, swamps, and shrubs that previously functioned as water catchment areas with a low runoff coefficient (C = 0.15) have now largely been replaced by plantations and residential areas that have a much higher runoff coefficient.

On the other hand, continued population growth, particularly in new development areas such as Tampan and Marpoyan Damai Districts, at a rate of around 3.9%, has simultaneously increased groundwater extraction (Andry, 2025). Groundwater thus faces dual pressures: decreased recharge due to the loss of catchment areas, and increased extraction due to the growing population. If both pressures continue without adequate intervention, the resulting difference will lead to a long-term decline in groundwater reserves and levels.

Infiltration wells are one technology designed to address this pressure. The Pekanbaru City Government has even formally regulated them through Regional Regulation No. 10 of 2006, which requires deep well users and groundwater users to provide infiltration facilities as a form of responsibility for maintaining a balanced hydrological cycle (MAHARANI, 2025). Infiltration wells operate by channeling surface runoff, which should replenish groundwater but is impeded by impermeable surfaces, back into the soil layer that functions as an aquifer.

However, the existence of regulations and physical infrastructure for infiltration wells does not necessarily guarantee their effectiveness. The effectiveness of infiltration wells is influenced by various technical factors, including well dimensions (diameter and depth), soil characteristics and local infiltration rates, and the density of well distribution relative to the area to be served. Sandhyavitri (2014) noted that infiltration rates vary greatly depending on the type of land cover and local soil structure, so not all locations provide ideal conditions for infiltration well performance.

Therefore, a systematic study is needed to determine the extent to which existing infiltration wells can compensate for the infiltration capacity lost due to land conversion. Projections (Rizki Rianda Putra, Manyuk Fauzi, 2014) indicate that the urban runoff coefficient could reach 0.49 by 2034 if land use patterns remain unchanged. This figure means that nearly half of rainfall will become surface runoff without infiltrating into the ground. In this context, infiltration wells are not merely complementary infrastructure, but rather a critical component of urban hydrological adaptation strategies.

This study thus seeks to fill this gap by evaluating the effectiveness of infiltration wells constructed in Pekanbaru City, both in terms of technical infiltration capacity and

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their contribution to the restoration and sustainability of groundwater resources. The study results are expected to provide evaluation material for infiltration well monitoring policies, as regulated by the Pekanbaru City Public Works and Spatial Planning Agency (MAHARANI, 2025).

This study also examines the economics of comparing the benefits and costs of constructing infiltration wells and the value of groundwater that can be saved using a replacement cost approach, which calculates the benefits of water reabsorbed into the ground based on the costs that would be incurred if the water were obtained from another source. This approach was chosen because groundwater is not traded on the market and therefore has no direct price.

In terms of the cost breakdown, constructing a household-scale infiltration well requires relatively affordable funds and varies depending on the type of material. Although the price breakdown for infiltration well construction refers to regional standards outside Pekanbaru City as a benchmark, the figures remain relevant for illustrating the estimated initial capital when adjusted to the technical conditions in Pekanbaru City. Based on research byMalikah and Yekti (2025), the cost of building a household infiltration well ranges from Rp1,510,000.00 if using concrete pipes to around Rp2,461,000.00 if using red bricks. This fund is calculated as initial capital (fixed cost). In addition, based on the same source, the cost of regular maintenance of infiltration wells ranges from Rp30,000.00 to Rp150,000.00 for each cleaning, assuming this maintenance activity is carried out once a year. All components of these expenses will later be measured along with the value of the benefits of water saved to see the feasibility of the overall benefits.

To measure the concrete magnitude of these benefits in Pekanbaru City, the volume of water collected was converted using the Perumda Tirta Siak clean water tariff structure based on the decision.Pekanbaru City Government (2024)Water rates for residential customers vary from Rp9,000.00 to Rp13,900.00 per cubic meter, while for commercial and industrial customers they range from Rp11,100.00 to Rp14,700.00 per cubic meter. This official rate from the local government serves as the shadow price for calculating the rupiah value of each cubic meter of rainwater infiltrated into the ground.

The availability of water volume that can be saved is greatly supported by the climate conditions in Pekanbaru City which has an average rainfall of 2,624.54 mm per year or around 218.71 mm/month.(Sukma et al., 2025). As a reference for building specifications, this study refers to the planningIstianah et al. (2025)Regarding one infiltration well with a radius of 0.5 meters and a depth of 2 meters, it has a capacity of approximately 1.57 liters per rainy season. In addition to high rainfall, rainy days in Pekanbaru occur throughout the year. Data from the Central Statistics Agency (BPS) included in the studym^3Hampratama (2024)The data recorded eight rainy days in July

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2021 and 20 days in April 2021. Given these conditions, heavy rainfall capable of filling wells is estimated to occur 20 to 30 times per year, or approximately twice per month. This figure is used as an estimate to reflect field conditions, not a direct measurement. Based on these estimates, one infiltration well can accommodate and infiltrate 31.4 to 47.1 liters of water per year.$m^3 m^3$

To ensure the wells are empty again before the next rain, the soil must be able to absorb water well. The soil in Air Putih Village has a moderate to fast water absorption rate, ranging from 1.58 to 6.66 cm per hour.(Sukma et al., 2025), although this data only represents one sub-district and may not reflect conditions across Pekanbaru City. If this annual water volume is multiplied by the clean water tariff of Rp9,000.00 per cubic meter, the gross benefit value reaches Rp282,600.00 to Rp423,900.00 per year. After deducting periodic maintenance costs, the net benefit value ranges from Rp132,600.00 to Rp393,900.00 per year.

A comparison of net benefits with construction costs shows that the break-even point is reached within 3.83 to 11.39 years for wells made of concrete pipes, and 6.25 to 18.56 years for red brick. These figures are still within the technical life span of the materials, which, according to Malikah and Yekti (2025), ranges from 20 to 50 years for concrete pipes and around 50 years for red brick if properly maintained. Thus, the construction of infiltration wells in Pekanbaru City is considered economically feasible at the cost of a residential house, although the payback period is quite long in the most conservative scenario.

To facilitate understanding, Table 2 summarizes all the calculation steps. This table combines costs and capacity from comparative literature with local data in the form of official tariffs from Perumda Tirta Siak.

Table 2. Simulation of Calculation of Costs and Economic Benefits of Infiltration Wells in Pekanbaru City Using the Replacement Cost Method

Analysis Components	Parameter	Magnitude of Value
Initial Investment Cost (Cost)	Construction of 1 unit of household scale infiltration well.	• Using Concrete Pipes: Rp1,510,000.00 • Using Red Brick:Rp2,461,000.00
Periodic Maintenance Costs	Maintenance and cleaning of infiltration wells	Rp. 30,000.00 – Rp. 150,000.00/ year

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Rainwater Storage Capacity	Volume of 1 well unit (diameter: 0.5 meters, depth: 2 meters	1.57 /rain eventm^3
Effective Rain Frequency	Estimated occurrence of heavy rain filling the well full	20 – 30 times / year
Total Volume of Conserved Water	Capacity×Rain Frequency	31.4 - 47.1m^3m^3
Shadow Price	Basic tariff for household clean water from Perumda Tirta Siak	Rp9,000.00 /m^3
Gross Benefit Value	Total Conserved Volume×Basic Rate	Rp. 282,600.00 – Rp. 423,900.00/year
Net Benefit Value	Gross Benefit - Cost of Care	Rp132,600.00 – Rp393,900.00/ year
Break-Even Period (Payback Period)	Initial Investment Cost ÷ Net Benefit Value	• Concrete Pipes:3.83 – 11.39 years • Red Brick:6.25 – 18.56 years

However, this feasibility can only be maintained if supported by the commitment of local governments to implement and oversee spatial planning policies. With such support, infiltration well construction can proceed sustainably.

Pekanbaru City Regional Regulation Law No. 10 of 2006 concerning Water Resources and Infiltration Wells explains that Infiltration Wells are wells or holes in the ground made to collect water in the ground made to collect water and store water reserves. The construction of infiltration wells is also an effort to increase groundwater reserves in the Pekanbaru city area. With the geographical conditions of Pekanbaru city, during the dry season it can cause a water crisis and during the rainy season there is excess water which causes flooding. This is what caused the Pekanbaru City government to create regulations in Law No. 10 of 2006 which regulates the construction of Infiltration Wells with the aim of maintaining the resilience of Water Resources in the ground.

The obligation to build infiltration wells for all development actors in the city of Pekanbaru is regulated in Law No. 10 of 2006 Article 19 Paragraph (4) which requires the construction of infiltration wells for all buildings standing on Pekanbaru City land.

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However, the effectiveness of these rules and regulations has not been fully implemented because looking from both sides, namely the government and the community, they have not optimally implemented these regulations. And in reality, many buildings standing in the city of Pekanbaru have not built or have infiltration wells. Judging from research conducted by Hendri, Ardiansah, and Sudi Fahmi (2024) from the conditions in the field starting from the government as the figure who made and held the greatest control over regulations regarding infiltration wells, it has not yet fully carried out its duties.

Communication problems also occur on the government side, namely the unclear flow of the licensing process until the issuance of permits from the Investment and One-Stop Integrated Services Agency, the Public Works, Spatial Planning, Sub-districts, and Villages which causes the sub-optimal implementation of Pekanbaru City Regional Regulation No. 10 of 2006 concerning infiltration wells. In addition, the government or related agencies have not fully checked buildings that do not have infiltration wells. This is not in accordance with Article 19 Paragraph 3 which states that an inspection is required for buildings to determine whether infiltration wells have been made and are in accordance with the provisions. The rapid population growth and development of the city area are in fact not balanced by the growth and development of the government bureaucratic resource framework in mapping the framework of population growth and the development of the city.

As the initiator and the party largely responsible for the regulations and policies that have been created, the government has also not imposed strict sanctions on building builders who do not have infiltration wells. Furthermore, it can be seen from the community's perspective, which is also not aware of the importance of infiltration wells to support sustainable life related to water reserves in the ground. However, the community is also not aware of many things and the urgency of building infiltration wells around their buildings. Even in the field, residents also admit that there is no strict supervision regarding the construction of infiltration wells around buildings, resulting in people being indifferent to this.

From the field conditions conducted in the research of Hendri, Ardiansah, and Sudi Fahmi (2024) it can be concluded that the implementation of Pekanbaru City Regional Regulation No. 10 of 2006 concerning Water Resources and Infiltration Wells has not been fully implemented because the government has not been able to act firmly accompanied by emphasis on the construction of infiltration wells in each building and also from the side of the community who have not cared about the construction of infiltration wells because they do not know the urgency of the infiltration wells themselves. Therefore, it is necessary to increase the firmness of the government's side regarding the regulations that have been made and increase socialization regarding the urgency of infiltration wells to the community.

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CONCLUSION

Groundwater availability in Pekanbaru City is currently under serious pressure due to the shrinking of natural infiltration areas from 48% in 2006 to only 10% in 2014, which has driven an increase in the runoff coefficient from 0.31 to 0.36, and is projected to reach 0.49 in 2034. The imbalance between the decreasing infiltration area and the soaring water needs of the population makes infiltration wells an urgent solution. One household well unit (radius 0.5 m; depth 2 m) can infiltrate 31.4–47.1 m³ of water per year and reduce runoff by 54–56%, although its effectiveness still depends on local soil characteristics.

Financially, the construction of infiltration wells is feasible for the community. Using the Perumda Tirta Siak water tariff (Rp9,000/m³) as a benchmark, these wells generate a net benefit of Rp132,600–Rp393,900 per year. The payback period ranges from 3.83–11.39 years (concrete pipes) and 6.25–18.56 years (red bricks)—still well below the technical construction lifespan of 20–50 years.

Despite its technical and economic feasibility, implementation in the field has not been optimal. Although it is regulated in Pekanbaru City Regional Regulation No. 10 of 2006 (including Article 19, paragraph 4, concerning the obligation to build follow-up infiltration wells), its implementation is still hampered by minimal public awareness, weak oversight, lack of firm sanctions, and inadequate coordination between agencies.

This research relies on secondary data and indirect estimates related to land cover dynamics and rainfall assumptions. Therefore, further studies need to be supplemented with direct measurements through infiltration tests and monitoring well data. On the policy side, the Pekanbaru City Government needs to strengthen outreach, supervision, and consistent regulatory enforcement to ensure groundwater sustainability for future generations.

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