Literature Review: How Does Water Play a Role in Forming Land Value?

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Abstract. This research synthesizes the causality of water: the supply of clean water and water-related disasters in forming the land value. Water has a significant relation to real estate. For example, the developing design at the built area will take much investment value to supply its clean water individually. Secondly, the damaged property caused by water-related disasters will make much value to invest in repairs. In other words, the considerable investment will take a role in it. This research uses a qualitative method by synthesizing literature reviews of water-related disasters, clean water supply, and property. This research found that the previous researchers correlated water-related disasters, clean water supply, or quality to property, respectively. However, no research has examined all the water's roles to property in our knowledge. Therefore, there is a suggestion for further research to prove this research using the quantitative method to relate the water's roles and land value.

1. Introduction
Jakarta is a province that also becomes the biggest city in Indonesia. Urbanization [1] in Jakarta has a significant role that makes a unique and attractive investment in property development. The developing urbanization in Jakarta has made good impacts and harmful impacts. As a good impact, urbanization develops economic growth and the city. On the other hand, some researchers [1] stated that urbanization had made some consequences. Those consequences are land conversion, massive groundwater extraction, destructive ecology-hydrology function in Jakarta's highland, and an explosion of density populated. Furthermore, it also caused land subsidence that became a crucial issue caused by massive groundwater extraction and life-environment quality changes [1].

A continuously developing Jakarta city induces clean water as one of the basic needs. In Jakarta, Palyja and Aetra collaborated and merged with Jakarta's regional corporation into PAM Jaya, supply west and east Jakarta's clean water. Thus far, PAM Jaya had been supplied clean water to about 60% of Jakarta, or equal to eight million people (Ardelia, 2015 in Seizarwati [2]). Hence, the other 40% area uses groundwater or buys as a source of clean water use. The ease of extracting groundwater freely and the lack of government control make groundwater use in large quantities.

Furthermore, massive groundwater usage caused saltwater intrusion. As a result, groundwater quality becomes brackish and does not suitable to be consumed in the north of Jakarta. In contrast, part of south Jakarta does still has a good quality of groundwater. Therefore, South Jakarta is one area where a part of the recharge area in the Jakarta groundwater basin should preserve the quality and groundwater level.

In the scope of the water's role, the clean water's source is not the only one to be discussed, but the water-related should be too. Water pollution and flood are the water disasters that are the most common happened in Jakarta. Firstly, water pollution in Jakarta is groundwater intrusion, which does not have
any infrastructure to cope, and polluted surface water, which does have. Secondly, frequent flooding in Jakarta also has the infrastructure to cope with, such as flood pumping, reservoirs, and dams. Due to previous researches, the property value was researched by the source of clean water or water-related only. The researchers found that the clean water resource, water quality, and water-related property value. The result shows that water quality has a good impact on raising the property value [3]. However, the water-related had a harmful effect in lowering the property value because the damage costs should be paid [4]. Therefore, designing and constructing the building to perceive flood disasters and any insurance building to protect the building from disasters will be costly. Also, besides the realization of establishing an individual clean water supply will be costly too. Suppose if the government’s clean water supply is sufficiently supplied and the water-related disasters can be minimized so that the property development will be profitable maximally. Simultaneously, the previous researches are done by relating any harms or any potentials to the property value. This research aims to understand these kinds of water: the harms and potentials of the water on property value. This paper will discuss some crucial issues about investing in real estate: how does the location get a supply of clean water that is safe to be consumed? How does the quality of the area? These two issues are closely related to how much value should be paid to real estate investment.

2. Method
This research uses the qualitative method by investigating the causes and the correlation between water and land value which analyzes Jakarta, Indonesia as the research sample. Firstly, this research investigated the land subsidence phenomena, which happens in Jakarta, becomes a crucial issue and impacts each other. Secondly, by looking at some impacts and causes of land subsidence, it was found that water has a crucial role. So, this research tried to synthesize other kinds of literature which correlate to water. Thirdly, by knowing the water, the research develops its correlation between each property value’s water’s perspectives. Lastly, this research also investigates what factors do influence property value.

3. Literature Review
The disasters, supplies, and water infrastructures have a crucial role in a city seen by its geographic conditions on the site samples. The water’s roles support water’s infrastructures, disasters, and any conditions related to land value. In this research, the water’s disasters are divided by the quantity and the quality of it. The quantity disasters are floods and water-level subsidence, whereas the quality disasters are surface water pollution and groundwater pollution. Lastly, this research also observes the water’s infrastructures as clean water resources, flood control, and wastewater management.

3.1. Quantity water-related disasters

3.1.1. Flood. The increasing population number in Jakarta has impacted destructive environmental quality, especially flooding [5]. Land-use conversion, water use, and any life sustainability cause this kind of disaster. Nevertheless, the land-use conversion in Jakarta had decreased the environment capacity for absorbing water, which causing flooding. The land-use conversion to a residential used and squatter settlement in water-absorbing land that causing tighten a river plain and decreases the quantity and continuity of water supply. The other impacts have made water quality harmful, such as socio-economic activities, urbanization, and the land necessity for a living [5-6].

3.1.2. Land subsidence which caused by the lowering groundwater level. The phenomenon of land subsidence had been making a polemic in such countries. In Indonesia, this phenomenon happens in many areas, such as Jakarta, Bandung, Semarang, Medan. The differences in the geographic condition of land subsidence in other areas have a different character than in Jakarta. The land subsidence is caused by the lowering of the land surface in the underground [7]. Jakarta’s land subsidence has been happening since 1926 in North Jakarta. By the time in 1978, the impacts of land subsidence had already happened. The damaged building and infrastructure, wide-spreading flood, saltwater intrusion, and land subsidence were happening [8]. Furthermore, the groundwater extraction, load mass of buildings, soil characteristics, tectonic movement, and a dense population and buildings have caused land subsidence [1,9]. Setyawan et al.
explained that tectonic movement does not significantly impact land subsidence in Jakarta. In Jakarta, due to land subsidence, groundwater lowering directly impacted land subsidence [1,8-13]. Nonetheless, some researchers stated this phenomenon occurs by the increase of population, business, and industrial, the availability of groundwater, land-use conversion, and the minimum clean water supply from the regional company [2,14-15].

Furthermore, this kind of phenomenon also impacts flood disasters [5]. Overall, urban development significantly relates to land subsidence, which risked lowering land surface [11]. Urban development made rapid development of building and infrastructure, population growth, the increasing economic and industrial growth, and the massive groundwater extraction. However, the rapid growth of urban development in Jakarta occurs due to achieving a wealthy social-economic condition.

The damaged environment caused by land subsidence had been making such impacts: the damaged infrastructure, the destructive environment quality, and the changing quality of social life [12]. The uncontrolled groundwater extraction made massively exploited groundwater which causing land subsidence too. How not, in Jakarta, the free and uncontrolled usage of groundwater extraction, such as the use of groundwater by excavation/pulley with < 40m of depth for individual usage, whereas the use of groundwater with > 40m of depth for industrial and business usage [9]. In this case, the control and unfree of massive groundwater extraction are needed [8]. The control of its usage is to maintain the strength of soil and groundwater, so the other phenomenon, such as saltwater intrusion, would not have happened that impacted groundwater quality. The correlation of urban development by the land necessity in Jakarta, which impacted economic and industrial growth, has related to property development.

### 3.2. Quality water-related disasters

#### 3.2.1. The polluted surface water.

The quality of water has related to population density, land use, supply, and water demand. The massive economic development to urban development marks the increasing gross domestic product (GDP) [6]. Polluted surface water plays a role in environmental quality-making and water quality in an area. Furthermore, the relation of environmental quality to destructive of water quality in surface area is polluted water. Based on the data in the year 2009, the Regional Environmental Management Agency (BPLHD) declared that the harmful surface-water quality from 2004 to 2009 was highly indexed.

#### 3.2.2. The polluted groundwater.

Land subsidence does not fasten impact, but the slower impact will happen in the future. Previous researches showed that land subsidence impacts caused destructive environmental quality, such as flooding and polluted water quality. The massive groundwater extraction has significantly contributed to land subsidence, impacting a highly changing economic cost that causes by floods and influences property prices [13]. In Jakarta, the cause of the flooding is the lack of water catchment areas covered by the building and infrastructure growth. Also, the groundwater level lowering could cause land subsidence and saltwater intrusion, making brackish quality to the groundwater and not being consumed [16].

The groundwater extraction, land-use conversion, climate change, and fluctuation seawater movement also make a saltwater intrusion phenomenon happen [17]. Saltwater intrusion is a contamination phenomenon that can extend and influence coastal areas and destroy environmental quality [14]. Besides that, groundwater is essential in economic and demographic growth [18]. This phenomenon occurs due to the loss of water function to fill the soil grains’ cavities. The groundwater extraction also occurs by urbanization, socio-economic, the continuity of groundwater sources, and the clean water supplies lack of Jakarta's drinking water company.

The other previous research also declared that the saltwater intrusion phenomenon in Jakarta's groundwater basin has already happened since ancient times [15]. Also, not all of the saltwater intrusion areas happened by groundwater extraction. Furthermore, the saltwater intrusion occurs by the closer aquifers to seawater and massive land subsidence, making the seawater and groundwater mixed, so groundwater quality becomes brackish. The density of seawater is more significant than the groundwater, which is why the seawater and the groundwater become mixed. However, the seawater
cannot mix up to the groundwater long because groundwater pushes the seawater and makes an interface [16].

The taste and color of saltwater intrusion are found in brackish groundwater. Generally, the yellowish turbid taste, elemental chloride, and the concentration of electrical conductivity are groundwater intrusion characteristics. In contrast, the freshwater does not have any color or taste, has less chloride of 500mg per liter, and a lower concentration of electrical conductivity of 1.500 umhos per cm [16].

3.3. Recharge and discharge area. Another relation to groundwater is that Jakarta is a part of the Jakarta Groundwater Basin covering a recharge area in South Jakarta and the main discharge area. Its groundwater flows from the south-southeast to the north-northwest in Depok and North Jakarta. The groundwater basin has a role in balancing the needs and supply of water in groundwater, determining the uses of land use, and acting as a groundwater hydrologic instrument. It also manages the groundwater supply based on its conservation, surface water supply based on its river, rumen, waterways, flood water-related disaster. So, the management of the groundwater basin should be well. Furthermore, the geological condition or other characteristics influence the groundwater basin, recharge, and discharge area. The correlation between recharge and discharge area with the surface water by making an Integrated Water Resources Management (IWRDM) manages the availability and the continuity of groundwater. The spatial planning to manage by making the surface water fills the groundwater from the infiltration field. Hence, spatial planning plays a role in making water use [19].

3.4. Infrastructures

3.4.1. Clean water sources. In Jakarta, clean water supply does not supply over Jakarta Province. By this time, PAM Jaya, as the drinking water supply company, has been supplying and covering about 60% of Jakarta's area, or equal to eight million people. Another 40% uses groundwater, buying from the other supplier, and so on, as the sources. However, uniquely, Jakarta's society still uses groundwater as the primary source. Even the connecting pipe of clean water has already been available in the area. The high cost of using clean water from PAM Jaya has made people use groundwater as the primary source and freely. By the realm of law, the extraction of groundwater should be allowed and controlled by the government. The lack of the extraction's control can cause massive exploitation.

The rainfall and the area's topographic, describing the groundwater-surface which correlate to the groundwater supply [16]. Also, there is a correlation between groundwater and surface water. The surface water can enter to fill the groundwater based on the topographic area and vice versa. In Jakarta, groundwater use is a hope of the society that can use a supply from PAM Jaya. Furthermore, the exploitation of groundwater massively can make an unbalanced continuity and availability of groundwater. This phenomenon can impact a lowering groundwater level, which correlates directly to land subsidence and the saltwater intrusion that enters the groundwater's surface [15].

The kind of alluvial soil in Jakarta, mixed with the clay watertight, keeps the groundwater well. In Jakarta, the layers of the aquifer divide into three aquifers [15]. Those are a free aquifer (shallow groundwater, an artesian aquifer (a suppressed groundwater), a common artesian (deep groundwater), which has a depth of 50 meters, 50 to 150 meters, and 150 to 250 meters underground, respectively. Due to its productivity, Jakarta's aquifer layers are divided by its production, a high productivity aquifer, a mediumly productivity aquifer, and a slow productivity aquifer. Those can produce about 5 liters above per second, up to 5 liters per second, and under 5 liters per second, respectively.

Jakarta's aquifer could save the groundwater and identify the balancing of the rainfall absorption and extraction. The unbalanced of this phenomenon cannot make an effective preventive for the clean water supply. Nevertheless, in reality, the building and infrastructure development had been aggressively using absorption land. It was also making unbalanced uses and groundwater availability, which causes a decreasing capacity of groundwater availability. Besides, Jakarta's society has been making groundwater the primary source of clean water. The use of groundwater has a characteristic of the user based on its capacity of use. For example, the industrial area does not use shallow groundwater as its primary source but deep groundwater.

3.4.2. Flood controlling infrastructure. A flood is a kind of 'water-related disaster which frequently happens in Jakarta. Therefore, the flood control infrastructure is crucial. The flood control infrastructure
plays roles as a hydrology, hydraulics, river territory erosion, river techniques, morphology, river sedimentation, manipulation of flood flow control, and city drainage system. The flood is controlled done by techniques, structural method, and non-structural method. By the structural methods are divided into two, which are (a) flood controlling building, such as dam or basin, retention pond, sediment trapper, declivity river building, retarding basin, and polder, (b) improving and arranging river, such as improving the quality of the river, incision, dike, flood flow way controlling, law enforcement, assurance of flood disaster, and giving an education to the society [20].

3.4.3. Wastewater management infrastructure. Management of wastewater is one of the structural planning created to throw the way of waste biological and chemical water [21]. The following activities can use the wastewater already processed. Jakarta's water quality has been polluted because of the lack of wastewater management infrastructure uses in the building, so it throws unmanaged. The government needs to make a regulator on excellent water quality [6]. Making a regulator and designing a good wastewater management infrastructure will create a healthy quality of the environment. The supply of clean water sources to society strongly correlates with this kind of infrastructure.

3.5. Correlation between location and real estate (land value)

The location has a remarkable correlation and an essential role in developing real estate. This kind of factor influences the creation of a property value. A complex, dynamic, and challenging characteristic of location that development studies should do by the time and location choices is usually due to factors and criteria [22]. Generally, the microenvironment influences location selection: demand and supply factor and microenvironment, the environment, technology, government regulatory, demand, supply, and some criteria for property functions. However, the correlation between location election strongly correlates with some unique and nonmonetary factors [22] and a determinant factor. An example is a determinant location factor in designing an industrial factory building located to its material sources, human resources quality, telecommunication, and pollution danger. The election of location has related to create land value. High demand for land necessities will increase the land value. Land value is a specific measurement in a property without a calculated building value [23]. It has a significant role in the real estate market [24].

Due to urbanization and other factors, such as economic, environmental, population structural, and land availability, land use has a role in determining land value [23-24]. The macro factors also influence the determining of land value related to government regulation, social development, economic development, and demographic structure. Also, the micro factors is a regional and individual factor, such as the soil characteristic, environment attribute, traffic condition, geographic location [24]. Furthermore, Floor Area Ratios or building codes are essential in creating land value [24-27]. Hence, urbanization is one factor in determining land value, increasing land value, and causing a land-use conversion due to the demand for land necessity [28].

The land value must be one of the property value's factors making. The city's image, environment quality, and other aspects influence land value. For example, the willingness to pay is one factor determining the and value, close to the CBD, less cost of transportation, public utility facilities, accessibility, a wide space, infrastructure, and environmental quality [29]. Another researcher also added that the land value is related to accessibility, environment elements, safeness, spatial configuration, connectivity, and density [30]. Furthermore, the factors influencing land value are interfering factors, transportation facilities, environment attributes, shopping facilities, development, topographic, housing attributes, utility facility, environment, social, government's policy, education facility, and recreation [23]. Also, land value is influenced by the history of disasters and the availability of clean water.

In Indonesia, the Indonesian Ministry of Agrarian Affairs and Spatial Planning (ATRBPN) has already created a map describing land value to minimize land transaction misuse. The mapping of land value is differentiated by color and boundaries to show the differences in area prices. In this case of forming land value, ATRBPN made some factors determine land value. Those factors are connectivity, land-use spatial planning, social and public facilities, and the risk of disaster [31]. However, in the forming land value can also other variables, such as environmental, geographic condition, proximity to the CBD, land-use, and the availability and accessibility of public and social-economic facilities. ATRBPN uses
a transaction value of offering value, individual demand value, and some variables above to get the closest value used for land transaction reference per m² in rupiah.

3.6. Correlation between water and real estate (land value)

Previous researchers have researched the relation of water to real estate. The studies showed that the quality of water is related to property value based on its quality. Firstly, clean water quality can influence the property value [32-33]. A high property value could significantly decrease the quality of the clean water supply. In contrast, the good quality of clean water positively impacts increasing property value [32].

Secondly, the contaminated groundwater does not influence all property types. However, only commercial and industrial property value is influenced due to the contaminated groundwater [34]. In contrast, the residential area is not influenced at all [35]. On the contrary, the other researcher contrasted those researches that the property value in a residential area and contaminated groundwater correlates impermanently [36]. As a result, about 2-6% decrease property value about the contaminated groundwater, but this condition is not permanent.

Next, there is increasing property value in an unpolluted surface water area [37-38]. The result showed that increasing water quality is also determined consumers to make their preferences about the environment personally [37]. Furthermore, the surface water could act as an ecological, environmental, recreation benefit.

Lastly, one of the common disasters in the world, a flood, is a water-related disaster that significantly impacts decreasing property value [4]. In more, a high cost for assurance will be costly due to the flood disaster. Furthermore, in an elite residential area, a decreased value is higher than in a non-elite residential area due to flood.

4. Result and Discussion

Based on the literature review, the correlation between water in this research is investigated by the sources of clean water and water-related disasters in an area. For example, in Jakarta, the supply of clean water is supplied by the government, PAM Jaya, or supplied individually using groundwater or buys from water's suppliers. Furthermore, some of the groundwater is already polluted and tasted brackish.

There is a water-related disaster in the following discussion, which frequently happens in Jakarta, floods. This disaster correlates with some other causes: land-use conversion and the building density in the area. The other disaster, the lowering groundwater level, causes another disaster, a saltwater intrusion that makes polluted groundwater. This kind of disaster is caused by a highly-populated area, a densely built, a massive groundwater extraction, and the land-use conversion that correlates with groundwater uses. Furthermore, the government of Jakarta has been trying to use some infrastructures to improve the city’s environmental quality and tackle water-related disasters. Those infrastructures are flood control's infrastructure (to control and minimize the risk of flood), wastewater management's infrastructure (to maximize the quality of surface water), and the supply of clean water by the government (to minimize groundwater usage). Hence, other disasters, like saltwater intrusion and lowering groundwater levels, are not covered by infrastructure. However, there is a chance by reducing a densely building and adding green spaces more for the water catchment area.

5. Further Research Recommendation

Previous research has researched the property value related to clean water supply, groundwater, and surface water, respectively. Those researchers showed that water-related disasters decrease property value, whereas the good quality of water increases property value. So, there is a niche, which yet no studies. As described above, that the coverage of water is all measured and correlated to property value. This research should be investigated more in the following study by measuring all variables in the quantitative method. Next, it can be seen and proved how much value does the water influences to land value.

6. References

[1] H Z Abidin, H Andreas, I Gumilar, and I R R Wibowo 2015 On correlation between urban development, land subsidence and flooding phenomena in Jakarta IAHS-AISH Proc. Reports 370
pp 15–20
[2] W Seizarwati, D Prasetya, M Syahidah, and H Rengganis 2015 Simulasi perilaku air tanah Jakarta akibat pengambilan air tanah berlebihan (in Bahasa) J. Sumber Daya Air 14 (2) 97–110
[3] H Klemick, C Griffiths, D Guignet, and P Walsh 2018 Improving Water Quality in an Iconic Estuary: An Internal Meta-analysis of Property Value Impacts Around the Chesapeake Bay Environ. Resour. Econ. 69 (2) pp 265–92
[4] L Zhang 2016 Flood hazards impact on neighborhood house prices: A spatial quantile regression analysis Reg. Sci. Urban Econ. 60 pp 12–9
[5] W S Pradafitri, S S Moersidik, and C Abdini 2018 East Canal Flood as PDAM water resource DKI Jakarta E3S Web Conf. 74 pp 1–6
[6] Apip, S A Sagala, and L Pingping 2015 Overview of Jakarta Water-Related Environmental Challenges Water Urban Initiat. Work. Pap. Ser. 4 pp 1–5
[7] M Bakr 2015 Influence of Groundwater Management on Land Subsidence in Deltas Water Resour. Manag. 29 (5) pp 1541–55
[8] H Z Abidin et al. 2001 Land Subsidence of Jakarta (Indonesia) and its Geodetic Monitoring Syst. Nat. Hazards 23 (2) pp 365–87
[9] H Z Abidin, H Andreas, R Djaja, D Darmawan, and M Gamal 2015 Study on the risk and impacts of land subsidence in Jakarta Proc. Int. Assoc. Hydrol. Sci. 372 pp 115–20
[10] A Suryawana, Y Fukuda, J Nishijima, and T Kazama 2015 Detecting Land Subsidence Using Gravity Method in Jakarta and Bandung Area, Indonesia Procedia Environ. Sci. 23 pp 17–26
[11] H Z Abidin, H Andreas, I Gunilar, Y Fukuda, Y E Pohan, and T Deguchi 2011 Land subsidence of Jakarta (Indonesia) and its relation with urban development Nat. Hazards 59 (3) pp 1753–71
[12] H Z Abidin, H Andreas, I Gunilar, and J J Brinkman 2015 Study on the risk and impacts of land subsidence in Jakarta Proc. Int. Assoc. Hydrol. Sci. 372 pp 115–20
[13] C M Wade, K M Cobourn, G S Amacher, and E T Hester 2018 Policy Targeting to Reduce Economic Damages From Land Subsidence Water Resour. Res. 54 (7) pp 4401–16
[14] A Wijaya, A A Kuntoro, and E A S Gondodinoto 2019 Pemodelan Intrusi Air Asin Pada Akuifer Lentur Dikota Jakarta J. Tek. Hidraul. 10 (1) pp 15–28
[15] S Samsohadi 2018 Pemanfaatan Air Tanah Jakarta (in Bahasa) J. Air Indones. 5 (1)
[16] H Ashriyati 2011 Terintrusi Air Laut di Dki Jakarta (in Bahasa) (Depok: University of Indonesia)
[17] A D Werner et al. 2013 Seawater intrusion processes, investigation and management: Recent advances and future challenges Adv. Water Resour. 51 pp 3–26
[18] E Abarca, E Vázquez-Suné, J Carrera, B Capino, D Gámez, and F Batlle 2006 Optimal design of measures to correct seawater intrusion Water Resour. Res. 42 (9) pp 1–14
[19] H Yosua 2019 Pengembangan Model Spasial Daerah Recharge-Discharge pada Cekungan Air Tawar Jakarta (in Bahasa) (Depok: University of Indonesia)
[20] S Ginting 2015 Kajian dan Efektivitas Pengelolaan Banjir di DKI Jakarta (in Bahasa) (Bandung: Bandung Institute of Technology)
[21] Y Kurniawati and N Maqfirho 2019 Analisis Effluent Limbah Cair Pt Dnp Indonesia. Pulogadung, Jakarta Timur J. Ilm. Kesehat. 11 (1) pp 64–72
[22] M Rymarrak and E Sieminska 2012 Factors affecting the location of real estate J. Corp. Real Estate 14 (4) pp 214–25
[23] B BV, N MA, and A K PP 2020 A methodology for identifying critical factors influencing land value in urban areas: a case study of Kerala, India Prop. Manag. 38 (5) pp 665–81
[24] J Ma, J C P Cheng, F Jiang, W Chen, and J Zhang 2020 Analyzing driving factors of land values in urban scale based on big data and non-linear machine learning techniques Land use policy, 94 p 104537
[25] C A Dehring 2006 Building Codes and Land Values in High Hazard Areas Land Economics 82 (4) pp 513–28
[26] R E Dumm, G S Sirmans, and G Smersh 2011 The Capitalization of Building Codes in House Prices J. Real Estate Financ. Econ. 42 (1) pp 30–50
[27] W Han, X Zhang, and X Zheng 2020 Land use regulation and urban land value: Evidence from China Land use policy 92 p 104432
[28] O Kilic, U Baser, and C Gulser 2019 Factors explaining urban land value variability: A case
study in Atakum District, Samsun-Turkey New Medit 18 (4) pp 79–88
[29] E S Gwanna, W Z W Yusoff, and M F Ismail 2015 Determinants of land use and property value,” Adv. Sci. Lett. 21 (5) pp 1150–53
[30] M Topcu and A Kuhat Sema 2009 The Analysis of Urban Features that Affect Land Values in Residential Areas Proc. 7th Int. Sp. Syntax Symp. January 2009 pp. 26.1-9
[31] ATRBPN 2015 Penelitian Pemanfaatan Zona Nilai Tanah Berbasis Penataan Ruang
[32] D R François, B Alain, and T Marius 1999 Environment and value Does drinking water quality affect house prices? J. Prop. Invest. Financ. 17 (5) pp 444–63
[33] S Nicholls and J Crompton 2018 A comprehensive review of the evidence of the impact of surface water quality on property values Sustain. 10 (2) pp 1–30
[34] G W Page and H Rabinowitz 1993 Groundwater contamination: Its effects on property values and cities J. Am. Plan. Assoc. 59 (4) pp 473–81
[35] M Dotzour 1997 Groundwater contamination and residential property values Appraisal J. 65 (3) 279–
[36] D Guignet, P J Walsh, and R Northcutt 2016 Impacts of ground water contamination on property values: Agricultural run-off and private wells Agric. Resour. Econ. Rev. 45 (2) pp 293–318
[37] O A Morgan, S E Hamilton, and V Chung 2010 Water Quality and Residential Property Values: A Natural Experiment Approach
[38] O Bin and J Czajkowski 2013 The impact of technical and non-technical measures of water quality on coastal waterfront property values in South Florida Mar. Resour. Econ. 28 (1) pp 43–63

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