

DECISION MAKING AND CONSCIOUSNESS OF STAKEHOLDERS FOR RIVER IN INDONESIA

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ABSTRACT

River restoration in Indonesia is very important to be implemented because the river quality has been degraded. This action aims to improve the quality and function of rivers. Actual action has been done for landscape function. Several river restoration alternatives are namely river restoration species, river restoration ecosystem/landscape, and river restoration of ecosystem services (flood control, raw water, and hydropower plants). This research was done with questionnaire survey which is distributed to experts. The proposed research consists of Analytical Hierarchy Process (AHP) with five criteria's, they are: river water, habitat, cost, landscape, and action. Based on these result several important sub-criteria were water quality, water quantity, water use, water usage, biodiversity, species, population, agriculture, and public education. The result showed that the river restoration of ecosystem services (flood control, raw water, hydropower plants) is the most suitable alternative for all experts, but each expert has a different suggestion. Furthermore, the next questionnaire survey includes stakeholders and community of watershed, and selecting river restoration public education for the community of watershed.

KEYWORD:

River restoration, AHP, criteria, alternative.

INTRODUCTION

Since early 2011's, the Indonesian government issued a regulation regarding the river restoration. It states that river restoration is very important to be implemented because the river quality has been degraded. Degradation caused silt of river erosion, the settlement on the river banks, the changes of riparian land use, decreasing quality of river water due to domestic waste, agricultural, and industrial [1]. River restoration action aims to improve the quality and function of rivers [2]. Actual action has been done for landscape function. Several river restoration alternatives are conducted namely river restoration species, river restoration ecosystem/landscape, and river restoration of ecosystem services (flood control, raw water, and hydropower plants) [3]. To implement river restoration required the following four stages, they are: setting a clear goal for restoration activities, choosing a prioritization scheme, using watershed analyses, prioritizing restoration actions based on assessment results [3].

The selection of river restoration priority is very complex because there is conflict of interest between river stakeholders namely public and private sector including policy makers, practitioners, scientists and non-government organizations, as well as river community potentially impacted [4]. By actively drawing these various stakeholders

into the process, visions can be shared and turned towards each other. This makes different interests to be met, and increases support for restoration efforts. [4]. Decision making is the process of selecting actions to solve problems that are done by formulating a problem, search for causative factors, seek alternative solutions, and choose the best alternative action with certain criteria and priorities.[5]. Problems and the needs for the river restoration described into five criteria: river water, habitat, cost, land use, and action. To select priority river restoration, we have distributed a questionnaire to stakeholders who are experts in the field of economy, river, urban planner, and environmental. We formulated the opinion of the experts to determine the interest level of criteria and sub-criteria in the selection of priority the restoration of the river so that the river restoration alternatives were selected based on the urgency. The method used in the research is the Multi-Criteria Decision Making analysis tool Analytical Hierarchy Process (AHP).

This paper presents the level of importance of criteria and sub-criteria and alternatives of river restoration in the opinion of the experts and consciousness of river restoration community of Sugutamu River community based on a socio-economic report.

METHODOLOGY AND DATA

Decision Making Methodology

Decision-making methodology for selection priority river restoration in Indonesia uses AHP. The AHP was developed to optimize decision making when one is faced with a mix of qualitative, quantitative, and sometimes conflicting factors that are taken into consideration. Principles of AHP (Saaty, 1970): 1) decomposition of problems into hierarchies, 2) comparative judgment and synthesis of priority, 3) logical consistency. AHP uses algebra matrix to sort out factors to arrive at a mathematically optimal solution. Decision-making framework river restoration can be seen in Figure 1. The criteria and sub-criteria specified and structured based on existing problems, stakeholder needs, constraints, and the impact of the implementation of river restoration. Weights of criteria and sub-criteria are calculated using expert choice 11. Solution alternatives are defined based on best practices and stakeholder needs.

Data used to select the restoration of the river is the primary data from river stakeholders namely economists, environmental experts, river engineer, and urban planner. The collection of primary data for the analysis of alternative decision-making river restoration used questionnaires distributed by email to stakeholders. A total of 38 samples were analyzed to get the weights of criteria and sub-criteria and alternatives restoration selected.

Consciousness of Stakeholders for River Restoration in Indonesia

The consciousness of stakeholders for river restoration in this study used the data from socio-economic report for Study of River Restoration Sugutamu.

The data for the analysis of stakeholders' consciousness from secondary data was from The Socio-Economic Study Report Sugutamu River Restoration. Data used in this report based on the results of questionnaires from 100 people who live along The River Sugutamu [10].

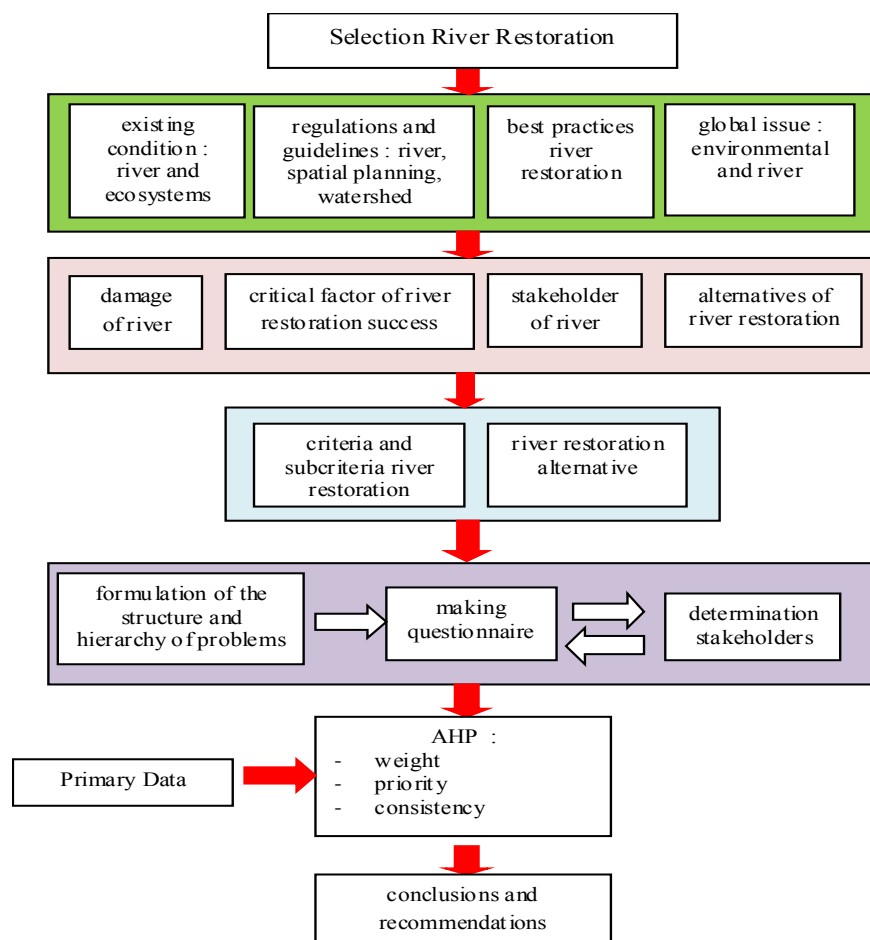


Figure 1. Decision Making River Restoration Framework

DISCUSSION

Decision Making of Stakeholders for River Restoration in Indonesia

River restoration goal is to provide water security, flood control, and ecosystem vitality. The objectives were to secure abundant water resources, implement flood control, improve water quality, and restore ecosystems, create of multipurpose spaces for local residents, develop rivers regional [6]. The impacts human activities to the river systems were flowed regime, habitat structure, water quality, food source, biotic interactions [7]. On the global scale of the problem of water pollution in developing countries is due to the increase in population and urbanization, the rise of industrials, deforestation, intensified agriculture, engineering works, such as the damming of rivers and the destruction of wetlands. [8]. The environment requires a flow of water (seasonality), depth of water, velocity, quality of water, and temperature. [8].

Freeman (1984) defines stakeholders as a group or individual who can affect or are affected by the achievement of certain goals [9]. Stakeholders for the users and beneficiaries of the river consist of government, private, and community. In this study, the stakeholders are the experts that are divided into groups of an economist, environmental expert, river engineers, and urban planning. A total of 38 questionnaires were analyzed and there were 8 respondents representing experts who can use the results of the analysis. The used analysis is the result of analysis with a consistency ratio rate of below 0.15.

Hierarchy structure of selecting river restoration priority

The hierarchy structure consists of four level (Fig.2): level I goal selecting river restoration priority, level II criteria: river water, habitat, cost, land use, and action, level III Sub-criteria, there are 20 sub-criteria, level IV alternatives, i.e.: restoration of species (RS), restoration of ecosystems of landscapes (REL), and restoration ecosystems services (RES).

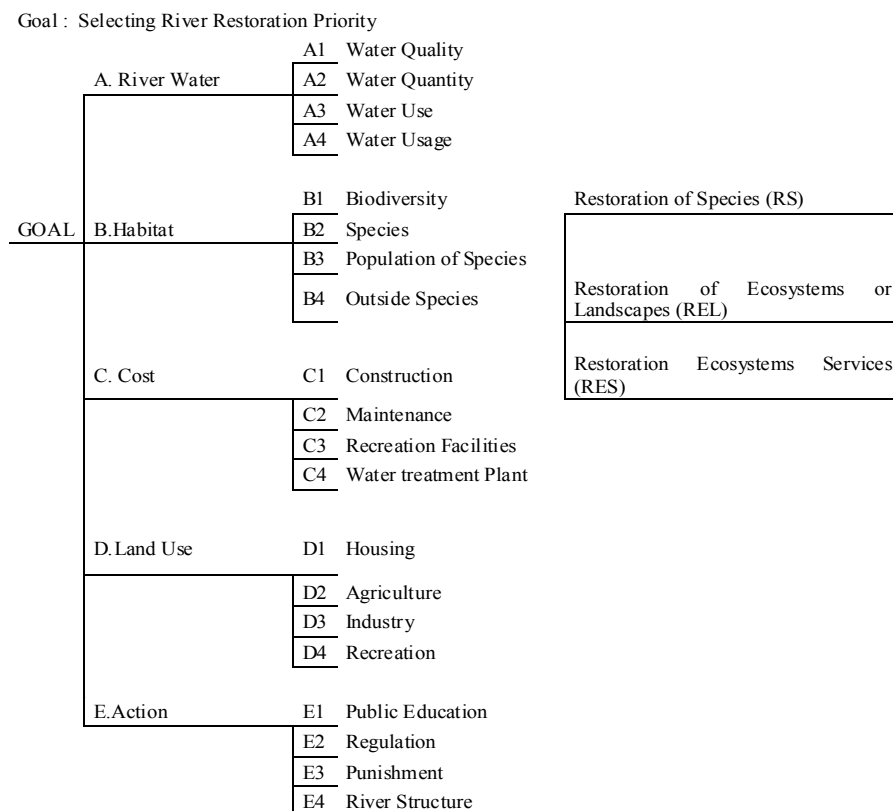


Figure 2. Hierarchy Structure of Selecting River Restoration Priority

Analysis of criteria for selecting priority river restoration

Clustering criteria for selecting river restoration are river water, habitat, cost, land use,

and action. Based on the results of questionnaires, they results were processed using software generating the following results:

Table 1.
Criteria for selecting priority river restoration

No.	Criteria	Economist	Environmental Expert	River Engineer	Urban Planning	Total
1	River Water	37.30%	27.00%	25.00%	19.00%	26,00%
2	Habitat	23.90%	24.00%	19.00%	22.00%	20,00%
3	Cost	15.30%	11.00%	13.00%	14.00%	14,00%
4	Landuse	13.30%	19.00%	22.00%	26.00%	21,00%
5	Action	10.20%	19.00%	22.00%	18.00%	20,00%

Based on the analysis in Table 1, it can be seen that the importance criteria for selecting priority of river restoration are the river water, about 26% according to experts. Meanwhile, an important criterion for selecting river restoration

priorities, according to each expert, is the river water with values varying between 25% to 37.3%. Urban planning expert who chooses land use as important criteria is 26%.

Table 2.
Sub criteria for river water criteria

Criteria/sub criteria	Economist		Environmental Expert		River Engineer		Urban Planning		Total	
	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight
River Water										
Water quality	43.10%	16.08%	41.30%	11.03%	35.50%	8.88%	21.50%	4.09%	32.60%	8.61%
Water quantity	24.60%	9.18%	24.20%	6.46%	23.90%	5.98%	22.90%	4.35%	24.20%	6.39%
Water use	18.90%	7.05%	19.30%	5.15%	20.90%	5.23%	31.60%	6.00%	21.90%	5.78%
Water usage	13.50%	5.04%	15.30%	4.09%	19.70%	4.93%	24.00%	4.56%	21.30%	5.62%

Based on the analysis in Table 2, it can be seen that the important sub-criteria for water criteria is the water quality accounted for 32.60 %, according to the experts. Meanwhile, an important sub-criterion for river water criteria according to

each expert is the water quality with values varying between 35.50 % to 43.10%. Urban planning experts who choose water use as an important sub-criteria is 31.6%.

Table 3.
Sub criteria for habitat criteria

Criteria/sub criteria	Economist		Environmental Expert		River Engineer		Urban Planning		Total	
	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight
Habitat										
Biodiversity	36.80%	8.79%	43.80%	10.60%	41.40%	7.87%	37.30%	8.21%	40.10%	7.94%
Species	36.80%	8.79%	21.80%	5.28%	28.20%	5.36%	25.90%	5.70%	28.80%	5.70%
Population	16.90%	4.04%	20.80%	5.03%	21.30%	4.05%	21.60%	4.75%	20.60%	4.08%
Outside species	9.60%	2.29%	13.60%	3.29%	9.10%	1.73%	15.20%	3.34%	10.50%	2.08%

Based on the analysis in Table 3 it can be seen that the important sub-criteria for habitat

criteria are a biodiversity 40.10%, according to total experts.

Table 4.
Sub criteria for cost criteria

Criteria/sub criteria	Economist		Environmental Expert		River Engineer		Urban Planning		Total	
	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight
Cost										
Construction	26.50%	4.06%	19.80%	2.12%	20.50%	2.67%	13.90%	1.95%	18.90%	2.57%
Maintenance	50.80%	7.77%	25.20%	2.70%	43.40%	5.64%	43.50%	6.09%	42.50%	5.78%
Recreation Facilities	7.50%	1.15%	8.00%	0.86%	14.30%	1.86%	12.30%	1.72%	14.60%	1.99%
Water Treatment Plant	15.10%	2.31%	47.00%	5.03%	21.70%	2.82%	30.30%	4.24%	23.90%	3.25%

Based on the analysis in Table 4, it can be seen that the important sub-criteria for cost criteria is maintenance (42.50%). Meanwhile, the important sub-criteria for cost criteria according

to each expert is the maintenance (43.40% - 50.80%). Environmental experts who choose water treatment plant as an important sub-criteria is 47%.

Table 5.
Sub criteria for land use criteria

Criteria/sub criteria	Economist		Environmental Expert		River Engineer		Urban Planning		Total	
	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight
Land Use										
Housing	27.60%	3.67%	17.50%	3.40%	14.20%	3.12%	21.50%	5.59%	15.30%	3.14%
Agriculture	48.70%	6.48%	31.00%	6.01%	33.20%	7.30%	37.00%	9.62%	32.50%	6.66%
Industry	11.80%	1.57%	11.20%	2.17%	9.40%	2.07%	12.10%	3.15%	10.80%	2.21%
Recreation	11.80%	1.57%	40.40%	7.84%	43.20%	9.50%	29.40%	7.64%	41.40%	8.49%

Based on the analysis in Table 5, it can be seen that the important sub-criteria for land use criteria is a recreation (41.40%). Meanwhile, an important sub-criterion for land use criteria according to each expert is the recreation with values varying

between 40.40 % to 43.20%. Economist and urban planning experts who choose agriculture as an important sub-criteria is between 37.00% to 48.70%.

Table 6.
Sub criteria for action criteria

Criteria/sub criteria	Economist		Environmental Expert		River Engineer		Urban Planning		Total	
	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight	Local Weight	Global Weight
Action										
Public Education	47.50%	4.85%	42.90%	8.11%	35.00%	7.70%	36.60%	6.59%	35.30%	6.95%
Regulation	27.50%	2.81%	19.90%	3.76%	23.40%	5.15%	18.70%	3.37%	22.90%	4.51%
Punishment	9.20%	0.94%	21.80%	4.12%	23.60%	5.19%	22.20%	4.00%	23.50%	4.63%
River Structure	15.80%	1.61%	15.50%	2.93%	18.00%	3.96%	22.40%	4.03%	18.30%	3.61%

Based on the analysis in Table 6, the important sub-criteria for action criteria is a public education

35.30 % according to total experts.

Table 7.
Sub Criteria for selecting priority of river restoration

Sub Criteria	Economist		Environmental Expert		River Engineer		Urban Planning		Total	
	Global Weight	Rank	Global Weight	Rank	Global Weight	Rank	Global Weight	Rank	Global Weight	Rank
A1. Water quality	16.08%	1	11.03%	1	8.88%	2	4.09%	13	8.61%	1
A2. Water quantity	9.18%	2	6.46%	5	5.98%	6	4.35%	11	6.39%	6
A3. Water use	7.05%	6	5.15%	8	5.23%	9	6.00%	6	5.78%	7
A4. Water usage	5.04%	8	4.09%	12	4.93%	12	4.56%	10	5.62%	9
B1. Biodiversity	8.79%	3	10.60%	2	7.87%	3	8.21%	2	7.94%	3
B2. Species	8.79%	4	5.28%	7	5.36%	8	5.70%	7	5.70%	10
B3. Population	4.04%	11	5.03%	9	4.05%	13	4.75%	9	4.08%	13
B4. Outside species	2.29%	15	3.29%	15	1.73%	20	3.34%	17	2.08%	19
C1. Construction	4.06%	10	2.12%	19	2.67%	17	1.95%	19	2.57%	17
C2. Maintenance	7.77%	5	2.70%	17	5.64%	7	6.09%	5	5.78%	8
C3. Recreation Facilities	1.15%	19	0.86%	20	1.86%	19	1.72%	20	1.99%	20
C4. Water Treatment Plant	2.31%	14	5.03%	10	2.82%	16	4.24%	12	3.25%	15
D1. Housing	3.67%	12	3.40%	14	3.12%	15	5.59%	8	3.14%	16
D2. Agriculture	6.48%	7	6.01%	6	7.30%	5	9.62%	1	6.66%	5
D3. Industry	1.57%	17	2.17%	18	2.07%	18	3.15%	18	2.21%	18
D4. Recreation	1.57%	18	7.84%	4	9.50%	1	7.64%	3	8.49%	2
E1. Public Education	4.85%	9	8.11%	3	7.70%	4	6.59%	4	6.95%	4
E2. Regulation	2.81%	13	3.76%	13	5.15%	11	3.37%	16	4.51%	12
E3. Punishment	0.94%	20	4.12%	11	5.19%	10	4.00%	15	4.63%	11
E4. River Structure	1.61%	16	2.93%	16	3.96%	14	4.03%	14	3.61%	14

Based on the analysis in Table 7, it can be seen that the important sub-criteria for selecting priority of river restoration are water quality, water

quantity, water use, water usage, biodiversity, species, population, agriculture, public education (total 53,8 % - 70,30 %).

Analysis comparative alternative

Table 8.
Alternatives Priority Weights

Alternative	Economist	Environmental Expert	River Engineer	Urban Planning	Total
Restoration Species	32.00%	31.60%	35.90%	27.40%	25.70%
Restoration Ecosystems or Landscape	27.60%	34.60%	27.90%	36.40%	30.10%
Restoration Ecosystems Services	40.40%	33.90%	36.30%	36.20%	44.20%

Based on table 8, the results are as follows: environmental and urban planning experts chose Restoration Ecosystems or Landscape but economist and river engineer selected Restoration Ecosystems Services.

Consciousness of Stakeholders for River Restoration in Indonesia

The definition of consciousness comes from the word conscious that means to know and understand. Consciousness is born from

the community, habits in society, influenced by the environment, regulations and the role of government. This study was conducted to determine the comprehension and understanding of the community of the importance of The River Restoration Plan Sugutamu. The location of the study includes the District Sukmajaya and Cilodong in Depok and District Cibinong in Bogor City with a total population of 507, 026 people. Sugutamu River is in a position 06°22'30 "LS - 106°50'20 " BT and 06°28'35 " LS - 106°50'50 " BT.

The total area of the watershed of Sugutamu is 13.21 km² and 13.74 km length of the river. These areas are included in the administrative area and Cilodong Sukmajaya Sub-district, Depok City, and also partly in the District of Cibinong, Bogor, West Java. In Subdistrict of Sukmajaya there are Sidomukti Lake with an area of 7.5 hectares, whereas in District Cilodong there are Cilodong Lake with an area of 1 ha and volume of 3,000 m³.

The knowledge and understanding of the river and river restoration by the community:

- For the people in the district of Sukmajaya: 32% use the river, 34% sometimes use the river, never use the river 34%.
- 29% used river for recreation, 17% fishing, and 54% others.
- 42% of the respondents have experience with the river flood and 58% never have.
- 61% thinks that the responsibility of the cleanliness of rivers and lakes is the government, 5% thinks developer, 34% choose the community.
- Knowledge of sanctions of throwing garbage around rivers and lakes are: there is 76% of respondents are aware, and 24% are not.
- Benefits of rivers and lakes in the community: helpful (94%), not helpful (1%), no response (5%).
- The response to the planned river restoration of Sugutamu, agree (95%), (4%) neutral, disagree (1%).
- The response of citizens to the benefits of the river restoration: useful (88%) and not useful (12%).
- • Participation of the community towards the river restoration activities: participating (48%), participate if asked (50%), and did not participate (2%).

CONCLUSIONS AND FUTURE STUDY

All criteria have a relationship with the goal. This indicates a great value. The most important criteria for experts in each field is river water, except planner expert (land use priority). The important sub-criteria component for river restoration is: water quality, water quantity, water use, water usage, biodiversity, species, population, agriculture, and public education.

The alternatives of river restoration for each expert based on their interest but the calculation shows that, in total, the experts prefers Restoration Ecosystems Services.

Public awareness of the importance of the restoration is 95%. Communities around the river expect rivers and lakes can be used for recreation, tourism, and fishing.

Furthermore, the next questionnaire includes stakeholders and community of watershed, and selecting river restoration public education for the community of watershed.

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