Socio-Economic Carrying Capacity of the Poleang Watershed Area Indonesia

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ABSTRACT

Watersheds are areas that hydrologically have the capacity to drain water, conservation areas, drain water gradually, maintain water quality and reduce mass discharges, and can also be utilized for socio-economic purposes. Improper management and over-utilization of natural resources in the watershed can lead to damage and criticality of the surrounding area. As is the case with the Poleang watershed, due to population growth and activities to fulfill economic needs, it is able to change the function of forests in the Poleang watershed area to other uses that can reduce the quality of the Poleang watershed, therefore monitoring and evaluating watershed management performance is needed. Watershed monitoring and evaluation is carried out to assess watershed support capacity based on the watershed monitoring and evaluation method according to Regulation of the Minister of Forestry of the Republic of Indonesia No. P.61/MENHUT-II/2014. In this study, the performance of the Poleang watershed was analyzed by assessing the performance of the watershed based on its socio-economic carrying capacity. Based on the results of the analysis of socio-economic carrying capacity parameters, it was found that social criteria in the form of population pressure on agricultural areas were in the high category, from economic criteria it was found that the population welfare index was in moderate condition, and institutions through the existence and enforcement of laws in the good category. Based on the assessment of the condition of these three criteria, the socio-economic carrying capacity of the Poleang watershed is in the good category with a value of 83.75. which means that the socio-economic conditions of the community are classified as good with the current condition of the Poleang watershed.

1. INTRODUCTION

Watershed commonly abbreviated as DAS is a combination of river and land areas that have a function as a reservoir and storage of water and drain rainwater either to the lake or to the sea that occurs on its own [1]. According to Beruntu et al. [2], watershed (DAS) is the area of life of living things in the area, meaning that watersheds are utilized by various activities in supporting the basic needs of living things, therefore with the increase in the number of living things in an area, the need for natural resources continues to increase. Watershed which is seen as a water system ecosystem [3] or hydrological study unit [4, 5] and positive interactions between agroforestry components [6].

Human efforts in managing watersheds (DAS) are an intermediary in the mutual relationship between humans and natural resources and the various activities that exist in it [3] The watershed is an intermediary in the reciprocal relationship between humans and natural resources and the various activities in it [3], whose performance can be optimized in terms of water management, land use, and socio-economics and institutions [7]. Watershed management in principle optimizes the use of land for various interests in a rational manner [8, 9]. Especially in developing countries, watershed management will be a very useful technology in development [10]. In addition, watershed management is a technology that is processed and used to improve poor management [11].

According to Anggraeni et al. [12] in monitoring various activities in the watershed area and preventing poor management, as well as regulating the load by pollution carried out by living things, it is necessary to assess the criteria for water quantity, quality and continuity. Meanwhile, appropriate watershed classification is based on the state of the region as well as the quality, quantity and continuity of water, socio-economic, water building investment and spatial utilization area [13]. Meanwhile, according to Aini et al. [14] the shift of economic activities of the community, especially those who work in the agricultural sector to the industrial, trade and service sectors, is evident throughout the watershed area.

Watersheds are very useful for the community in maintaining water availability. The availability of water for the community is very important, both for the needs of drinking water, washing, and bathing and for livelihood needs such as

farmers, planters, farmers and ranchers. All of them need sufficient water. The Poleang watershed area of Southeast Sulawesi Province is an opportunity for most people to improve social and economic welfare by utilizing the potential of available natural resources. There are three areas of the Poleang watershed in Southeast Sulawesi Province, namely Bombana, Kolaka and East Kolaka. The existence of the watershed can help the surrounding community in fulfilling every need of life and encourage the improvement of socio-economic and welfare. Syaf et al. [15] stated that changes in activities carried out by the Poleang watershed community caused various problems, namely changes in its utilization, such as the opening of mining areas, use for agricultural land areas, opening new settlements, and other land function changes.

As an area with hydrological functions to drain water, conservation areas, drain water gradually, maintain water quality and reduce mass discharges, as well as being utilized for socio- economic interests, the quality of the watershed is very important to maintain its sustainability, therefore to monitor watershed performance, it is necessary to monitor and evaluate the carrying capacity of the watershed in carrying out its functions. Especially in the socio-economic support capacity because for the surrounding community, the Poleang watershed is an opportunity to fulfill the needs of their socio-economic life.

Based on the description above, it is very important to assess the performance of the Poleang watershed, so the purpose of this study is to assess the Sosail Support Capacity of the Poleang watershed economy of Southeast Sulawesi Province in providing environmental services. The assessment of Supportability is based on Government Regulation No. 04 of 2009 [16], which states that the three benchmarks are on the social parameter, namely: (1) concern from oneself; (2) community involvement; and (3) population pressure. Meanwhile, there are four benchmarks seen in the economic parameters, namely: (1) human dependence on agricultural land, (2) the level of community income, (3) the level of land productivity, and (4) environmental services.

Assessment of the socio-economic carrying capacity of the Poleang watershed was carried out [13]. The criteria analyzed were Social, Economic and Institutional, with sub-criteria of community pressure on agricultural land, level of community welfare, and Existence and Enforcement of Regulations, which were then used to determine the classification of Watershed Supportability in Poleang watershed.

2. METHODS

2.1 Location and time of research

This study was conducted in the Poleang watershed area of Southeast Sulawesi Province, which covers three districts: Bombana, Kolaka and East Kolaka. Overall, the Poleang watershed has an area of 108,830.42 ha. Based on information obtained through the research of Syaf et al. [15], it is known that the largest area of Poleang watershed is in the administration of Bombana Regency with an area of 72,027.20 ha, the area in the administration of Kolaka Regency is 18,487.03 ha and in East Kolaka Regency is 18,316.19 ha. This research was conducted from April to September 2022.

2.2 Data collection and analysis methods

This research is guided by the watershed monitoring and evaluation method [13]. The data collected starts from the survey and desk analysis stages, where the data consists of primary and secondary data. Primary data was obtained through surveys and interviews with resource persons while secondary data from related agencies such as BPS, DLHK, BPDAS, and DPU data [17, 18]. Secondary data in the form of Poleang watershed land area, agricultural land area, and total population in each administrative area passed by the Poleang watershed.

In supporting watershed performance analysis activities, several variables are needed, including population, poor families, number of farmer households, number of poor households, number of all households and agricultural area as well as regulations regarding watersheds, land conversion, and availability of environmental services. The criteria, sub-criteria, and benchmarks used are presented in Table 1.

2.3 Monitoring and evaluation of socio-economic conditions

Monitoring activities continued at the initial evaluation stage of socio-economic conditions in the watershed area are based on Regulation of the Minister of Forestry of the Republic of Indonesia NO. P.61/MENHUT-II/2014 [13]. Based on the social criteria and economic criteria carried out, the weight of the role and influence of watershed carrying capacity conditions is 100, where community pressure weighs 50, community welfare has a weight of 35 and the existence and enforcement of regulations has a weight of 15.

2.4 Community pressure

The criteria for community pressure based on the land availability index (LAI) is a comparison of the area of agricultural areas with the total number of farmer households in the watershed. The calculation of community pressure is presented in Table 2.

2.5 Community welfare index

The level of community welfare is based on the ratio (percentage) of poor households to the total number of households in the watershed area. The calculation of the level of community welfare can be seen in Table 3 below.

2.6 Existence and enforcement of regulations

The criteria used in the existence and enforcement of regulations in monitoring and evaluating the carrying capacity of watersheds are based on the presence or absence of regulations and institutions owned by the community in the watershed area. The criteria used are seen in Table 4.

2.7 Watershed deliverability assessment

Based on the results of the criteria assessment by weighting, a classification is made based on the total score. Comparison of values with the classification of watershed carrying capacity (DDD) is presented in Table 5.

Table 1. Criteria, sub-criteria, and parameters for assessing the performance of a watershed based on socio-economic carrying capacity [13]

Criteria	Sub Criteria	Parameters
Social	Community Pressure	Community Pressure is measured by the Land Availability Index (LAI), where: $$LAI = \frac{Farmland\ area\ (A)}{Number\ of\ farmer\ households}$$
Economic	Community Welfare Level	The level of community welfare is measured by the percentage ratio of the total number of poor families to the total number of families in the watershed
Institutional	Existence and Enforcement of Regulations	The existence or absence of community regulations related to conservation in the watershed

Source: Regulation of the Minister of Forestry of the Republic of Indonesia: P.61/Menhut-II/2014 [13].

Table 2. Sub criteria, parameter, value, class and the score of community pressure

Sub Criteria	Parameters	Value	Class	Score
Community Pressure	LAI $= \frac{Farmland\ area\ (A)}{Number\ of\ farmer\ households}$	LAI > 40	ST	0.5
		2.0< LAI ≤4.0	T	0.75
		1.0< LAI ≤2.0	S	1
		0.5< LAI ≤1.0	R	1.25
		LAI ≤0.5	SR	1.5

Description: ST = Very High, T = High, S = Medium, R = Low, SR = Very Low, LAI = Land Availability Index.

Table 3. Community welfare sub-criteria, parameters, values, classes, and scores

Sub Criteria	Parameters	Value	Class	Score
Level of Community Welfare (LCW)	$LCW = \frac{Number\ of\ Poor\ Households}{Total\ number\ of\ households} \times 100\%$	LCW ≤ 5	SB	0.5
		5< LCW ≤10	Ba	0.75
		10< LCW ≤20	S	1
		20< LCW ≤30	Br	1.25
		LCW > 30	SB	1.5

Description: SB = Very Good, Ba = Good, S =Medium, Br = Poor, SB = Very Poor.

Table 4. Sub-criteria, parameters, values, classes and scores of existence and enforcement of regulations

Sub Criteria	Parameters	Value	Class	Score
Existence and Enforcement of Regulations	The presence or absence of regulations and institutions owned by the community in the watershed area	Existing, widely practiced	SB	0.5
		Existing, limited practice	Ba	0.75
		Existing, not practiced	S	1
		No regulation	Ma'am	1.25
		There is regulation but it is counter-conservation	SB	1.5

Description: SB = Very Good, Ba = Good, S = Medium, Br = Poor, SB = Very Poor.

Table 5. Comparison of values with watershed carrying capacity classes (DDD)

No.	Value	Class
1	DDD ≤ 70	SB
2	70< DDD ≤90	Ba
3	90< DDD ≤110	S
4	110< DDD ≤130	Bu
5	DDD > 130	SB

Source: Regulation of the Minister of Forestry of the Republic of Indonesia No: P.61/Menhut-II/2014 [13]
Description: SB = Very Good, Ba = Good, S = Medium, Br = Low, SB = Very Low.

3. RESULT AND DISCUSSION

3.1 Assessment of Poleang watershed carrying capacity based on community pressure levels

The Poleang watershed area of Southeast Sulawesi Province has community pressure in the use of agricultural land in the high category, meaning that community pressure on the land exceeds the upper limit of land capability, making the carrying capacity of the land low. This situation arises because each community organizes the expansion of agricultural areas because the productivity of their agricultural areas cannot meet their basic needs. The ratio between the total number of farmers, the total number of people and the growth rate of the community and the agricultural area is no longer balanced. Community pressure that falls into the high category will cause environmental imbalance and disrupt the surrounding ecosystem. For more details, it is presented in Table 6.

In general, high and low population pressure on land in a watershed area is influenced by several factors, including the

high rate of community growth, limited agricultural land cultivated by the community, land management that is not maximized, and spatial plans have not been implemented properly and responsibly. Communities in managing land, there are often some problems between them such as those related to development, where people want to continue to build but without realizing it will be related to the carrying capacity of the land which of course will be a problem [19, 20]. The level of community density in the Poleang watershed of Southeast Sulawesi Province can be used to measure community pressure on the existence of natural resource management. Poleang watershed of Southeast Sulawesi Province covers an area of 108,830.42 hectares with a total population of 51,940 inhabitants, and it has a density level of 2.10 Ha/inhabitant. Based on the sub-criteria, weights, and values and classification of population pressure is at a weight of 50, a value between 2.0<IKL<4.0, in the high class with a score of 0.75. This value shows that there is an imbalance between the amount of agricultural land and the total population in the Poleang watershed area as a whole, one of the causes is the increasing demand for land for non-agricultural purposes due to higher population growth causing land conversion from agricultural land to non-agricultural land. High pressure on land can cause vulnerability to food security and can reduce the ability of agricultural land [20].

3.2 Assessment of Poleang watershed carrying capacity based on community welfare level (TPM)

The level of community welfare in the Poleang watershed of Southeast Sulawesi based on the ratio of the poor and the total population can be seen in Table 7.

The total number of poor people in the Poleang watershed area of Southeast Sulawesi Province reached 6,991 people with a total population of 51,940. Thus, the classification of the index of the level of community welfare in the Poleang

watershed of Southeast Sulawesi Province reached 14.47 so that it is included in the value between 10 <KP<20, which is in the medium category and a score of 1. Law No. 11 of 2009 explains that a prosperous society is those whose material, religious and social needs are fulfilled as citizens so that they have a decent life and can develop themselves to carry out their social functions. The level of community welfare through a two-way approach, namely first looking at the ratio of poor families and the second by looking at the average level of community per capita per year is the ratio of the ratio of the amount of income a year to the total community [7]. One of the benefits of watershed management is community welfare, where there must be alignment between economic development activities and environmental protection, so as to achieve sustainable watershed development for better utilization of natural resources.

3.3 Assessment of Poleang watershed carrying capacity based on the existence and enforcement of regulations

Based on the results of the field survey, it is known that there are rules related to conservation in the watershed area formed by local communities and village governments only in Kabupaten Bombana, which are rules agreed upon only verbally by the community and local village officials such as the prohibition of throwing garbage in the river, fishing in the river using poison and the prohibition of clearing land around the embankment. These rules have been in place since 1990. Meanwhile, in Kolaka Regency and East Kolaka Regency, there are none. For more details, see Table 8 below.

Table 8 shows that in general the existence and enforcement of rules have been carried out even though the practice is still limited. Based on the classification of rule enforcement in the Poleang watershed, Southeast Sulawesi Province is in the Good category and has a score of 0.75.

Table 6. Community pressure on agricultural land by sub-district in the Poleang watershed area of Southeast Sulawesi Province in 2022

District	Total Population (People)	Watershed Land Area	Value	TP Parameters	Category
Bombana	40,177	72,027.20	1.79	1.0<TP ≤2.0	Medium
Kolaka	6,534	18,487.03	2.83	2.0<TP ≤4.0	High
East Kolaka	5,229	18,316.19	3.50	2.0<TP ≤4.0	High
Total	51,940	108,830.42	2.10	2.10	High

Source: Primary Data Processed, 2022.

Table 7. The level of community welfare in the Poleang watershed of Southeast Sulawesi based on the ratio of poor people and total population

No.	District	Total Population (People)	Number of Poor People (People)	TKP Indeks	TPK Parameters	Category
1	Bombana	40,177	5,219	12.99	10<TP ≤20	Medium
2	Kolaka	6,534	906	13.87	10<TP ≤20	Medium
3	East Kolaka	5,229	866	16.56	10<TP ≤20	Medium
	Total	51,940	6,991	14.47	10<TP ≤20	Medium

Source: Primary Data Processed, 2022.

Table 8. Existence and enforcement of regulations in the Poleang watershed, Southeast Sulawesi

No.	District	Value	Category	Score
1	Bombana	Existing, limited practice	Good	0.75
2	Kolaka	Not Existing	Low	1.25
3	East Kolaka	Not Existing	Low	1.25

Source: Primary Data Processed, 2022.

Table 9. Assessment of social and economic carrying capacity of Poleang watershed Southeast Sulawesi

No.	Variable/Parameter	Weight Parameter	Score Parameters	Class	Value (Weight*Score)
1	Community Pressure	50	0.75	High	37.5
2	Community Welfare Index	35	1	Medium	35
3	Existence and Enforcement of Regulation	15	0.75	Good	11.25
	Total				83.75

Source: Primary Data Processed, 2022.
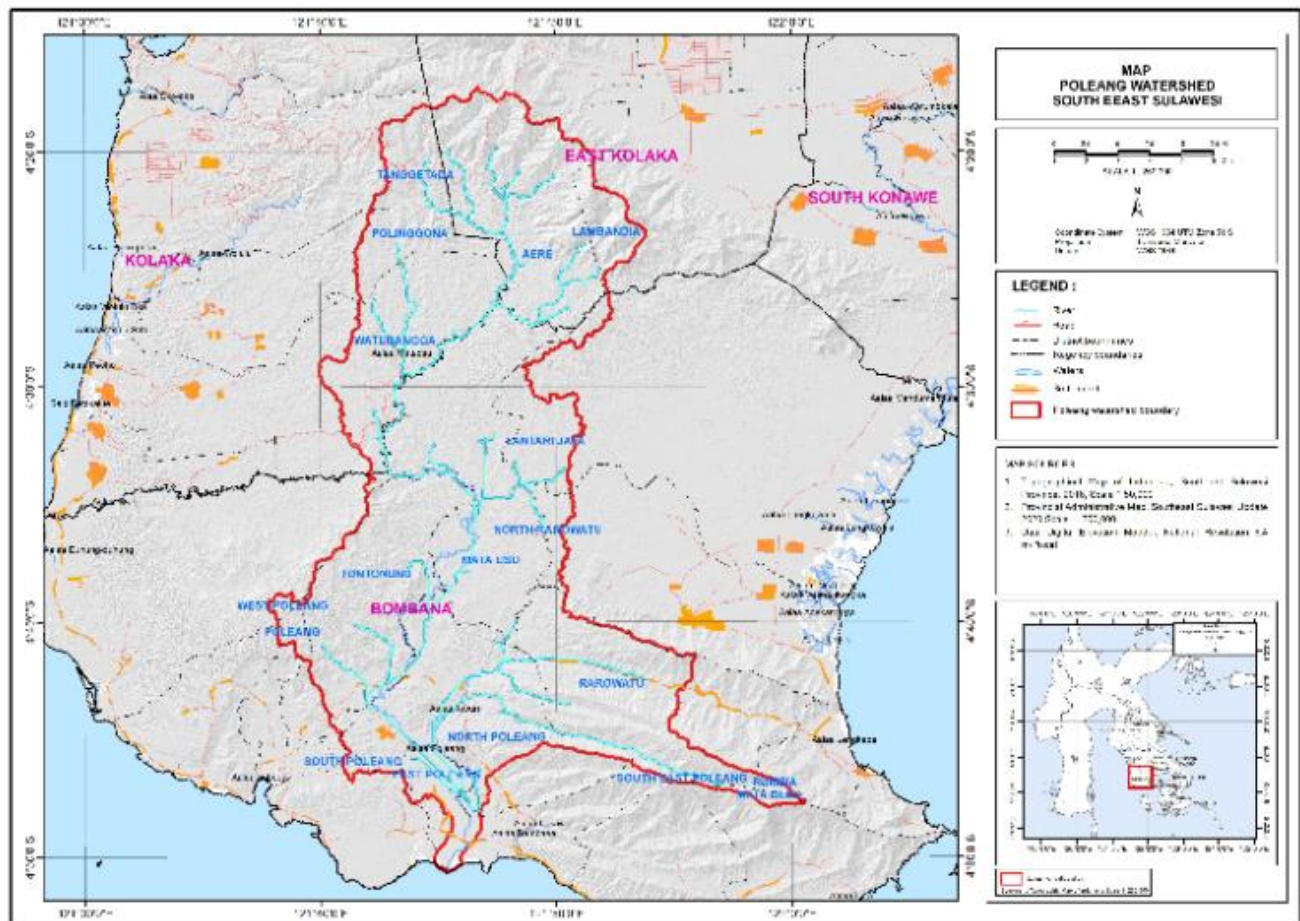
Figure 1. Map of Poelang watershed area of Southeast Sulawesi

3.4 Socioeconomic support capacity of watershed

Assessment of the carrying capacity of the watershed (DDD) is based on indicators of Socio-Economic (Sosek) of the watershed with the accumulated value of each social and economic parameter. The acquisition of the Poleang watershed socio-economic value is presented in Table 9.

Table 9 shows that the value obtained on the carrying capacity of the socio-economic conditions of the Poleang watershed is 83.75. This value is in the category 70 < DDD ≤ 90, which means that the socio-economic conditions of the community are classified as good. The decline in the carrying capacity of community land can be overcome in various ways, namely land conversion, land intensification, and land conservation.

Land conversion is changing the variety of land use towards small and large businesses that are more profitable but must be in accordance with the region, by choosing crops that have good/high economic value (to reduce the minimum area of the area to live properly). Land intensification, namely using the latest technology on farms that are being cultivated by doing land intensification, the ability of an area to support people's lives commonly called the carrying capacity of the land, can change for the better. Land conservation is an effort to prevent land degradation and surface runoff. This condition occurs if each individual expands agricultural land because the productivity of agricultural land is no longer able to meet the basic needs of life. The ratio between the total number of farmers, the total number of people, and the growth rate of society with the area of agricultural areas is not balanced. Land intensification and extensification can be done to increase the production of agricultural commodities while still paying attention to soil and water regulations [21] (Figure 1).

4. CONCLUSIONS

This study concludes that the socio-economic conditions of the Poleang watershed of Southeast Sulawesi Province, community pressure on agricultural land which is classified in the very high category. The population welfare index is in the medium category and the existence and law enforcement criteria are in the good category, so the carrying capacity for the Poleang watershed is in the good category with a value of

83.75. From the socio-economic aspect, the carrying capacity of the Poleang watershed is in a condition where it is able to provide functions both hydrologically and as a provider of environmental services, but it should be noted that the condition of agricultural land pressure due to population growth and conversion of agricultural land, one of the things that can be done is to optimize the economic potential of the agricultural sector and create jobs in the agricultural sector by involving the government and related stakeholders.

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