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Community Participation for Providing Green Infrastructure of Riverbanks is South Sulawesi, Indonesia

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Abstract: The green infrastructure of riverbanks is an indicator of the environmental quality of the watershed area. The community has a leading role in producing green infrastructure. This study describes factors related to community participation in the provision of green infrastructure. Provision of infrastructure which is the planting of protective trees provides land for green infrastructure and maintains green infrastructure. The method of data completion was using the questionnaire as an instrument and involving 200 respondents at Jeneberang River in South Sulawesi. Sample determination using accidental sampling technique. Spearman Correlation analyzed correlation Method. Furthermore, results indicate that the willingness to provide land, assessments of ecological benefits and assessments of economic benefits related to community participation. The strongest factor associated with the willingness of land provision is land ownership. While the assessment factor on ecological benefits is strongest about tree planting and willingness to maintain the green infrastructure

Key words: Green infrastructure · Participation · Community

INTRODUCTION

Flood disasters caused by river flows are common in Indonesia and caused material harm and humans. The flood management as an effort to create the safety and comfortable environment. Green infrastructure is a support system of ecosystems and natural life and the indicator of the quality of the ecosystem. As an example of green infrastructure is greenways, parks and other conservation areas [1, 2]. Furthermore, the green infrastructure is an instrument of strategic planning in sustainable development. This concept aims to protect biodiversity and protection of ecosystem values. Water conservation and land conservation are the main activities in green infrastructure [3, 4]. Green infrastructure can help protect and restore ecosystem function and serve as flood control, water treatment system and rainwater management. This concept is a non-structural river management.

The watershed is a dynamic system with the characteristic is very closely related to the behavior of people who live around the river. The river as one element of the hydrologic cycle collects three types of runoff that is surface runoff, intra-flow (interflow) and groundwater runoff. Rainwater that falls on the soil surface is partially infiltrated and partially fills the contours of the ground surface, then flows into the lower areas and the river. This water flow is a surface runoff. Intra flow comes from the water flow first absorbed by the soil and out back to the river. Ground water runoff comes from groundwater that gradually exits for a long time to a low surface.

River morphology includes not only the river bodies but also the surrounding areas. The riverbank area is the boundary between the river body and the surrounding flat area. While the edge separates the flow area with the river body. The area of riverbank with good vegetation formed as green infrastructure space. However, most of the riverbanks in Indonesia have cultivated spaces such as plantations or agriculture. Also, settlements on the banks of the river are also growing with consideration of proximity to water sources. The activities of people living in riverbank will have an impact on the quality of the environment. Riverbank becomes garbage dumps and affects water pollution events. Also, due to large volume of waste and accumulate on the bottom causes sedimentation. The riverbanks should serve as water

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conservation areas and protect river bodies from erosion. Riverbank with good vegetation potential can be useful as oxygen-producing and absorb air pollutants. Also, it can maintain biota life both on land and in water.

Many rivers in South Sulawesi has supports the watershed ecosystem and also a resource for drinking water and irrigation needs. Water potential and physical potential of the river must be maintained to support life in the ecosystem. One of the rivers in this administrative area is the Jeneberang River with a length of 80 km. Intensive river management is characterized by the dams that are the controllers of the Jeneberang River flood. This dam provides raw water of 3300 liters/s with an irrigated area of 24, 585 ha. The dam also has hydroelectric power with an installed capacity of 20.1 MW.

The development of water resources on the Jeneberang River is not only the responsibility of the government. The community is a major stakeholder in river management. Conventionally, infrastructure development or rehabilitation of dams or dikes is the main choice in disaster reduction due to climate change. Green infrastructure as the elaboration of the river management concept that takes into account socio-economic aspects of society [5].

Community involvement in river basin management is part of Integrated Water Resources Management (IWRM). The program integrates technical concepts with appropriate management and institutional paradigms. Human dimension becomes part of the management system. Community involvement with participation requires knowledge transfer and the development of interest to engage in the program [6].

Based on the concept and fact description, this study aims to describe factors related to community participation in the provision of green infrastructure on river banks. Research location in settlement area along Jeneberang River.

MATERIALS AND METHODS

This research is a survey with quantitative approach. Methods of data collection using questionnaires as an instrument involving 200 respondents on the banks of the Jeneberang River in South Sulawesi. Community participation in river management is divided into three indicators *viz.,* tree planting on riverbanks, provision of land for green infrastructure and maintenance of green infrastructure area. The internal factors of the community which are the factors of participation are land ownership, the assessment of the ecological benefits of green infrastructure and the evaluation of the green infrastructure economic benefits. Sample determination using accidental sampling technique Methods of cross tabulation assist the researcher in determining therelation between themedium variable strength of relationship using Spearman Correlation.

RESULTS

Respondent Characteristics: Characteristic description of respondents covering education, annual income, knowledge about green infrastructure are presented in Table 1. This shows that most of the respondents are senior high school graduates with an average income of Rp. 20 million - Rp.30 million. Social conditions affect people's willingness to engage in a conservation program. With low incomes and only enough to meet daily needs, community participation tends to be low. Most of the respondents are landowners on riverbanks. However, the riverbank utilization form is agriculture, plantation and residential. Efforts to protect riverbanks have not been supported by community participation indicates of evident by the low level of public knowledge about green infrastructure.

Community Participation in the Provision of Green Infrastructure: Communities who live or manage the land on riverbank show low participation. People's willingness to plant trees on riverbanksin moderate categories (60%) and only 7.5% had high participation in tree planting (Fig. 1). Community participation to provide green infrastructure land is also low. As many as 40.5% of respondents who have participated with middle level and 40% of respondentsshowed low desire to participate (Fig. 2).

Community participation in the maintenance of green infrastructure is also illustrated by the average category (64%) moreover, there are 33.5% who have high participation in maintaining natural facilities on river banks (Fig. 3)

The Correlation Between Internal Factors and Community Participation: Statistical analysis with cross tabulation describes the relationship of internal factors of society with its participation. The relationship between land ownership and community participation is described in Table 2, 3 & 4. Land ownership is divided into three categories: low (managing land less than 1ha), moderate (managing land of 1ha to 2ha) and high category for respondents who manage the land more than 2ha.

Table 1: Description of respondent characteristics

Factor	Criteria	Frequency	Percentage
Education	University	59	29.5
	Senior High School	78	39
	Junior High School	34	17
	Primary school	22	11
	None	7	3.5
Annual income	more than Rp.40 million	12	6
	Rp.30 - 40 million	63	31.5
	Rp.20 - Rp 30 million	94	47
	Less than Rp. 20 million	31	15.5
Knowledge about	High	23	11.5
green infrastructure	Moderate	72	36
	Low	105	52.5
land ownership status	Own property	104	52
	Rental/cultivators	73	36.5
	Borrow	23	11.5

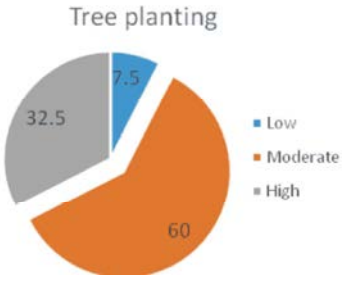

Fig. 1: Community participation to plant the tree in riverbank

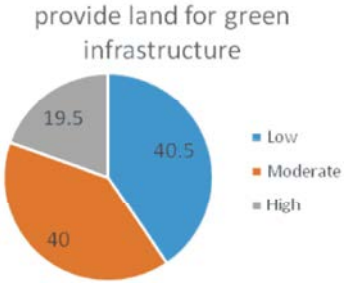

Fig. 2: Community involvement to provide land in the riverbank for green infrastructure

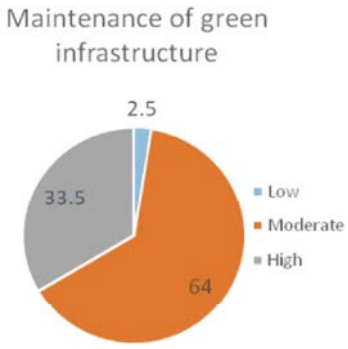

Fig. 3: Community participation to maintain the green infrastructure

Table 2: Cross Tabulation the land ownership with the participation to provide land

	Providing Land			
Land Ownership	Low	Moderate	High	Total
Low	48	4	3	55
Moderate	12	41	3	56
High	21	35	33	89
Total	81	80	39	200

Table 3: Cross Tabulation the land ownership with the participation to planting tree

	Planting			
Land Ownership	Low	Moderate	High	Total
Low	11	36	8	55
Moderate	3	51	2	56
High	1	33	55	89
Total	15	120	65	200

Table 4: Cross Tabulation the land ownership with the participation to maintain the green infrastructure.

	Maintenance			
Land Ownership	Low	Moderate	High	Total
Low	0	55	0	55
Moderate	4	51	1	56
High	1	22	66	89
Total	5	128	67	200

Table 5: Cross Tabulation ecological value with the participation to providing land for green infrastructure

	Providing Land			
Ecological	Low	Moderate	High	Total
Low	34	27	22	83
Moderate	28	38	4	70
High	19	15	13	47
Total	81	80	39	200

Table 6: Cross Tabulation ecological value with the participation to planting tree

	Planting			
Ecological	Low	Moderate	High	Total
Low	15	51	17	83
Moderate	0	67	3	70
High	0	2	45	47
Total	15	120	65	200

Table 7: Cross Tabulation ecological value with the participation to maintain green infrastructure

	Maintenance			
Ecological	Low	Moderate	High	Total
Low	2	80	1	83
Moderate	1	46	23	70
High	2	2	43	47
Total	5	128	67	200

Table 8: Cross tabulation economic value with the participation to providing land for green infrastructure

	Providing Land			
Economic	Low	Moderate	High	Total
Low	20	29	14	63
Moderate	46	45	20	111
High	15	6	5	26
Total	81	80	39	200

Table 8: Cross tabulation economic value with the participation to providing land for green infrastructure

	Planting			
Economic	Low	Moderate	High	Total
Low	0	24	39	63
Moderate	11	80	20	111
High	4	16	6	26
Total	15	120	65	200

Table 9: Cross Tabulation economic value with the participation to providing land for green infrastructure

	Maintenance			
Economic	Low	Moderate	High	Total
Low	2	4	57	63
Moderate	1	105	5	111
High	2	19	5	26
Total	5	128	67	200

Table 10: Chi square analysis.

Internal factor	Providing Land	Planting	Maintenance
Land ownership	0.000	0.000	0.000
Ecological	0.003	0.000	0.000
Economic	0.205	0.000	0.000

Table 11: Spearman correlation analysis.

Internal factor	Providing Land	Planting	Maintenance
Land ownership	0.517	0.502	0.638
Ecological	-0.018	0.539	0.675
Economic	-0.131	-0.392	-0.669

Respondents who live on the riverbank are managed land area more than 2ha. A total of 89 respondents with high land ownership. The willingness of the community to provide land in the medium category. Furthermore, the habit of these respondents to plant trees on the banks shows good behavior, as well as the willingness to maintain green infrastructure.

The following internal factors that influence the community participation in green infrastructure provision are the assessment of ecological benefits of green infrastructure. This assessment is divided into three categories: low-ranking, medium-sized and high-valued appraisals. This assessment is based on respondents' answers about air temperature in riverbanks, the quality of river ecosystems and water pollution. The relationship between these assessments and community participation is presented in Table 5, 6 & 7.

Analysis of respondents' answer indicates that most of the respondent (83 people) gave a low assessment of the environmental value of green infrastructure. With these assessments, the participation to provide land and maintain green infrastructure is also low. The third internal factor is the respondent's assessment of the economic value of land in green infrastructure. This assessment is also divided into three categories. The description of these internal factors is presented in Table 8, 9 & 10.

Assessment of respondents to the economic value of land showed moderate category (111 respondents). This assessment causes community participation in the provision of green infrastructure also in the moderate category. Other analysis results on respondents with a low assessment of the land economy. This group of respondents is willing to plant trees and maintain green infrastructure but is not willing to provide land. The Chi square analysis revealed the relationship between the variables shown in Table 10. The Chi square values smaller than 0.05 indicate that the two variables are related.

With SPSS program, Chi square analysis shows that the three internal factors influence the community participation, except the economic valuation factor for the willingness to provide green infrastructure land. The next analysis is the closeness of the relationship between two variables (Table 11).

The interpretation of the strength of relationship is divided into five categories:

- Very weak if the correlation value between 0.000 – 0200.
- Weak relationship if the correlation value is between 0.200 - 0.400.
- Moderate the relationship if its correlation value is between 0.400 - 0.600.
- Strong relationship if the correlation value between 0.600 – 0800 and
- Very strong if the correlation value is between 0800-1000.

The results of Spearman Correlation analysis indicate that the internal factors have astrong relationship with community participation in green infrastructure provision. Respondent's assessment of the economic and ecological value of green infrastructure has a very weak relationship to community participation.

DISCUSSION

The result of frequency analysis gives an idea that the best society participation is the willingness to maintain green infrastructure. Internal factors of society show a strong correlation with the form of community participation. Specifically, the highest community participation in the shape of green infrastructure maintenance, while the willingness to provide land and tree planting is very lacking.

Sustainable river management involves local community participation. Sustainable river ecosystem services can be achieved with people's ability to maintain natural ecosystems. River restoration as part of environmental management must consider socio-ecological conditions effectively. Complex institutional arrangements also support the management of river corridors. In general, river basin management with green infrastructure support should include: (1) the ability of community participation, (2) representation of hydro-geomorphological, ecological, socio-economic and riverine culture processes; (3) transparency and community involvement in decision-making processes; and (4) development of community motivation to maintain environmental quality [7, 8].

A comprehensive approach to environmental management has been implemented worldwide. Are increasingly being used to address environmental issues. Collaborative processes for building social capital that support programs and can prosper the community [9].

CONCLUSIONS

Land ownership, an assessment of the benefits of ecology and an assessment of the economic benefits associated with community participation. The strongest factor related to the willingness of land supply is land ownership. While the valuation factor on ecological benefits is strongest about tree planting and the desire to maintain green infrastructure.

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