Study of environmental carrying capacity in Pemalang Regency

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Abstract. To achieve sustainable development goals, the environment is one of the aspects that is taken into account. Environmental problems such as population growth, changes in land use, climate change lead to a decrease in the carrying capacity of the environment for the community. Pemalang Regency is included in the administrative area of Central Java Province, Indonesia. This writing aims to determine the extent of the Environmental Carrying Capacity in Pemalang Regency in the sector of water resources and land availability, as well as the resilience of the Environmental Carrying Capacity to the projected population growth in Pemalang Regency. This study found that the water resources sector has deficit since the first year of projected population growth in 2020. While in the land availability sector, it was found that the surplus condition occurred in the first year of projected population growth from 2020 to 2022

Keywords: Environmental Carrying Capacity, Water Carrying Capacity, Land Carrying Capacity.

1.Introduction

In Law no. 32 of 2009 concerning Environmental Protection and Management, every regional spatial planning must be based on a Strategic Environmental Study and determined by taking into account the carrying capacity and capacity of the environment with KLHS, RPPLH and utilization of natural resources.

The carrying capacity of the environment includes the carrying capacity of land and the carrying capacity of water. The carrying capacity of land and carrying capacity of water according to Muta'ali (2014) is basically a comparison of availability and demand or demand and supply. Environmental carrying capacity of each region will have different capabilities that are influenced by the conditions and characteristics of the resources in the relevant expanse of space. While the capacity of natural resources depends on the ability, availability, and need for land and water, so that the determination of Environmental Carrying Capacity is determined based on 3 (three) approaches, namely:

a) Land capability for spatial use allocation.
b) Comparison between supply and demand for land.
c) Comparison between supply and demand for water.

If the supply > demand, the component's carrying capacity is declared surplus and if supply < demand, the component's carrying capacity is declared in deficit or exceeded.

Pemalang Regency is one of the areas in Central Java Province, Indonesia. Located between 8° 52' 30" and 7° 20' 11" South Latitude and between 109° 17' 30" - 109° 40' 30" East Longitude. Total area

± 113.885 Ha. Population growth and development in various sectors in Pemalang Regency is very likely to cause a decrease in the carrying capacity of the environment, so that it can threaten the sustainability of human life and other creatures. To avoid this, it is necessary to study the carrying capacity of the environment in Pemalang Regency, with the hope that it can be the basis for planning and utilization of natural resources and spatial planning in Pemalang Regency.

Figure 1. Pemalang Regency Map

This writing aims to determine the extent to which the carrying capacity of the environment in Pemalang Regency is in the water resources sector and land availability, as well as the resilience of the environmental carrying capacity of the projected population growth in Pemalang Regency.

2. Methodology

This research was conducted with the coverage of water and land resources in Pemalang Regency. By calculating the availability and demand for water and land resources, then comparing the value between the availability and the need for these two resources. So that it is known how much the carrying capacity value is in Pemalang Regency, as well as the resilience of the Environmental Carrying Capacity to the projected population growth in Pemalang Regency.

2.1. Water carrying capacity

Based on the guidebook for calculating the carrying capacity and carrying capacity of the environment, to determine the availability and demand for water are as follows:

Water Supply :

$C = \Sigma (Ci \times Ai) / \Sigma Ai$

$R = \Sigma Ri / m$

$SA = 10 \times C \times R \times A$

Where :

SA = Water supply (m3/year)
C = Weighted runoff coefficient
Ci = Land use coefficient
Ai = Land use area
R = average annual rainfall (mm/year)
Ri = Annual rainfall at the station i
m = Number of rain observation stations
A = Area (Ha)
10 = Conversion factor of mm.ha to m3.

Water Demand :
DA = N x KHLA

Where :
DA = Total water demand (m3/year)
N = Total population
KHLA = Water needs for a decent life (1600m3/person/year)

2.2. Land carrying capacity

Based on the guidebook for calculating the carrying capacity and carrying capacity of the environment, to determine the availability and demand for water are as follows:

Land Supply. :
SL = (Σ (Pi x Hi) / Hb)) x (1/Ptvb)

Where :
SL = Land supply (Ha)
Pi = Annual commodity productivity (ton)
Hi =Comodity unit price
Hb = Rice unit price / Kg
Pvtb = Rice productivity (ton/Ha)

Land Demand :
DL = N x KHLL

Where :
DL = Land Demand
N = Total population
KHLL = Land area for living per person s a decent living requirement per person divided by local rice productivity, a decent living requirement per person is assumed to be 1 ton of rice/person/year

3. Results

3.1. Runoff coefficient

In the Regulation of the Minister of the Environment No. 17 of 2009 concerning Guidelines for Determining Environmental Carrying Capacity in Spatial Planning, the value of the Runoff Coefficient (C) is determined in table 1

Table 1. Runoff Coefficient.

Surface Description	Runoff Coefficient
City, asphalt road, tile roof	0,7 – 0,9
Industrial area	0,5 – 0,9
Multi-unit settlements, shops	0,6 – 0,7
Housing complex	0,4 - 0,6
Villa	0,3 – 0,5
Garden, cemetary	0,1 – 0,3
Heavy earth yard :	
a. > 7 %	0,25 – 0,35
b. 2 - 7 %	0,18 – 0,22
c. < 2 %	0,13 – 0,17
light earth yard :	
d. > 7 %	0,15 – 0,20
e. 2 - 7 %	0,10 – 0,15
f. < 2 %	0,05 – 0,10
Heavy land	0,40
maedow	0,35
Agricultural cultivation land	0,30
Production forest	0,18

3.2. Land use

Pemalang Regency has an area of 113.885 Ha, consisting of 14 sub-districts and 222 sub-districts and villages. Pemalang Regency is an agricultural area with a percentage of 31.03% of paddy fields. Then the area of land in a row is 24.17% production forest, 24.08% garden, 11.87% settlement, 4.61% protected forest, 2.43% pond, 1.04% river, the rest is conservation land, industry, moor, field and sea. Land use in Pemalang Regency can be seen in table 2

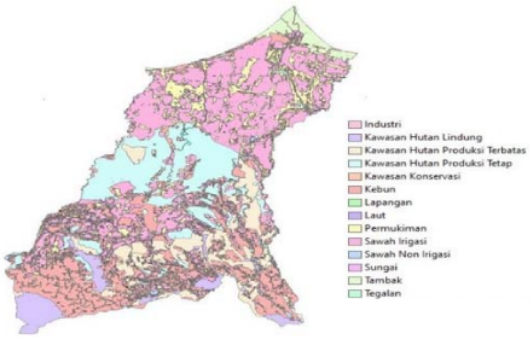

Figure 2. Pemalang Regency Land Use Map

Table 2. Land Use Area

Land Use	Land Area in Ha (Ai)	Run Off Coefficient (Ci)	Ai x Ci
Settlements, city, road	13.519,01	0,90	12.167,11
Industry	174,39	0,90	156,95
Protected forest	5.253,32	0,18	945,60
Production forest	27.529,80	0,18	4.955,36
Conservation land	57,34	0,18	10,32
Kebun	27.427,43	0,25	6.856,86
Tegalan	620,09	0,25	155,02
Irrigated rice field	34.369,31	0,30	10.310,79
Non-irrigated rice field	965,90	0,30	289,68
Field	2,30	0,35	0,81
Tambak	2.771,38	1,00	2.771,38
Rivers	1.189,08	1,00	1.189,08
Sea	5,84	1,00	5,84
	113.884,89		39.814,80
	Weighted runoff coefficient	**Σ (AixCi) / Σ Ai**	**0,3496**

3.3. Population number and projection

Population Projection can be calculated by arithmetic method as follows :

Pn = Po + Ka (Tn-To)

= Po + (P2-P1) / (T2-T1) x (Tn – To)

Where :

Pn = projected population in year n

Po = total population data for the last year
Ka = the average number of population growth
Tn = year of the last population data
To = year of initial population data
P1 = total population data in the initial year
P2 = total population data in the last year
T1 = year of initial population data
T2 = year of the last population data

Based on data from the Central Statistics Agency, the population of Pemalang Regency in 2010 was 1,263,273 people and experienced population growth until 2019 of 1,203,814 people. Can be seen in table 3.

Table 3. Population Number And Projection

Population Data		Projection	
Year	Number of Population	Year	Projected Population
2010	1.263.273	2020	1.307.207
2011	1.269.078	2021	1.311.601
2012	1.277.437	2022	1.315.994
2013	1.279.597	2023	1.320.388
2014	1.284.238	2024	1.324.781
2015	1.288.566	2025	1.329.175
2016	1.292.573	2026	1.333.568
2017	1.296.272	2027	1.337.962
2018	1.299.433	2028	1.342.355
2019	1.302.814	2029	1.346.748

3.4. Rainfall

Pemalang Regency has 19 rainfall monitoring stations. The average amount of rainfall in Pemalang Regency in 2021 is 4,427.1 mm/year. Can be seen in table 4.

Table 4. Rainfall

No	Monitoring Station	Annual Rainfall
1	Kejene	3.516
2	Warungpring	4.166
3	Kecepit	4.400
4	Randudongkal	4.371
5	Nambo	4.434
6	Moga	6.217
7	Pulosari	6.780
8	Belik	7.343
9	Banjardawa	2.622
10	Sungapan	2.811
11	Karangsuci	2.889
12	Klareyan	2.871
13	Karangtengah	2.675
14	Sokowati	2.615
15	Bantarbolang	3.441
16	Pedagung	4.149
17	Watukumpul	6.342

18	Sipedang	5.733
19	Bongas	6.740
	Σ Ri	84.115
	R = Σ Ri	4.427,1

3.5. Comodity productivity

Pemalang Regency has a rice harvest area of 97,558 hectares, with a productivity of 591,584.3 tons/year. So that the productivity of rice is 6.060 kg/ha/year. Based on productivity data for 2021 at the Department of Agriculture. Productivity of other commodities from the highest in a row is pineapple honey 76,628.3 tons/year, corn 62,143 tons/year, mango 20,536 tons/year, broiler chicken 8,390 tons/year, ginger 5,756.2 tons/year, jasmine 5,010,2 tons/year, big chili 4,740 tons/year, shallot 2,432.4 tons/year. The complete productivity of Pemalang Regency commodities can be seen in table 5.

Table 5. ComodityPruductivity

No	Comodity	Production Quantity ton/th (Pi)	Price /ton (Hi)	Pi x Hi
1	Rice	591.584,300	5.000.000	2.957.921.500.000
2	Corn	62.143,000	4.800.000	298.286.400.000
3	Soya bean	365,600	14.000.000	5.118.400.000
4	Cassava	892,000	3.000.000	2.676.000.000
5	Sweet potato	1.763,000	6.000.000	10.578.000.000
6	Peanuts	245,000	28.000.000	6.860.000.000
7	Red onion	2.432,400	28.000.000	68.107.200.000
8	Big chili	4.740,000	46.000.000	218.040.000.000
9	Curly chili	384,000	30.000.000	11.520.000.000
10	Cayenne pepper	562,000	32.000.000	17.984.000.000
11	Durian	1.116,300	30.000.000	33.489.000.000
12	Mango	20.536,000	8.000.000	164.288.000.000
13	Honey pineapple	76.628,600	20.000.000	1.532.572.000.000
14	Beef	1.481,220	125.000.000	185.152.500.000
15	Buffalo meat	26,724	125.000.000	3.340.500.000
16	Lamb (kambing)	1.317,536	120.000.000	158.104.320.000
17	Lamb (domba)	351,216	120.000.000	42.145..920.000
18	Layer chicken	103,414	40.000.000	4.136.560.000
19	Broiler Chicken	8.390,154	40.000.000	335.606.160.000
20	Free-range chicken	2.166,118	80.000.000	173.289.440.000
21	Duck	297,359	60.000.000	17.841.540.000
22	Ginger	5.756,245	20.000.000	115.124.900.000
23	Lime	110,000	10.000.000	1.100.000.000
24	Cardamon	45,283	79.500.000	3.599.998.500
25	Aromatic ginger	26,672	24.000.000	640.128.000
26	Turmeric	188,554	12.000.000	2.262.648.000
27	Galangal	127,632	12.000.000	1.531.584.000
28	Lempuyang	32,578	15.000.000	488.670.000
29	Aloe vera	29,042	4.000.000	116.168.000
30	God crown	277,400	20.000.000	5.548.000.000
31	Noni / mengkudu	24,008	9.000.000	216.072.000
32	Sambiloto	18,000	90.000.000	1.620.000.000
33	Lemongrass	129,870	20.000.000	2.597.000.000

34	Temuireng	21,876	12.000.000	262.512.000
35	Temukunci	19,020	12.000.000	228.240.000
36	Curcuma	22,659	12.000.000	271.908.000
37	Jasmine	5.010,200	40.000.000	200.408.000.000
	Σ (Pi x Hi)			6.583.073.668.500

3.6. Water carrying capacity

Water Supply :

SA = 10 x C x R x A

Water Demand :

DA = N x KHLA

Population projections are calculated based on the latest available population data from 2010 to 2019. Population projection figures can be calculated starting in 2020 for 10 years until 2029. Based on formula, the water carrying capacity of Pemalang Regency based on population projections, it is found that the Pemalang Regency has experienced a deficit since the calculation of the population projection for 2020. Along with the projected population growth, the value of the deficit is getting bigger every year. Can be seen in table 6.

Table 6. Pemalang Regency Water Carrying Capacity Projection

Projection		Water Carrying Capacity		Description
Year	Projected Population	Supply	Demand	
2020	1.307.207	1.762.612.569	2.091.531.200	Defisit
2021	1.311.601	1.762.612.569	2.098.560.000	Defisit
2022	1.315.994	1.762.612.569	2.105.590.400	Defisit
2023	1.320.388	1.762.612.569	2.112.619.200	Defisit
2024	1.324.781	1.762.612.569	2.119.649.600	Defisit
2025	1.329.175	1.762.612.569	2.126.678.400	Defisit
2026	1.333.568	1.762.612.569	2.133.708.800	Defisit
2027	1.337.962	1.762.612.569	2.140.737.600	Defisit
2028	1.342.355	1.762.612.569	2.147.768.000	Defisit
2029	1.346.748	1.762.612.569	2.154.796.800	Defisit

3.7. Land carrying capacity

Land Supply :

SL = (Σ (Pi x Hi) / Hb)) x (1/Ptvb)

Land demand :

DL = N x KHLL

The land carrying capacity of Pemalang Regency based on population projections, it was found that Pemalang Regency experienced a surplus from 2020 to 2022. However, in 2023 the carrying capacity of the land will begin to experience a deficit in line with the projected population growth. And the deficit is increasing every year. Can be seen in table 7.

Tabel 7. ProyeksiDayaDukungLahanKabupatenPemalang

Projection		Land Carrying Capacity		Description
Year	Projected Population	Supply	Demand	
2020	1.307.207	217.263	215.711	Surplus
2021	1.311.601	217.263	216.436	Surplus

2022	1.315.994	217.263	217.161	Surplus
2023	1.320.388	217.263	217.886	Defisit
2024	1.324.781	217.263	218.611	Defisit
2025	1.329.175	217.263	219.336	Defisit
2026	1.333.568	217.263	220.061	Defisit
2027	1.337.962	217.263	220.786	Defisit
2028	1.342.355	217.263	221.511	Defisit
2029	1.346.748	217.263	222.236	Defisit

4. Conclusions

Based on the results of the study, it can be seen that the carrying capacity of the environment in Pemalang Regency based on production data in 2021, spatial planning in the 2018 RTRW and projections from population data until 2019 is known to have experienced a deficit in the water resources sector since the first year of projected population growth in 2020. Meanwhile, in the land availability sector, it was found that the surplus condition occurred in the first year of the projected population growth from 2020 to 2022, while for the following years there would be a deficit condition. These results can be used as a reference for the Pemalang Regency government in making efforts to manage water resources and management in the field of food availability to become even better

5. References

[1] Law No. 26 of 2007 concerning Spatial Planning.
[2] Minister of Environment Regulation No. 17 of 2009 concerning Guidelines for Determining Environmental Carrying Capacity in Spatial Planning
[3] Muta'ali, L (2011). Environmental Carrying Capacity Based on Spatial Planning. Indonesian Journal of Geography, 43 (2), 142-155.
[4] LawNo. 32 of 2009 concerning Environmental Protection and Management.
[5] Meilani (2013). Environmental Carrying Capacity of Rasau Jaya District Based on Land Availability and Needs. Journal of Wetland Environmental Technology, 1 (1).
[6] Guidelines for Determining the carrying capacity and carrying capacity of the environment (2014). Ministry of Environment Deputy 1 for Environmental Management
[7] Admadhani DN, Hajil AHS, Susanawati LD (2014). Analysis of Water Supply and Water Demand for Carrying Cpacity Assessment (Case STudy of Malang). Journal of Natural Resources and Environment, 1 (3), 13-20.
[8] A R Pramesty, Azwa N, A Asripin (2014). Calculation of Environmental Carrying Capacity Based on Water Availability and Land Productivity in TujuhBelas District, Bengkayang Regency. Journal of Wet Environmental Technology, 2(1), 1-10.
[9] Sumberdaya J, Fadilah N, Tunggul A, Haji S, Widiatmono R (2015). Water Balance Model for Carrying Capacity Assessment (Case Study of Batu). Journal of Natural Resources and Environment, 1 (2), 7-13
[10] Dian Hudawan Santoso (2015). Study of Water Carrying Capacity on Bintan Island, Riau Islands Province. Journal of Environmental Science & Technology, 7(1), 01-17.
[11] Pemalang Regency Regulation No. 1 of 2018 concerning the Pemalang Regency Spatial Plan for 2018 – 2038
[12] Ignatius Sriyana (2018). Evaluation of Watershed Carrying Capacity for Watershed Management (a Case Study on Bodri Watershed, Central Java, Indonesia). MATEC Web of Conference, 195, 05003.
[13] Ade Mulawarman (2019). Carrying Capacity of Water and Food Availability in Sukamaju District. LINEARS Journal, 2 (2), 92-99.

[14] Nasrudin (2019). Carrying Capacity of Grompol Watershed Settlements, Central Java. Earth and Environmental Science, 328 (2019) 012072.
[15] K M Maulana, F Lihawa, S Maryati (2020). Analysis of Water Carrying Capacity in Pulubala Sub-Watershed, Gorontalo Regency, Gorontalo Province. Earth and Environmental Science, 575 (2020) 012220.
[16] Muhammad Ma'arijHarfadli (2020). Study of environmental Carrying Capacity and Water Criticality Index Based on Availability Water in Balikpapan City. Presipitasi Journal, (17-3), 253-162.
[17] Central Bureau of Statistic(2022). Pemalangin Numbers
[18] Comodity Production Data at Pemalang Regency Agriculture Office in 2021 (2022).

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