Value of domestic water economy and sustainability of regional cross water resources management

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Abstract. Water resources has economic, political, social and cultural values becomes a commodity desired by many people. On a cross-border administrative scale, the struggle for water can be a problem and is a source of conflict between communities, regions and even countries. A view of water resources as public commodity that is not subject to prices is time to change especially for water use in a business. Water companies need to take into account the water value in relation to the cost of supply, in order to create sustainable water resources. The principle of paying users is applied to obtain compensation for the benefits received. Costs charged to water users need to be calculated through a reasonable payment mechanism in order to cover the costs of managing water resources that have been spent. The value of water benefits is the basis of the application of economic instruments to help the calculating process of water prices. This paper discusses the case of cross-regional water resource management in Indonesia Kuningan Regency – Cirebon City by emphasizing the value of water benefits as a basis for calculating water prices. Thus this paper will examine how the contribution of water resources if used for domestic water business (drinking water) based on the value of economic benefits and how the implications for the continuity of water resources management. Based on the results of the analysis it has been shown that if the raw water source is used for domestic water business, PDAM in Cirebon City is able to return 75% of the total cost of managing water resources that have been spent. Considering regulations where users of water sources outside the administrative boundaries are required to pay water prices, with this capability, water resources management across the Kuningan Regency -Cirebon City area has the opportunity to continue. On a global scale, the application of economic benefit values as a basis for calculating water prices can be used as a lesson for resolving cases of water resources conflict with characteristics similar to regions in Indonesia. By ensuring sustainable water resource management, at least the completion of cross-regional water resources in Indonesia can reduce the burden to resolve the problem of the water crisis in Southeast Asia.

1. Introduction
Water can flow beyond the borders of regional administration, both within a country and between countries, then water is often referred to as common pool resources; its use is not exclusive but between users can compete [1]. As long as water is still adequately available, free use does not cause problems, but in reality the water that can be used properly is increasingly limited so that there is inequality and competition to meet human needs [2,3]. This inequality and competition comes from a scarcity that assumes human needs are unlimited, so that a resource will be limited and eventually scarce [4].
The current water condition is a global concern because of water scarcity as well as the quantity and quality of water which is declining by various causes [5,6]. A strategic issue that develops among experts in the field of water resources that due to water resources are seen as a public commodity that is not charged or the cost of water is too low [7] which causes excessive water use. In the end water that has economic, political, social and cultural values becomes a commodity desired by many people. On a cross-border administrative scale, the struggle for water can be a problem and is a source of conflict between communities between regions and even countries. Even though national, regional and international peace stability increasingly depends on effectiveness and sustainability in the management of clean water resources in the world [8].

Sustainable water management is indicated by the following three things, the availability of sufficient and safe water to meet various needs, allocate water effectively and fairly among users, as well as efforts to protect water resources from the threat of degradation [9]. Efforts to protect water source ecosystems that are generally upstream, watersheds are an important part of sustainable water management [10]. In order to maintain the existence of sustainable water resources, the preservation of water resources is a major challenge facing the world today [11]. Sustainable water resources management requires considerable costs, especially for maintenance operating costs, return on investment, opportunity costs, economic externalities and environmental externalities [12].

Water prices determination is one of the solutions to drive water utilization efficiently, minimize conflict and direct sustainable water resources management. Water prices and investment recovery costs are issues that have been debated for decades in several countries due to not having a maximum return, most in Italy which has only reached 60% [6]. Water companies need to take into account the water value in relation to the cost of supply, water users need to pay for water resources according to their level of use, treat water as an economic good and not as a form of public service provided by the government that does not need to be paid [13]. Determining the value of water benefit is basically a neo-classical economic problem that offers the "principle of paying users" as a principle to collect money from users to finance investments and activities related to water resources management [14,15].

This paper raises the practice of applying the economic benefits of domestic water as a basis for water pricing in Indonesia. Water sector cooperation across administrative boundaries which requires users to pay still leaves problems. Payment mechanism of water prices that have been provided by users by making a profit sharing system is still considered unreasonable with an indication of the decreasing carrying capacity of water resources. Some previous studies have concluded the need for recalculation so that the price of water that needs to be paid by users is in accordance with water conservation needs [9,16,17]. On the other hand, increasingly aggressive raw water demand has the potential to threaten the sustainability water resources management due to possible conflicts. Permission to supply water for excessive domestic water activities will eliminate the opportunity of the surrounding community to obtain water sources. Thus this paper will examine how the contribution of water resources if used for domestic water business (drinking water) based on the value of economic benefits and how the implications for the continuity of water resources management.

2. Methodology

2.1. Research site
This paper raises the issue of water resource management across administrative areas in the West Java Province, Indonesia. Kuningan Regency (water resources supplier) with Cirebon City (water user) for domestic water business (drinking water) managed by Water Supply Company (PDAM) in Cirebon City.

2.2. Methods
To complete this study, quantitative methods were used with simple mathematical calculations based on Ministerial Regulations PUPERA No. 18/PRT/M/2015. All calculation results are stated in Indonesian currency expressed in Rupiah (Rp).
Cost of Managing Water Resources. The cost of managing water resources (BPSDA) is analyzed with the aim of identifying the amount of costs needed to manage water resources. Secondary data needed in this analysis include planning costs, information system costs, operating and maintenance costs, construction costs, monitoring, evaluation and community empowerment costs and operational costs of the manager's office. Data collection is carried out through visits of related agencies such as the Water Resources and Mining Agency, the Directorate of Public Works and the Central River Region, and the Regional Planning Agency. The cost of managing water resources is simply calculated by the following equation:

\[ \text{BPSDA} = \text{SI} + P + \text{PK} + \text{OP} + \text{PL} + \text{OK} \]  

Note:
- BPSDA: the cost of managing water resources
- SI: information system costs
- P: planning costs
- PK: construction costs
- OP: operating and maintenance costs
- PL: report preparation costs for institutional capacity building and community natural resource management
- OK: operational costs office

2.2.1. Value of economic benefits. The benefits obtained by water users to do business are called the value of economic benefits (VEB). In this research the value of total economic benefits will be calculated to obtain the value of domestic water economic benefits. At this time, Paniis Spring is used for agricultural and domestic water activities.

a) Benefits of agricultural economics (VEBAgricultural). Analysis of the benefits of agricultural economics uses primary data and secondary data. Primary data such as selling prices and production unit costs were obtained through limited interviews using the guideline questions on a group of farmers in the Paniis irrigation service area. While secondary data such as paddy fields, the number of harvests is obtained through visits of agencies such as the Office of Agriculture and the Civil Registration Agency. The value of agricultural economic benefits is calculated by the following mathematical equations.

\[ \text{VEBAgricultural} = \text{Income} - \text{Total Production Cost} \]  

Note:
- Income = Number of harvests x selling price
- Total Production Cost = paddy field area x production cost

b) Value of Economic Benefits of domestic water (VEBdomestic). Secondary data such as the average drinking water rate, the volume of water used, the level of water leakage are processed to analyze the value of domestic water economic benefits. This data is obtained through a survey of agency visits, namely PDAM Kota Cirebon.

\[ \text{VBEdomestic} = \text{Average rates} \times \text{volume of water utilized} \]  

Note:
- Volume of water utilized = volume of water used \( \times (100\% - \% \text{leakage}) \)
creation of sustainable management of water resources and users of water services (water, drinking business activities, industrial business activities, hydropower business activities, and agricultural business activities) must bear management costs in accordance with the benefits obtained [7]. To calculate BJPSDA simply use the following equation:

\[
BJPSDA = \frac{BPSDA \times \% VBE_{domestic}}{amount \ of \ water \ used}
\]  

Note:
BJPSDA : the cost of water resources management services
BPSDA : The cost of managing water resources
\% VBE_{domestic} : percentage of Value of Economic Benefits of Domestic

3. Result and discussion

3.1. Analysis of the price of water management services
Based on information obtained from the Office of Water Resources and Mining, Kuningan District Public Works, the costs required for water resources management activities amount to Rp. 3,875,590,943. This cost includes the cost of managing water resources, information system costs, planning costs, construction costs, operating and maintenance costs, the cost of preparing reports on institutional capacity building and the community for natural resource management, office operational costs.

3.2. Analysis of the value of economic benefits
The benefits obtained by water users to do business are called economic benefit values (VBE). In general, VBE use of water is obtained from flood control, flushing, drinking water, agriculture, hydropower, and industrial businesses. In this research economic benefit values will calculate domestic water. Currently water resources produced by Paniis Spring are used for domestic agricultural and water activities. Economic benefit values domestic water is the total percentage weight of VBE's Paniis Tear service.

3.2.1. Value of economic benefits of agricultural. Agricultural commodities discussed in this study are paddy rice commodities which are assumed to flow from Panis Springs. The total rice fields served reached 988 hectares with a total harvest of 6,267,000 Kg. If the selling price of grain drying at the farm level is Rp. 5,200 per Kg, the farmers' income from rice paddy farming is Rp. 32,588,400,000. Production costs in the conventional system are Rp. 1,5 million per hectare, then the total production cost that must be spent reaches Rp 1.120,502,852. By using equation (2) the value of agriculture economic benefits of paddy rice farming in irrigated land of Paniis Spring is Rp 31,467,900,000.

3.2.2. Value of economic benefits of domestic water: Information obtained from PDAM Kota Cirebon, recorded in 2017 the volume of water withdrawals from PDAM Kota Cirebon from the Paniis Spring source reached 1,054 l / sec or about 33,238,944 M³ / year. While the overall system leakage rate is 28.13%. The average rate set for obtaining clean water by the community is Rp. 3,991.75 / M³. By using equation (5), the value of domestic water economic benefits sought by PDAM Kota Cirebon reaches Rp 95,358,233.372.

3.3. The price of water management services
It is known that the cost of managing water resources and the percentage of the value of benefits from each water user, then can be calculated by BJPSDA. For more details, see the following table 1.
Table 1. The price of water management services.

| No | Description                                              | Calculation Results   | Information       |
|----|----------------------------------------------------------|-----------------------|-------------------|
| 1  | Cost analysis of water resources management services (BPSDA) | Rp. 3.875,590,943     |                   |
| 2  | Economic benefit values (VBE)                           |                       |                   |
| 2.1| Agricultural                                             | Rp. 126,826,130,520   |                   |
| 2.2| Domestic Water                                           | Rp. 95,358,233,372    | 75% VBE Total     |
| 3  | The price of water management services (BJPSDA)          | Rp. 2,913,985,436     |                   |

Source: The Calculation Results, 2017

The value of economic benefits of domestic water businesses by PDAM Kota Cirebon is 75% of the total value of economic benefits. By using equation (7), the value of the price of water management services (BJPSDA) is Rp. 88 per M³. If calculated based on water usage in a year, BJPSDA that must be paid by Cirebon City is Rp 2,913,985,436.

The economic benefit of domestic water businesses by PDAM in Cirebon City is 75% of the economic benefits of water for all uses. Possibly due to people's purchasing power in Cirebon City which is able to boost the value of the benefits of the water. Kuningan Regency is a regency with a level of regional income that is much smaller than Cirebon City. The results of previous studies indicate that drinking water consumption for households in Kuningan Regency 15 m³ is smaller than Cirebon City at 28 m³. Water consumption tends to increase with increasing household income and family members, whereas the amount of water consumption tends to decrease if the cost of obtaining water is higher. With higher income, the Cirebon City’s community consume more drinking water than in Kuningan Regency. Based on the findings, it can be illustrated that if the raw water source from Paniis Spring is used for domestic water business, especially in areas that have very high purchasing power, it will provide an opportunity to continue cooperation in the water resources sector. PDAM in Cirebon City is able to return 75% of the total cost of managing water resources that have been spent and if asked for as a price of water that can be compensated for paying for environmental services that are useful for water source conservation activities.

4. Conclusion

The utilization of Paniis Springs raw water sources for domestic water (drinking water) businesses by drinking water company provides the greatest value of economic benefits compared to other entrepreneurs. Natural resources management (cooperation) with other parties outside the administrative boundaries with the ability of very high purchasing power has provided enormous benefits if the benefits of the domestic water economy are converted into the amount of water prices they have to pay as environmental services. The greater the amount of water allocated to the domestic water business, the greater the cost of environmental services obtained. However, to avoid conflict, it is necessary to consider the balanced allocation of water to the needs of the surrounding community for other activities. Water optimization needs to be done. If the water prices determination is able to sustain efforts to conserve water resources, especially for the purpose of managing sustainable water resources, this case can provide valuable lessons about the importance of water pricing based on the benefits of water. On a global scale, with the sustainable water availability at least the completion of water resources across the Kuningan Regency – Cirebon City area can contribute to the reduction of the water crisis in Southeast Asia.

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