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Economic Valuation of Water Resources in Gasing Watershed in Talang Kelapa Sub-district, South Sumatera, Indonesia

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Abstract. Water resources have economic value seen from the type of water utilization. At the study area, water resources, especially groundwater used to supply daily water demands and traded by the drinking water industries. From the activities of water taking, the water availability for supply will gradually decrease, thus needed to analysis the economic value that shows the value of water that decrease or changed function after taken from time to time. The purpose of this study is to analysis the economic value of the availability of water resources in the Gasing watershed. The methodology used by interview techniques and questionnaires for the analysis of the economic value of availability. The category of total economic value used by the market pricing technique. The category value of water calculated is the direct use value, the indirect use value, the existence value and the option value or bequest. From the calculation shows that the economic value of the longer will be greater. In 2017 the total economic value in Gasing watershed is Rp.4.097.033.992 , and in 2032 become Rp. 7.649.103.227.

Key words: economic value, groundwater availability, water demands

I. INTRODUCTION

The Gasing watershed is part of sub-river systems in the downstream Musi river basin. Based on data from the Mining and Energy Official of South Sumatra there are 13 industrial wells in 2017 at Talang Kelapa Sub-district [2]. This shows that there are many groundwater extraction activities. The current water availability feared to be inadequate [4].

The availability of water resources and its utilization economically can be estimation by economic valuation technique [3]. The results of economic valuations in a watershed can contribute substantially to watershed management for maintain availability, demands and maintenance of water resources in a sustainable management to avoid problems in the future [12].

The research by Maunida Isnin, Hairul Basri, dan Romano,2012 [9] suggests that water resources of Kreung Jreu watershed in Aceh Besar district has a high economic value because the availability of water can not supply the water demands of household and agriculture, especially in the dry season. Other research shows that the economic value will be

higher every year when used to supply water demands [4], [6].

The economic value shows that the water resources have been managed in a time. The economic value indicates it is beneficial or losses to be seen from the value of water resources as a result of environmental degradation each year [4].

There have been many other studies on economic valuation but the valuation of water is still left behind [7]. Research on other economic valuations such as forest resources, mangrove, and irrigation [8], [11]. Therefore, this research was done to analysis the economic value of groundwater availability in Gasing watershed that indicated the value of water resources utilized and support the management of water resources effectively and efficiently.

II. MATERIALS AND METHODS

2.1. The Study Area

The study area is in banyuasin district part of South Sumatera province, Indonesia. Site selection is due to existing groundwater resources utilized to supply domestic water

demands and utilized for the groundwater processing industry production by pumping. The Gasing River Basin is located in Talang Kelapa Subdistrict which consists of 5 villages namely Sukamoro, Sukajadi, Tanah Mas and Talang Buluh and Pangkalan Benteng as in Figure 1.

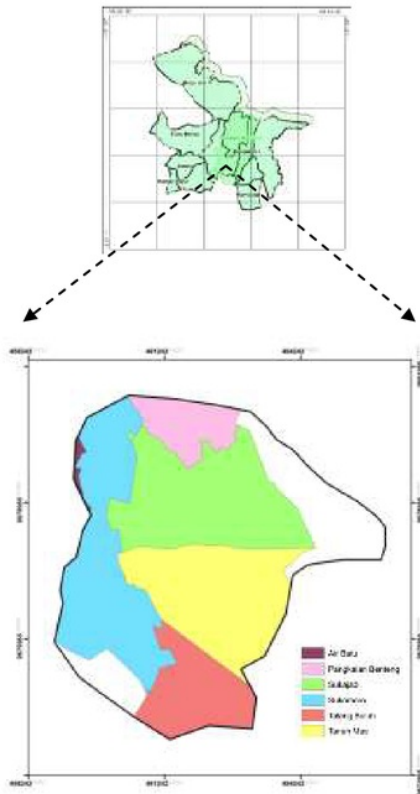


Fig 1. Gasing Watershed

The results of the calculation of water availability using todd and foliot method obtained the total water availability in 2017 is 48,456,247 m³ / year. The calculation of water needs based on the standard directorate general ciptakarya, 2010, the water demand in 2017 is 3,697,019,54 m³ / year. The water demand for 2017 is used as a parameter to calculate the economic value of water resources.

2.2. Study Methods

The method used is survey method to determine the power of electricity used by the household, type of pump used, and additional costs incurred to supply water demands. Household samples were by 20626 Head of Family. In industry, the surveys on

groundwater industries, there are 5 of industrial.

2.2.1. Economic Valuation

The value of natural resources based on their uses, there are grouped into the use values and the value contained or non use values [12]. The use values are *direct use values*, *indirect use values* and *option values*. The *non use values* are *existence values* and *bequest values*.

The economic valuation application describes the relationship between conservation of natural resources and economic development, therefore an understanding of economic valuations can contribute in policy making to determine the use and management of natural resources to be effective and efficient [7].

Economic valuation is valuing the product of natural resources and environment in the form of goods and services. The valuing techniques are *market value* and *non market value* [12], [1]. The calculation of economic value using the market price technique, because the water resources that exist in the Gasing watershed is traded by the industry.

Total Economic Value Analysis

Total economic value (TEV) derived from the total of the use value non use value [12]. The concept of economic valuation can be seen in mathematical equations for *Total Economic Value (TEV)* as follows :

$$TEV = UV + NUV \text{ or } TEV = (DUV + IUV + OV) + (EV + BV)$$

dimana:

TEV = *Total Economic Value*

UV = *Use Values*

NUV = *Non Use Value*

DUV = *Direct Use Value*

IUV = *Indirect Use Value*

OV = *Option Value*

EV = *Existence Value*

BV = *Bequest Value*

NPV

The NPV method is basically moving the *cash flow* through of the investment towards the initial investment [5]. The equation used to calculate the NPV is :

$$NPV = \sum_{t=0}^n CF_t(FBP)$$

NPV = *net present value*(Rp.)

CF= *cash flow*

FBP = interest factor *present* (%)

RESULTS

Direct Use Value of Water Resources in Gasing Watershed

The value of direct use for households is derived from the amount of water use such as drinking, cooking, bathing, washing, etc. The calculation of the direct use value on domestic water demands is obtained from the market price approach by multiplying the monthly domestic water demand with the water base price. The value of the water base price used the standard price of groundwater by the local government or the price of groundwater to be paid by the groundwater industries, it is Rp.450/m³.

The value of direct use of the water treatment industry is obtained from the multiplying the total monthly water pumping with the price of groundwater in Banyuasin District or the cost of water per m³. Results of calculating the direct use value of water resources in Gasing watershed seen in table 2.

Table 2. Direct Use Value of Water Resources in Gasing Watershed

Type of Water Demand	Water demand (m ³ /year)	DUV (Rp)	Total DUV (Rp.)
Households	1,718,047	773,121,137	1,654,134,591
Industries	1,978,973	890,537,655	

Indirect Use Value of Water Resources in Gasing Watershed

In the Gasing watershed there are many recreation area, but there are not exploit water resources. The recreation areas consist of historical building or park. Thus, the indirect use value for Gasing watershed is zero [9].

Existence Value of Water Resources in Gasing Watershed

Analysis of the existence value by the household, the area at the study site is divided into two categories, there are category I is an area that located near water treatment industry, and category II is an area where there is no industry. The areas included in category I are Sukamoro, while Sukajadi, Pangkalan Benteng, Tanah Mas and Talang Buluh are included in category II. Category I have additional cost to buy drinking water. One month the average cost is Rp.70000.

The amount of domestic water demands in the study area is 130 Liter/person/day based on Ditjen PU Ciptakarya,2010. The water demands consist of household unit and hydrant connection. For a household that consists of 4 people, the water demands are 520 liters.

The cost by domestic is known by monthly the electricity cost. Specification of household pumps are known by the description of the pump specification on the manual pump usage. The average power of pump household are 220 V-50 Hz, output power 125 W and Inlet 1.55 A. Electricity power of households at Talang Kelapa sub-district especially in the study area included in Gasing watershed is 900 VA. electricity tariff for household purposes of State Electricity Company in Indonesia for the power is Rp.1352 per VA [10].The calculation result of monthly electricity cost of pump used, obtained that a household will spend Rp.2535 per month. Calculations of the existence value for household in the Gasing watershed can be seen in table 3.

The existence value for the groundwater industries is derived from industry taxes. Based on Undang-Undang 28, 2009 on local taxes and retribution, the taxes is 20% of the value of groundwater acquisition [13]. In this study, the value of groundwater industries is the direct use value that discussed earlier. The groundwater tax in 2017 is 20% x Rp.890.537.655 = Rp. 178.107.530. Thus, the existence value of groundwater industries is Rp. 178.107.530 for the year 2017.

Tabel 3. Existence Value of Water Resources for Households in Gasing Watershed

	Category I		Category II
	Wet Season (december - june)	Dry Season (July - October)	
Monthly Cost (Rp.)	2,535	75,000	2,535

Total Household	4,272	16,352
Existence Value (Rp.)	129,954,240	961,200,000
Total Existence Value (Rp.)	1,588,566,870	

Option Value and Bequest Value of Water Resources of Gasing Watershed

The option value and bequest value in the Gasing watershed is the conservation costs. The conservation activities are carried out by the government and community in Talang Kelapa sub-district, especially in the study area. The conservation cost can be seen in table 4. In 2017 used the value of the average cost of conservation from 2012-2016 is Rp.666.700.800.

Table 4. Option Value and Bequest Value

Num.	Year	Conservation Costs (Rp.)
1	2012	691,899,000
2	2013	248,825,000
3	2014	1,286,480,000
4	2015	613,900,000
5	2016	492,400,000

Source : mine and energy official

Discussion

Total Economic Value of Water Resources of Gasing Watershed

Total economic value is obtained by total all the values contained in the Gasing Watershed such as direct use value, indirect use value, bequest value and existence value. The total components of the total economic value is Rp. 4,097,033,992. The total economic value of water resources in the Gasing Watershed in 2017 can be seen in table 5.

Table 5. Total Economic Value

Water Resources Value	Users	2017 (Rp.)
DUV	Households	773,121,137
	Industries	890,537,655
Existence Value	Households	1,204,086,870
	Industries	178,107,531
Option Value and Bequest Value		666,700,800
Total (Rp.)		4,097,033,992

Net Present Value (NPV)

Net present value (NPV) of Total economic value (TEV) in the Gasing watershed is analyzed to estimate the future value with the bank interest factor at the moment. The interest rate used is 4.25% based on the value of usage

at Bank Indonesia starting August 19, 2016. Investment value is assumed until 2032 or in accordance with the spatial plan of Banyuasin district in 2012-2032.

The TEV value as a number of current values is used as the basis calculation. The current value of TEV is Rp 4.097.033.992, the value is obtained for 15 years based on with the spatial plan of Banyuasin district. it is Rp 7.649.103.227 in 2032.

The NPV in Gasing Watershed indicated that the water resources in the Gasing watershed was supply the water demands along time, the economic value will increase. The more rare a kind of natural resources be used, the higher its the economic value.

The total economic value of water resources used as a reference for the water resources management in the Gasing watershed by means of total economic value in the next year should be less than the calculation of the NPV the total economic value of water resources. Thus, the economic value of water resources does not increased, because the economic value continues to increase shows that water become expensive goods overtime. The main factor that causes it, is decreasing the availability of water while water demand continues to increasing.

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