
| RESEARCH ARTICLE

Study of Water Economic Value to Improve the Role of Society in Watershed Management

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| ABSTRACT

The water economic value nowadays is relatively still low considering the limited understanding of water economic value due to the lack of interest from the people to the water resource system, particularly in a watershed. The increase of space demand in catchment areas which has the hydrological function to support water availability, has caused an impact on water availability. To improve the role of society in watershed protection and management, this research studied the water economic value from a society point of view. The relation among the variables to the water economic value could bring the ideas on how to improve the society understanding of water economic value. A better understanding of the water economic value of the society could enhance their role in watershed protection and management to support the watersheds carrying capacity as the supplier of water availability of current and future. The method used in this research was explanatory research which explains the causality among the relation of the variables through the hypothesis testing. This approach was chosen by considering the aims of the research, including the efforts to define the relation and influence to society estimation of water economic value. Therefore, variables used in this research consisted of water economic value, society's social-economic condition, society's understanding of the hydrological cycle in the watershed, and the availability of water distribution system. Furthermore, based on the result analysis, the estimation indicators of each variable relation were defined. The relation among the variables and its indicators were tested by SEM (Structural Equation Model). The result showed that the social-economic condition of the society influences their understanding of hydrological cycle in the catchment area, the availability of water distribution system does not indicate the influence of society understanding on the hydrological cycle in the catchment area, the social-economic condition of the society does not influence their estimation on water economic value, the availability of water distribution system indicate the influence to society estimation of water economic value and the land-use changes which are the manifestation of understanding on the hydrological process in catchment area influence to water economic value estimation.

| KEYWORDS

Watershed, Land use change, Social economy, Economic water value, SEM

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1. Introduction

The water economic value nowadays is relatively still low considering the limited understanding of water economic value due to the lack of interest from the people to the water resource system, particularly in the watershed. The increase of space demand in the watershed, which has the hydrological function to support the water availability, has caused an impact on water availability, such as the decreasing of water available and the frequent of water-scarce. The elimination of hydrological function to obtain the temporary advantage potentially degrades the watershed carrying capacity to support the water availability. Acquiring water is a right of all the people in the world. Therefore, all conscious or unconscious activities obstructing people's access to obtain the water is a human rights violation. However, the high demand for land in the market mechanism is the most important factor to earn the benefit economically.

The degradation of environmental services quality is caused by the low support to the improvement of ecosystem quality in the watershed, even though the action of changing the ecosystem function to the commercial region in the watershed is allowed. The minimum understanding of ecosystem existence in the watershed as the water supply system is caused by the low effort of

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estimating the economic water availability, which brings about the lack of interest to the watershed ecosystem. Most people considered that the available water in the river and groundwater was the free access resource that could be used whenever without any pricing cost to the water supplier (watershed ecosystem).

The watershed integrated management requires collaboration and long term duration, and huge operational financing. According to Tampubolon (2009), the limited financing from the government for watershed management was the most influential factor to depress the rate of environmental quality degradation. The approach of environmental management financing recently referred to the polluters' pay principle was inadequate that needs to be developed by adding the charged fare to environmental service users (user-pay principle). Accordingly, environmental management financing could be considered the multi stakeholders' responsibility. Similarly, Purboseno et al. (2014), stated that one method to build a similar perception among the disciplines to simplify the understanding of watershed function was pricing the water availability supplied by a watershed. However, if the valuation of the water economy is understood wrong, it will cause more difficulty in eliminating the problem of water crisis (Hanemann,2000).

To improve the role of society in watershed protection and management, this research studied the water economic value from a societal point of view. The proposed variables were social-economic condition, the understanding of watershed existence, water balance, water distribution system, and Willingness to pay/WTP). The relation among the variables to the water economic value could bring the ideas on how to improve the society understanding of water economic value. A better understanding of the water economic value of the society could enhance their role in watershed protection and management to support the watersheds carrying capacity as the supplier of water availability of current and future.

2. Materials and Method

2.1 Research Stages

This research aimed to study the variable and indicators that affect society estimation of water economic value. The study was started by analyzing the watershed system to understand the variables influence on the watershed system and its relation to society estimation of water economic value. The first step was data collection include watershed map, image satellite, water demand and supply, population, water use pattern and water resource management in research site from Balai Besar Sungai Wilayah Sungai, Balai Pengelolaan DAS, Dinas Pertanian Kabupaten and water management company.

The system analysis was started by studying the watershed hydrological system, evaluating all watershed components that affect hydrological balance, interrelating each described component after identifying the watershed component, then defining the main variable of research. The next step was inventorying the chosen variable indicators aligned to the research's goal. Those indicators were used as the items in the research questioner.

Finally, SEM analysis was run to evaluate the construction between variables and their indicators. Holistically, all the research's steps are shown in Figure 1.

2.2 Research Design

The method used in this research was explanatory research which explains the causality among the relation of the variables through the hypothesis testing (Ghojali, 2014). This approach was chosen by considering the aims of the research, including the efforts to define the relation and effect on society estimation of water economic value. Based on the result analysis of the watershed system, the variables used in this study are defined. Therefore, variables used in this research consisted of water economic value, social-economic condition of society, society understanding of the watershed's hydrological cycle, and the availability of water distribution system. Furthermore, based on the result analysis, the estimation indicators of each variable relation were defined. The relation among the variables and its indicators were tested by SEM (Structural Equation Model).

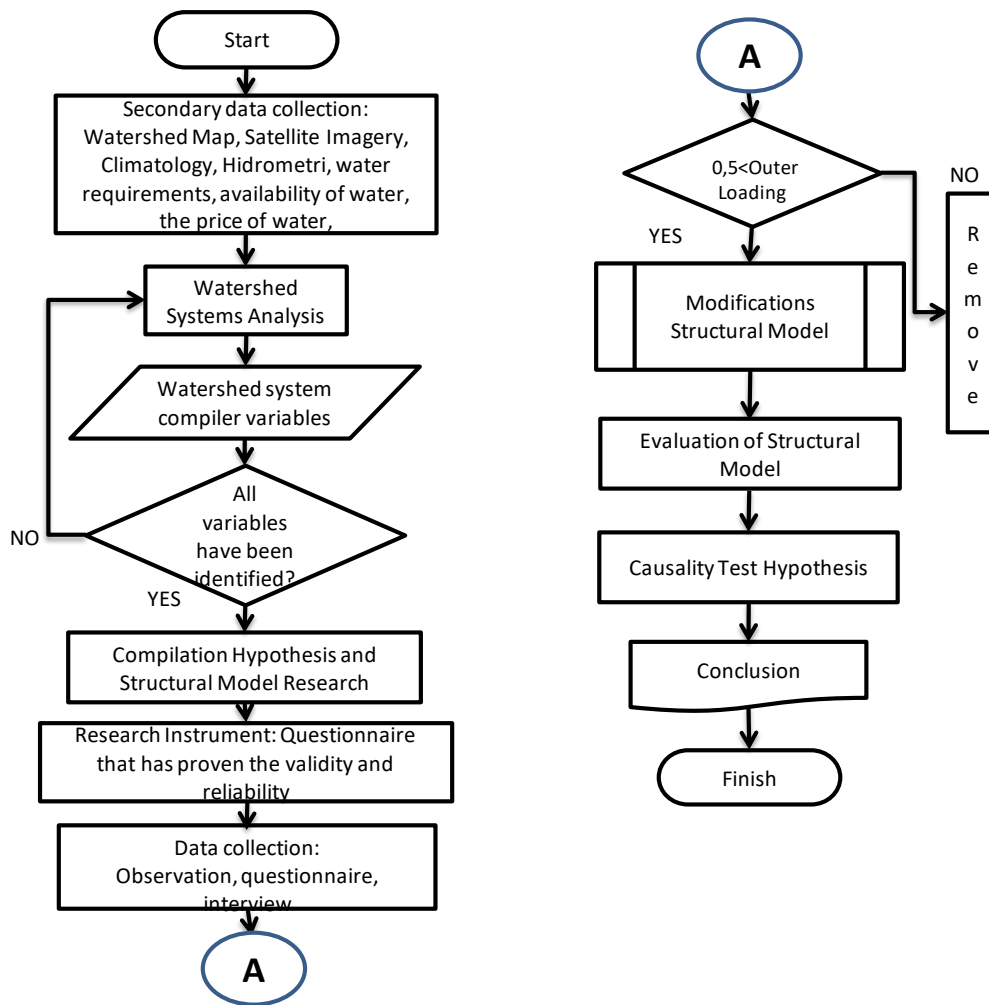


Fig 1. Flow Chart of Research

2.3 Variable identification consisted of :

1) *Endogenous variable:* Endogenous variable or dependent variable was Economic Water Value (Y) with the indicators; (Yn) where n :1,2,3.....

2) *Exogenous variable:* Exogenous variable or independent variables include:

- Social-economic condition of society (X1) and the indicator; (X1, n) where n :1,2,3.....
- Society understanding on hydrological cycle (X2) and the indicator; (X2, n) where n :1,2,3.....
- Availability of water distribution system (X3) and the indicator; (X3, n) where n :1,2,3.....

2.4 Method of Data Analyses

1) *SEM Analysis (Structural Equation Model):* The method of data analysis used in this study was SEM (Structural Equation Model). SEM is a statistical approach that allows simultaneously testing a complex relation. Those complex relations could be built from one or several dependent variables with one or several independent variables. It is possible to have a double role both as a dependent and independent variable. Each dependent and independent variable can be constructed from several indicators. The variable can be a single variable from observation or directly measured in the research process. SEM is also commonly known as Path Analysis or Confirmatory Factor Analysis. A flow chart or path diagram is highly fundamental in SEM because it enables the researcher to describe the hypothesized relations, which are called a model. The diagram is notably important to design the ideas of the relation of the variables that will be derived from the equations used in hypothesis testing.

2) *Hypothesis:* The proposed hypotheses in this study were:

- 1st hypothesis: there is a significant influence of the social-economic condition of the society to water economic value.
- 2nd hypothesis: there is a significant influence of society understanding of the hydrological cycle in the catchment area to water economic value.

- 3rd hypothesis: there is a significant influence of the availability of water distribution systems on water economic value.
- 4th hypothesis: there is a significant influence of water economic value on the role of society in watershed protection and management.

3. Results and Discussions

The aim of this study was to understand the influence of social-economic condition, water distribution system, land-use change to the water economic value using the Partial Least Square (PLS) with Smart PLS program seeing the 30 respondents involved in this research. The result of PLS analysis are described below:

A. Outer Model Evaluation

The data testing in the outer model evaluation consisted of convergent validity testing, discriminant validity testing, and composite reliability testing explained below:

1) *Convergent validity*: The first evaluation in the outer model was convergent validity. Convergent validity testing used the outer loading value where an indicator conforms to convergent validity if the outer loading value > 0.5. [5]

- The outer loading value of 3 indicators of social-economic condition variable including the number of family members, monthly water requirement and position house were > 0,5. While the outer loading value of the monthly revenue indicator was < 0,5. This showed that there was an indicator (monthly revenue) constructed the social-economic variable that did not meet the convergent validity so that the monthly revenue indicator was not able to use in the further analysis.
- The outer loading value from the four indicators X2.4, X2.5, X2.6 and X2.8 of water distribution system variable were > 0,5. Meanwhile, the outer loading value of indicators **X2.1, X2.2, X2.3, X2.7, and X2.9** were < 0,5. This showed that the indicators **X2.1, X2.2, X2.3, X2.7, and X2.9** constructed the water distribution system variable didn't meet the convergent validity, so the indicators **X2.1, X2.2, X2.3, X2.7, and X2.9** was not able to use in further analysis.
- The outer loading value from the four indicators X3.1, X3.2, X3.3 and X3.4 of land-use change variable were > 0,5. Meanwhile, the outer loading value of indicator **X3.5** was < 0,5. This showed that the indicator **X3.5** constructed the land-use change variable didn't meet the convergent validity, so the indicator **X3.5** was not able to use in the further analysis.
- The outer loading value from the six indicators Y1.1, Y1.3, Y1.4, Y1.6, Y1.7 and Y1.8 of water economic value were > 0,5. Meanwhile, the outer loading value of indicators **Y1.2, Y1.5 and Y1.9** were < 0,5. This showed that the indicators **Y1.2, Y1.5 and Y1.9** constructed the economic water value variable didn't meet the convergent validity, so the indicators **Y1.2, Y1.5 and Y1.9** were not able to use in the further analysis.

Table 1 : The Result of Outer Loading Value (2nd Analysis)

Variable	Indicator	Outer Loading
Social Economic	X1.10	0.713
	X1.7	0.671
	X1.8	0.593
Water Distribution System	X2.4	0.931
	X2.5	0.847
	X2.6	0.940
	X2.8	0.859
Land Use Change	X3.1	0.672
	X3.2	0.960
	X3.3	0.627

	X3.4	0.934
Water Economic Value	Y1.1	0.607
	Y1.3	0.654
	Y1.4	0.820
	Y1.6	0.713
	Y1.7	0.601
	Y1.8	0.583

Source : outp PLS, proceed

According to the second convergent validity, the outer loading value of social-economic, water distribution system, land-use change and water economic value indicators were > 0,5; thus, the indicators have conformed to convergent validity. Briefly, those indicators were valid to measure the social-economic, water distribution system, land-use change and water economic value.

2)Discriminant Validity: The second evaluation of the outer model was discriminant validity. The discriminant validity was measured by cross loading value. One indicator conforms to discriminant validity when the cross-loading value to constructs should be more than its cross-loading value to other constructs. The cross-loading value of each indicator was pointed out in Table 2.

Table 2: The Result of Cross Loading Value

	Water Economic Value	Water Distribution System	Social Economic	Land Use Change
X1.10	-0.311	0.047	0.713	-0.376
X1.7	0.014	0.313	0.671	-0.446
X1.8	-0.019	0.128	0.593	-0.250
X2.4	0.451	0.931	0.246	-0.095
X2.5	0.305	0.847	0.125	-0.334
X2.6	0.530	0.940	0.284	-0.017
X2.8	0.674	0.859	0.193	0.171
X3.1	0.242	-0.185	-0.396	0.672
X3.2	0.580	-0.038	-0.569	0.960
X3.3	0.366	0.075	-0.109	0.627
X3.4	0.624	0.035	-0.579	0.934
Y1.1	0.607	0.534	0.026	0.447
Y1.3	0.654	0.494	0.166	0.202
Y1.4	0.820	0.549	-0.257	0.449
Y1.6	0.713	0.313	-0.257	0.431

	Water Economic Value	Water Distribution System	Social Economic	Land Use Change
Y1.7	0.601	0.068	-0.255	0.476
Y1.8	0.583	0.174	-0.233	0.364

Source: Output PLS, proceed.

According to Table 2, the highest cross-loading values were obtained from the 3 indicators of social-economic variable, the 4 indicators of the water distribution system, the 4 indicators of land-use change and the 6 indicators of water economic value. Therefore, those indicators with the highest cross loading value conformed to discriminant validity.

3) *Composite Reliability*: The last evaluation of the outer model was composite reliability. The composite reliability tested the reliability value of each indicator in a construct. A construct or variable conform to composite reliability when the value of composite reliability is > 0.7 (Monecke,, 2012). The value of composite reliability of each construct or variable is shown in Table 3.

Table 3: The Result of Composite Reliability

	Composite Reliability
Social Economic	0.827
Water Distribution System	0.942
Land Use Change	0.698
Water Economic Value	0.882

Source: Appendix 4

Based on the result in Table 3, the composite reliability of social-economic, water distribution system and water economic value variable were more than 0,7, while the composite reliability of land-use change variable was slightly less than 0.7. Hence, all variables conformed to composite reliability.

B. Inner Model Evaluation (Structural Model)

The structural model developed to study the influence of social-economic, water distribution system and land-use change to economic water value was described in Figure 2.

4) *R-Square*: First evaluation of the inner model was shown by the R-Square or determination coefficient. Based on data processing by PLS, the result of R-Square was pointed out in Table 4.

Table 4: The Result of R-Square

	R Square
Economic Water Value	0.712
Land Use Change	0.325

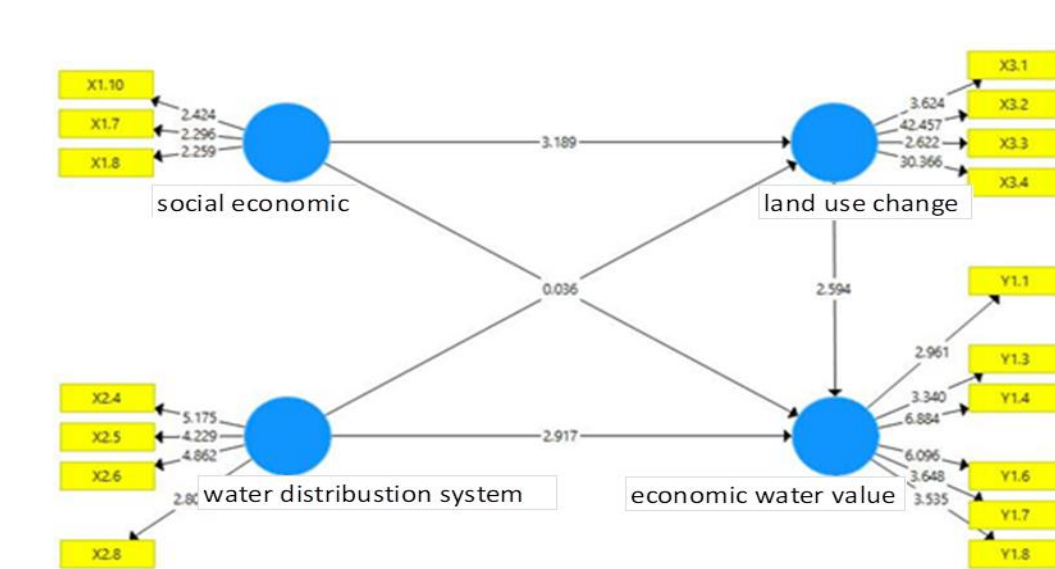
Source: Output PLS, proceed

The goodness of fit in the PLS model was determined by the value Q². The Q² has a similar interpretation of the determination coefficient (R-square / R²) in regression analysis (Peng, 2012). The higher R², the fit model to data. According to Table 4, the result of R² was explained below:

R² of the land-use change variable was 0.275, which means the rate of change from the land-use change variable that is explained by social economic and water distribution system was 27.5%. While, R² of economic water value was 0.679, which means that the rate of change the economic water value that explained by social-economic, water distribution system and land-use change was 67.9%.

5) Causality Test

The further analysis of the inner model was a causality test to analyze the research hypotheses: the influence of social-economic, water distribution system and land-use change to economic water value. The hypotheses was accepted if t-statistic > t table at error rate (α) 5% or similar to 1,96, or if p-value < 0.05. The path coefficient (original sample estimate) and t-statistic of the inner model can be observed in Table 5.



4. Discussion

A. Table 5
B. The Result of Causality Test

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Water Distribution System -> Economic Water Value	0.599	0.549	0.205	2.917	0.004
Water Distribution System -> Land Use Change	0.118	0.096	0.348	0.338	0.735
Social Economic -> Economic Water Value	0.009	0.074	0.243	0.036	0.972

Fig. 2 The Structural Model of Social Economic, Water Distribution System and Land Use Change and Economic Water Value

Society's understanding of the watershed's function to support the hydrological cycle was influenced by their social, economic condition. Meanwhile, the education level, marital status and monthly revenue as well didn't show a significant influence. The rate of water demand and geographical location precisely influence society's understanding of the hydrological cycle in the watershed due to the direct impact of land-use change in the watershed faced by society, i.e., floods and droughts. Society understanding of the environmental conditions to determine the success of community-based watershed management (Yavuz, 2015). However, the

social-economic condition didn't influence economic water value as long as the people obtained the water easily with the under standard water quality level (Arbués, 2003). Otherwise, the economic water value according to the water distribution or PDAM showed a significant influence considering that the people have to pay to PDAM although the rate was relatively low.

Water distribution systems' availability to end-users (homes) obscures the hydrological function of land-use change in the watershed since water availability to fulfil the people's water demand is relatively easy to access currently through the water distribution managed by PDAM. The decrease of water availability due to the damage of the watershed's hydrological function doesn't affect the society directly, although the water distribution system managed by PDAM does. When the raw water quality is poor, it requires a higher cost to treat the water into potable water. The rising cost doesn't influence society directly considering the subvention by the government. The additional operational cost to the society will be allowed until the local regulation of water fare is issued. According to Kurian and Dietz (2005), participatory community in the river basin management is easier through the water companies of the group social community.

Referring to Yoganand and Gebrimedhin (2006), the failure of society involvement in watershed protection and management in India as a result of the developing program was only based on a land condition, not local society condition. According to this research, in order to improve people participation in managing and protecting the watershed, the program must refer to not only the watershed condition but also the actual condition of local society. Meanwhile, in Brazil, people's participation in watershed management has been started since 1998, with the approach on the principles of water management: (1) stakeholders' participation; (2) the watershed as the planning and management unit; and (3) the economic value of water (Porto, 1999).

5. Conclusions

1. The social-economic condition of the society influences their understanding of the hydrological cycle in the watershed.
2. The availability of a water distribution system does not indicate the influence of society understanding on the hydrological cycle in the watershed.
3. The social-economic condition of the society does not influence their estimation of water economic value.
4. The availability of a water distribution system indicates the influence on society estimation of water economic value.
5. The land-use changes, which is the manifestation of understanding the hydrological process in the catchment area, influence water economic value estimation.

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