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Full Length Research Paper

Environmental Factors for Simultaneous Unconfined Aquifer

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Simultaneous analysis of unconfined aquifer in Pekanbaru city should consider environment factors such as additive, etika, and government intervention factors. The additive factor of 5% and biocentricetika factor of 70% contribute to the correction of unconfined aquifer in the safe condition with percentage deviation of 40.57% and 11.02% respectively for year of 2013 and 2014. The additice factor of 5% and biocentricetika of 70% in 2015 contribute to the head-hydrolic deviation of -29.62% which means still in safe condition.However, the additive factor of 8% will contribute a correction to head hydrolikof unconfinedaquiferin 2016, 2017, and 2018. It also sucsessfully improve unconfinedaquifer condition from a shortages condition to the safe condition (-29.41%) in 2016, from a critical condition to the shortages condition (48.97%) in 2017 and from a demaged condition to the critical condition (-63.76%) in 2018. Certainly, additive factor of 8% and biocentric of 70% supported by government statement of industry sectorial only allowed consuming water of 75% from the unconfinedaquifer will contribute to the safe condition in 2017 and 2018 with the reduction percentage of the unconfinedaquifer from the natural condition is -19.15% and -32.85% respectively.

Keyword: Unconfined aquifer, *etika*, and government intervention.

INTRODUCTION

The uses of area and demaged environment in Pekanbaruwere studied by Yusri*et al*. (2010). He said that the demaged environment was caused by the human treatment to the environment. There are three theories of environmental *etika*known as antroposentrisme, biocentric, and ekosentrisme. These three theories have different principle to the human, nature and the human-nature relationship (Veitch and Arkkelin, 1995)

The effect of *etika* to the water comsumtion of unconfined aquifer can be reduced based on the qualitative concept exhibited by Neolaka (2008) and qualitative statement as

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Figure 1. Pekanbaru city (1000 141 - 1010 341 east longitude; 00 251 – 00 451northern latitudes)

exhibited by Hutasoit (2009). It was qualitatively continued as given by Equation (1)

$$F_{pm} = E_t \times d \quad \text{.....(1)}$$

F_{pm}= *Groundwater extraction for human behavior factor* $(m^3/year)$
E_t = *Groundwater extraction by residents and industry tahun* $(m^3/year)$
d = *ethical factor (%)*

Government intervention will positively affect the simultaneous of water underground. The government statement is described in Pasal 18. Ayat 1 UU No.7 2004 which states about the responsibility to make an uptake wells for individuals and corporation, which will build on the area more than 5.000 m^2, has to prepare 2% of their area for land-water conservation out of uptake wells. Uptake area (recharge) is known as the area where the current direction of land water keeping away from the surface. This uptake calculation need to consider landstone and aavaluable location. A numbers of this uptake is calculated by using the following Equation (Binnie dan Partners, 1984):

$$R = P \times A \times C \quad \text{.....(2)}$$

R = *infiltration* $(m^3/year)$
P = Annual rainfall $(m^3/year)$
A = Expansive soil or rock (m^2)

Many studies of underground water have been done such as: the existence of land water and water output in Karst area based on geoelectricinterpretation (Bambang, 2004). The study of land-water condition in this area in (Merauke, Papua province) describes the use of land water as source of clean water production (Adang, 2003). Laton*et al.* (2007) investigated that mathematical techniques can be used to identify the contamination potential of underground water. Furthermore, Neyamadpour*et al.* (2009) has successfully applied geoelectric method to investigate the underground water system, which was experiencing the contamination. Juandi*et al.* (2013) has also analyzed the parameter effect of transmisivityaquiferto the simultaneous of unconfined aquifer. In different case study, Juandi*et, al.* (2012) analyzed hydrolic conductivity on the unconfined aquifer system. He also studied unconfined aquifer system of head hydrolics for steady state current.

Shemin (1992) used mathematical model to estimate the pressure deformation at a basin. Rajamanickam (2010) studied environmental factors corresponding to the cesspool and to identify its relationship to the land water quality for ten years later. According to Ramon *et al.* (1992), Hydrologists have to identify government statement which effect to the environment. They also have to show how important the statement to the procedure of underground water management simultaneously.

A theoretical study to set the environmental attitude as a strong predictor of ecology behavior was proposed by Florian *et al.* (1999). This studied global environmental problems, pollution, and population growth, etc. Other

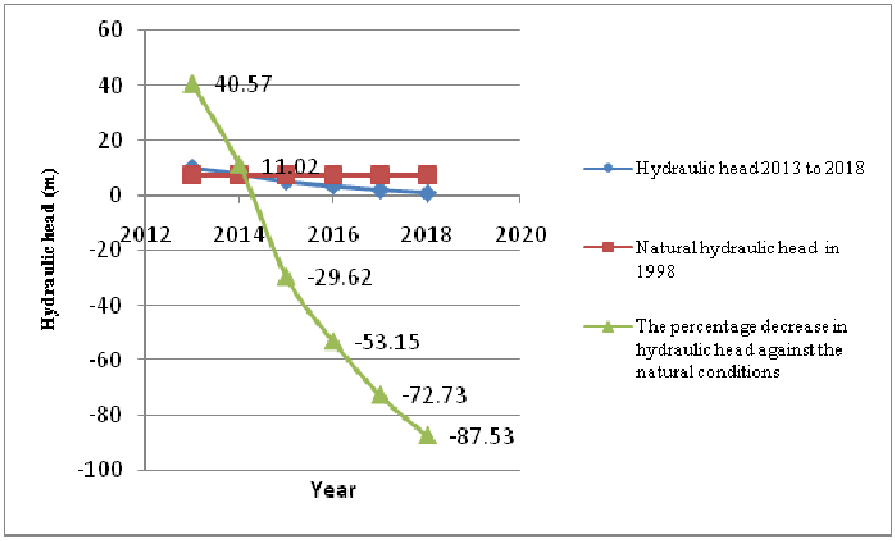

Figure 2. Head hydrolic comparison 2013 – 2018 againts nature head hydrolic 1998 and reduction percentage of head hydrolic to the nature condition with Biocentric of 70% and additional additive factor of 5%.

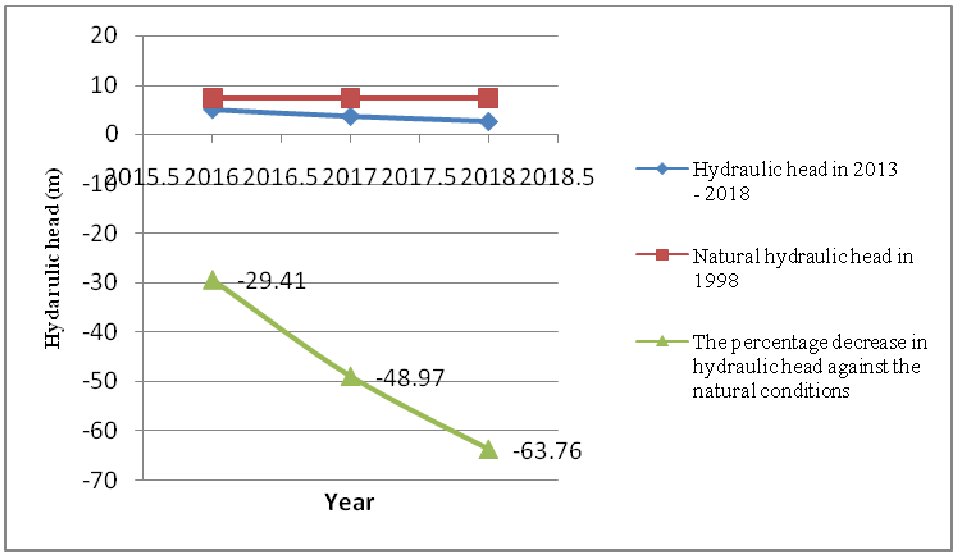

Figure 3. Head hydrolic comparison for 2016 - 2018 against nature head hydrolicin 1998 and reduction deviation of head hydrolic against nature condition with additional additive factor of 8% Biosentric 70%

study was conducted by Trabelsi and Zounari (2010) to identify the effect of land water exploration to the simultaneous of water underground

Based on the literature review, there are no studies focused on the effect of additive factor,*etika* and government intervention to the simultaneous of unconfined aquifer. This research is conducted to identify the effect of environmental factors to the simultaneous of unconfined aquifer in Pekanbaru city.

RESEARCH METHODOLOGY

Research Location

Location of this research is in the administrative area of Pekanbaru city. This location is geographically at the $100^0\ 14^1$ - $101^0\ 34^1$ east longitude and $0^0\ 25^1$ – $0^0\ 45^1$ northern latitudes that it can be seen in Figure 1.

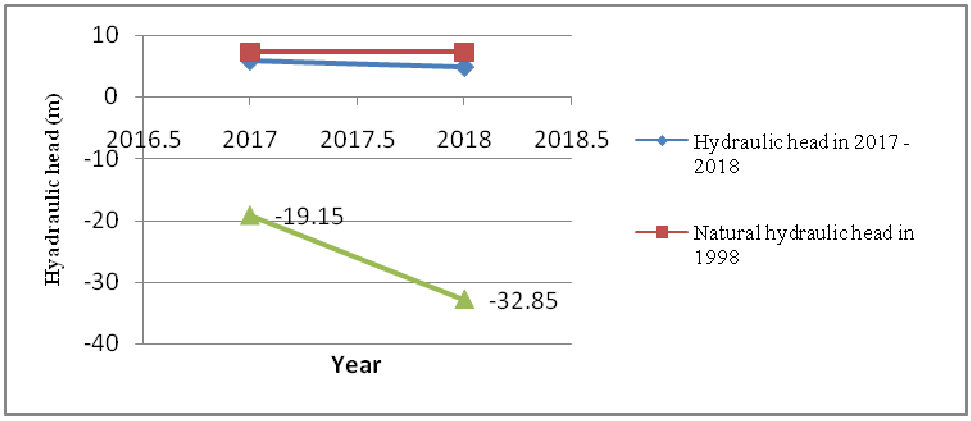

Figure 4. Head hydrolic comparison 2017 – 2018 againts nature head hydrolic in 1998, and deviation percentage of nature head hydrolicagains nature condition with government decision that industrial sector only consumes unconfined aquifer water of 75% with additional additive factor of 8% biocentric 70%

Data Collection

Data collection in this research is related to the biophysics, socioeconomic society, population and others supporting data.

Biophysics Data

To determine the additive factor needs annual rainfall data, land permeability, volume dimension of uptake wells, absorbtion coefficient, aquifer thickness, and the green area.

Social Economic Data

1. To calculate a numbers of water comsumtion of unconfined aquifer due to the *etika* effect needs an *etika* factor.
2. To estimate the effect of government statement requires the development housing data

Tools and Equipment.

1. Geology map of Pekanbaru
2. GPS and Water Level Indikator

RESULTS AND DISCUSSION

A model has been examined for unconfined aquifer in Pekanbaru so that the simultaneous of unconfined aquifer continue until 2018. This is expected to obtain biosentric of 70% with additive factor of 5%. However, model is still required zoning analysis such as given by Figure 2.

Figure 2 shows that in 2013 and 2014 the value of head hydrolics higher than the head of theoretical value. This means that unconfined aquifer condition is in safe condition with a deviation percentage of 40.57% and 11.02% respectively. This improvement is caused by the model of additive factor to contribute a correction. It means that consumption of unconfined aquifer for 2013 and 2014 can be balanced or improved to safe condition by the additive factor. In 2015, the head hydrolic deviation of -29.62% means that the value of head hydrolic is lower than the value of nature head hydrolics. But, the deviation value still yields the unconfined aquifer in safe condition in 2015. Although, there is additional additive factor of 5% from 2016 to 2018 that can not be able to balance the water consumption of unconfined aquifer both domestic and industry hence it contributes a good enough deviation value of -53.15%, -72.73% and 87.53%. These occurred since the unconfined aquifer is not in safe condition, but it is in shortages, critical, and demaged condition respectively. In this situation, the model still requires to optimize so that the simultaneous unconfined aquifer occurs in Pekanbaru city until 2018.

Figure 2 also shows that the improvement of head hydrolic condition of unconfined aquifer in 2016, 2017, and 2018 with additional additive factor of 8%. The unconfined aquifer condition has been sucessfully optimized in 2016 from the shortage condition to the safe condition (-29.41%), from damaged condition to the critical condition (-63.76) in 2017 and from the damaged

condition to the critical condition (-63.76) in 2018. These results have not shown the simultaneous until 2018 so that it is still required to optimize.

The improvement of unconfined aquifer condition in 2017 and 2018 can be optimized by taking the decision that the industrial sector only allowed to take water of 75% from the unconfined aquifer as it can be seen in Figure 3. Figure 3 depict that the aquifer condition in 2017 and 2018 shows a safe condition with the reduction percentage is -19.15% and -32.85% respectively. Certainly, the model has shown the simultaneous of unconfined aquifer in Pekanbaru city until 2018.

Figure 2 and Figure 3 can explain the allocation concept of underground water by identifying existing condition in the area and from the comparison results of naurehead hydrolic value which it is considered as undamaged condition in 1998. Technically, Figure 2 and Figure 3 can be used to determine water allocation of unconfined aquifer for various needs of water consumption which is based on the avaluability of unconfined aquifer and it can be determined by principle model.

This statement is according to the hierarchy of water underground allocation. If the water availability of unconfined aquiferis sufficient compared with the needs, all users will obtain their quota according to their needs. On contrary, if it cannot be reached, the water allocation of unconfined aquifer determined is based on specific criteria.

CONCLUSION

This research can be summarized as follows.

1) The additive factor of 5% and Biocentric *etika* of 70% contributes to the correction of unconfined aquifer in safe condition for 2013, 2014, and 2015 respectively with devation percentage is 40.57%, 11.02%, and -29.62% respectively.

3) The additive factor of 8% and Biocentric*etika* 70% improves the condition of unconfined aquifer in 2016 from the shortages condition to the safe condition (29.41%), from a critical condition to the shortages condition (-48.97%) in 2017 and from a demaged condition to the critical condition (-63.76%) in 2018.

4) The additive factor of 8% and government statement to the industry only allow to consume 75% water from unconfined aquifer with Biocentric *etika* of 70% yields the safe condition of unconfined aquifer in 2017 and 2018 with reduction percentage from a nature condition is -19.15% and -32.85% respectively. This study recommends to government of Pekanbaru to consider the additive factors until 2018.

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