International Journal of
Science and Engineering Investigations vol. 6, issue 69, October 2017
ISSN: 2251-8843

Local Wisdom in the Management of Freshwater Resources on the Small Islands of Tatoareng Subdistricts, Regency Sangihe

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Abstract-This article describes the local wisdom in the small islands of Tatoareng, Sangihe Regency in managing freshwater resources. The study was conducted in 12 villages located on three islands in Tatoareng Sub-district, Para Island, Kahakitang Island, and Mahangetang Island. The identification of water availability conditions is divided into three categories: abundant, sufficient, and less. Local wisdom of society is obtained by interview method. The result of the research shows that there are differences of land degradation causing variation of water availability in the three islands. The three island communities have local wisdom in managing freshwater resources that require reinforcement for the restoration of rain catchment areas.

Keywords- *Local Wisdom, Small Island, Freshwater*

I. INTRODUCTION

An island is said to be a small island when its size is less than 2,000 km2 [1]. Problems faced by communities in small islands are the availability of fresh water, the rate of land surface erosion and coastal abrasion. The problem of freshwater availability on small islands increased [2,3,4,5] because of their small size, not in exploitable form [6,7]. Community interaction with the environment on small islands that must face the condition of lack of clean water, establishing the values or behavior of local people's lives called local wisdom [8] passed down from generation to generation [9]. Local wisdom varies by place and time due to the challenges of nature and the necessities of life that are different. Various external factors due to technological advances, government policies, and reduced forest area can threaten the preservation of local community wisdom [10].

The study was conducted in Tatoareng Sub-district, Sangihe District, consisting of nine small islands, six of them in permanent populations, while the three islands only serve as resting places. The total land area of the Tatoareng subdistrict is 18.56 km2, with a population of 4291 inhabitants, and a population density of 231 jima / km2 [11]. Population density on inhabited islands remains higher than this average. Settlement patterns are generally concentrated in the coastal areas, so population density in coastal areas is high. The only remaining forest on the hilltops, the area of land for agriculture is very small and is only used for food crops (foodstuffs of local people) such as cassava, sweet potatoes, vegetables, spices and fruits. The main livelihoods of the people are fishermen (traditional), with low incomes due to limited marketing of catches. In the nine islands there are coastal swamps, overgrown with mangroves and a kind of giant swamp taro (Dalugha local language) that feeds the local community.

The small catchment area size and the lack of vegetation cover (mostly overgrown land) often raise the issue of water availability during long droughts. Preliminary survey results indicate that erosion rates on certain parts of all islands are high. The community basically has local knowledge and wisdom related to resource utilization, but this knowledge can be degraded due to pressure or market demand that encourages the exploitation of marine products. In 2006, there was a clash (violation of fishing catch agreement) which resulted in the loss of life between Para Island and Mahengetang Island community.

Regions of islands in Tatoareng District is very potential to be developed as a tourist area, with its icon of Mahengetang undersea fire which is increasingly visited by foreign and domestic tourists. Sangihe District Government has launched a program of tourism development with the main destination is the islands in the district Tatoareng. Anticipation of development. The development of tourist areas with various alternative economic activities of the community potentially increase the intensity of natural resources utilization. Analysis of existing conditions and the development / utilization of future resource potentials needs to be anticipated by improving the community's understanding of resource management that ensures sustainable economic utilization while maintaining the ecological functions of forests, coastal swamps and coastal waters.

This study systemically analyzes the existing condition in relation to the potential of water resources for future utilization, degraded areas for restoration and potential degradation for prevention and conservation. Systemic analysis of water resources management includes biophysical, socio-cultural and economic components as a whole and characteristic of small islands [12]. Existing conditions analysis is also used for predicting global impacts such as climate change [13], sea level rise [14] or interaction between global pressures with local dynamics that contribute to increasing environmental

vulnerability [15]. The role of communities is the most important element in water resources management. In this research the optimization of the role of the community is done through the strengthening of local wisdom and knowledge-skills of the community through the integration of local knowledge with external knowledge about ecological principles of resource management. This paper aims to provide information on the differences in land degradation that lead to variations in water availability and local wisdom existing in small islands of Tatoareng Sub-district, Sangihe District.

II. RESEARCH METHODS

The study was conducted on 12 villages on three islands, namely Kahakitang Island, Pulau Para, and Mahengetang Island in Tatoareng District, Sangihe Regency, part of Sulawesi Island (Figure 1).

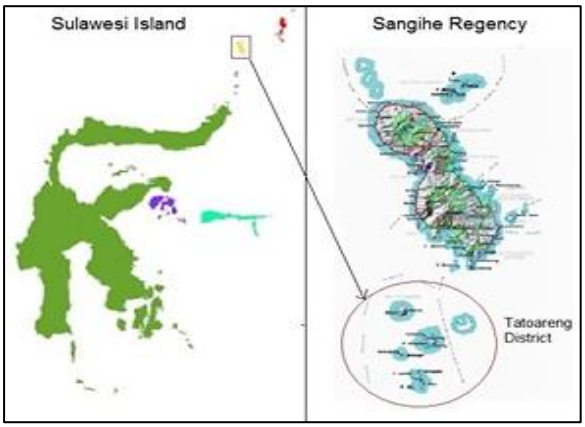

Figure 1. Research locations in Tatoareng District, Sangihe Regency

This research is conducted in two stages: 1. Identification of water availability, divided into abundant categories, sufficient, and lacking in three water sources, ie springs, drill/well water, and rain storage. 2. Local community wisdom related to the management of fresh water sources in some sites, implemented by qualitative descriptive method using interview technique. The sample data source is the informant/informant/participant determined purposively [16].

III. RESULTS AND DISCUSSION

The results of identification of fresh water availability in several villages on three islands: Kahakitang, Para, and Mahengetang are presented in Table 1. Based on Table 1 it can be seen that the condition of water availability in Kahakitang Island in the four villages has a spring in the category of enough, better than Pulau Para and Mahangetang Island which obtained fresh water from drill/well sources in less category and deep rain container enough category.

TABLE I. AVAILABILITY OF FRESHWATER IN THE DISTRICT TATOARENG

Islands	Villages	Freshwater supply								
		I			II			III		
		A	B	C	A	B	C	A	B	C
Kahakitang	Behongang						√		√	
	Kundaha		√			√				
	Ene Mitung		√			√				
	Sowaeng		√				√		√	
	Batusaiki		√				√		√	
	Kaleko			√					√	
	Dalako						√		√	
	Bombanehe			√					√	
Para	Para lele						√		√	
	Apenglawo						√		√	
	Salengkere						√		√	
Mahengetang	Mahengetang						√		√	

Description: I=Springs; II=Drill/well water; III. Rain storage; A=Abundant; B=Enough; C=Less

The scarcity of freshwater resources is increasing globally and this is particularly felt for small islands [17]. Limited surface area, highly sensitive to natural disasters, and highly permeable aquifers in close proximity to seawater make freshwater resources vulnerable [18]. Threats to the quality of freshwater resources and their availability on small islands can be naturally and anthropogenic to the extent of water catchments, natural disasters, sanitation, contamination by human and livestock wastes, human and animal waste, deforestation, pollution of industry and agricultural activities, losses from storage and delivery systems, over-abstraction, sand and gravel mining from freshwater source areas, saline intrusion due to over-extraction and rising sea levels, and deposition of water-borne contaminants from local and distant sources [17].

Result of identification, measurement and classification of land area in three islands: Kahakitang, Para and Mahengetang are presented in Table 2. The classification of land conditions is based on indicators related to groundwater availability: i.e. surface erosion, infiltration capacity, top soil depth and surface cover conditions. The results of these identification-measurements are based on the results of image delineation and field checks.

TABLE II. PERCENTAGE OF AREA BY CATEGORY OF LAND CONDITIONS

Island	% area by category of land conditions (related to fresh water availability)			
	Excellent	Light degradation	severe degradation	Critical
Kahakitang	11	38	31	20
Para	8	42	34	16
Mahengetang	15	45	28	12

Land conditions on the three islands studied showed variations of freshwater availability ranging from very good to critical. Associated with local wisdom, the community still maintains some of its local wisdom to keep some of the land cover as a water storage.

Identification of local community wisdom obtained the following results:

1. Forest condition is still naturally maintained on mountain / hill tops. The community has a perception that good forest conditions will affect the availability of clean water for community life related to the role of trees in the process of infiltration of rainwater into the soil.

2. Utilization of timber forest products for houses and boats is limited. There is an unwritten agreement that timber forest products should not be removed from the island and cannot be sold to avoid over-exploitation of forest products that will reduce tree density and reduce the capacity of forests to store water.

3. Forests are optimized for their functions by utilizing forest land for raising livestock (pigs). Communities are not familiar with the term agroforestry, but have practiced one form of agroforestry that is sylvopasture or a combination of forestry activities with farms. This activity on the one hand increases the income of the community, and on the other hand, animal waste will increase the organic matter that affect the increase of soil fertility and the capacity of infiltration of rainwater into the soil.

4. In agricultural areas, communities implement agroforestry system with agrisylviculture pattern, where nutmeg and coconut plants are combined with banana. This pattern can additionally increase the income of the community, can also increase the amount of organic matter in the soil surface that positively affect the conservation of soil and water.

5. In residential areas, people plant seasoning crops in the home garden and roadside. This activity in addition to increasing the income of the community is also an effort to optimize the narrowness of land on the small island for infiltration of rainwater by adding vegetation cover.

6. Waste is managed by creating a waste shelter and an agreement not to throw garbage into the sea.

7. Source of clean water for drinking water and washing clothes, and bathing is obtained by digging wells and holding rain water reservoirs.

8. The existence of a culture of mutual cooperation to clear roads and ditches and cultures to share water for other people who lack clean water.

IV. CONCLUSION

The conclusion of this study shows that the people's difficulty in obtaining clean water that has long been experienced by them in their interaction with the natural environment in small islands has resulted in a unique adaptation by the people living on small islands, in Tatoareng Sub-district to the condition of limited water supply. The adaptation has shaped an understanding of the importance of forests and the optimization of vegetation cover on farms for storing clean water and gotong royong culture to address the problem of limited clean water on small islands

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