IDENTIFICATION OF WATER CARRYING CAPACITY IN KORPRI JAYA VILLAGE, SUKARAME SUB-DISTRICT, BANDAR LAMPUNG CITY

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Abstract

Water is a natural resource that has a vital role and function to fulfill the basic needs of all living things, especially humans, which need to be maintained. Korpri Jaya Village, Sukarame Sub-District, Bandar Lampung City is an area affected by the development of higher education institutions, namely UIN Raden Intan and the Sumatra Institute of Technology, which is characterized by a growing population and housing needs. There is a potential imbalance between water demand and water availability. Water demand is increasing due to population growth, while water availability is decreasing due to changes in land use and a lack of green open spaces. Even Bandar Lampung City has been identified as being in a state of water deficit based on the Strategic Environmental Assessment (KLHS). Therefore, it is necessary to identify the carrying capacity of water in Korpri Jaya Village. The analysis methods used in this study include a grid system approach and calculations of the environmental service index (IJLH) for water providers, which refer to surface water discharge to determine water carrying capacity. The results showed that Korpri Jaya Village has a water carrying capacity of 465,467 m^3/year. Water carrying capacity is used as a reference point in spatial planning to anticipate potential water deficits in the future, along with increasing population and land use changes.

Keywords: *Water Support Capacity, Korpri Jaya Village*

Introduction

In the development process, each country has a different approach to utilizing natural resources. Two approaches that are often used are anthropocentric and ecocentric. Indonesia, as a developing country, tends to adopt an anthropocentric approach, where humans are positioned as the center of nature (Nash, 1989).

Law No. 26 of 2007 on Spatial Planning emphasizes that spatial planning must consider the carrying capacity of the environment to ensure the sustainability of natural resources. Development that only oriented towards economic growth without paying attention to the environment risks causing ecological crises such as water scarcity. Water resources have a vital role in human life. Population growth in urban areas has led to an increase in water demand and exploitation of natural resources (Virssa & Roh, 2018). Therefore, it is important to consider the preparation of a well-structured spatial planning document so that development aligns with the principles of environmental conservation (Sari, 2020).

Based on Law No. 17 of 2019 concerning Water Resources, water resources management is based on the River Basin by considering the interrelated use of surface water and groundwater and prioritizing the utilization of surface water. Lampung Governor Regulation No. 46 of 2023 concerning Control of Spatial Utilization in the Way Sekampung Watershed,

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which establishes part of Sukarame Sub-district, including Korpri Jaya Village, as part of Control Zone E. This control zone is established due to a high concentration of space utilization that has the potential to exceed the carrying capacity of the environment.

In document of Information on National Water Carrying Capacity 2019, Lampung Province ranks fourth as the province with the highest water demand on the island of Sumatra, at 24,401,586,542.63 m³ per year. Forty percent of the Bandar Lampung City area is dominated by clean water supply services categorized as "very low and low." This indicates that most areas in the city have limited capacity to provide clean water (Tambunan, 2021). This condition is not commensurate with the increasing demand. Based on the Strategic Environmental Assessment (KLHS) of the 2021–2026 Regional Long-Term Development Plan (RPJPD) for Bandar Lampung City, the city is in a state of water deficit, with water demand at 1,932,134.400 m³ per year and water availability at only 1,846,910.400 m³ per year. The water demand in Sukarame District is recorded at 108,619,200 m³ per year. This situation reflects the high pressure on water resources in Bandar Lampung City, including in the Korpri Jaya Village area, which is part of Sukarame District.

Bandar Lampung City Regional Regulation No. 4 of 2021 stipulates Sukarame Sub-district as a center for settlements and higher education zone, namely the UIN Raden Intan and Institut Teknologi Sumatera (ITERA). Based on ITERA's Strategic Plan 2014-2019, the growth number of students and lecturers has increased the need for boarding houses and changes in land use. ITERA is targeted to accommodate up to 64,000 students in the next 25 years. This has an impact on Korpri Jaya Village, especially on housing needs and the potential decrease in water availability.

Korpri Jaya Village has the potential to experience a water crisis due to the imbalance between the need and availability of water resources which tend to be limited. Based on that potential problem, this study raises a fundamental question: "What is the water carrying capacity in Korpri Jaya Village, Sukarame Sub-District, Bandar Lampung City?"

Research Methodology

The provisions for calculating water carrying capacity refer to Guidebook for Determining the Carrying Capacity of the Regional Environment 2019 from Ministry of Environment and Forestry. Explicitly, Decree No. 297/MENLHK/Setjen/PLA.3/4/2019 directs the determination of the carrying capacity based on the performance of environmental services to focus on water availability.

Calculating water availability based on the environmental service index (IJLH) water providers. Basically, the performance of environmental services is a function of landscape parameters, natural vegetation types, and land cover. Where landscape and natural vegetation types are natural characteristics that form ecoregions. Meanwhile, land cover is an economic correction factor for land-based activities. These three parameters specifically have distinct characteristics in each ecoregion, which in this context refers to a single island or archipelago. Therefore, developing this method requires a good understanding of the local area to produce accurate and comprehensive analysis.

This study uses a grid system approach. The grid resolution size is 5" × 5", with each grid cell representing an area of 0.150 km × 0.150 km. The smallest grid resolution size was chosen to obtain more detailed information for research in the Korpri Jaya Village scale.

Research Location

The research location in this study is Korpri Jaya Village, Sukarame District, Bandar Lampung City.

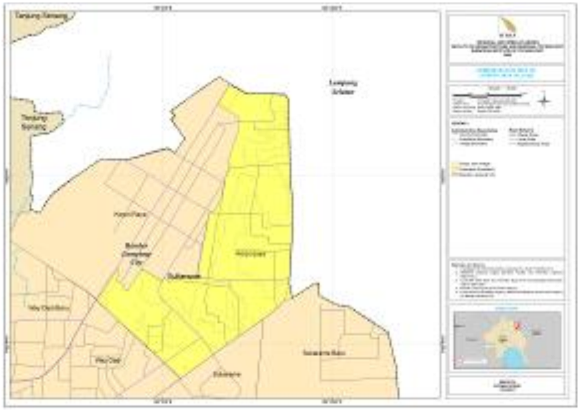

Figure 1. Adminitstrative area map of Korpri Jaya Village

Tools and Materials

The determination of the weight of landscape, natural vegetation type and land cover is based on the role of each parameter in providing water.

Table 2. Parameter Weight Environmental Services Index Water Providers

Parameter Weight Water Regulating Environmental Services Index	Weight
Landscapes	28%
Natural Vegetation	12%
Land cover	60%

Source: Information on National Water Carrying Capacity 2019

The following tables is the score determination for each parameter.

Table 3. Landscapes Score

No	Landscape Typology	Score
1	Lake	5
2	Fluvial Plain of Sumatra	
3	Volcanic Plain of Bukit Barisan Line	4
4	Volcanic Hills of Bukit Barisan Line	
5	Peat Plain of Sumatra	3
6	East Coastal Plain of Sumatra	
7	Structural Plain of Bukit Barisan Line	
8	Structural Mountains of Bukit Barisan Line	
9	Volcanic Mountains of Bukit Barisan Line	
10	Denudational Hills of Bangka Complex Belitung- Natuna	
11	Structural Hills of Riau Islands Complex	
12	Structural Hills of Mentawai Complex	
13	Structural Hills of Bukit Barisan Line	
14	Karst Hills of Sumatra	2

Source: Information on National Water Carrying Capacity 2019

Table 4. Natural Vegetation Score

No	Natural Vegetation Typology	Score
1	Understory dipterocarp forest vegetation	4
2	Understory (non dipterocarp) forest vegetation	
3	Lakeside terna vegetation	
4	Understory ultrabasic rock forest vegetation	3
5	Mountain ultrabasic rock forest vegetation	
6	Coastal forest vegetation	
7	Upper montane forest vegetation	
8	Lower montane forest vegetation	
9	Subalpine forest vegetation	
10	Riparian forest vegetation	
11	Nipah vegetation	
12	Freshwater swamp terna vegetation	
13	Lakeside terna vegetation mountainous	
14	Riverbank terna vegetation	
15	Pamah dryland savanna	2
16	Pamah limestone forest vegetation	
17	Pamah landscape limestone forest vegetation	
18	Mountain limestone forest vegetation in karst landscape	
19	Pamah coral forest vegetation	
20	Brackish water swamp forest vegetation	
21	Brackish riverbank forest vegetation	
22	Brackish water swamp terna vegetation	
23	Brackish riverbank terna vegetation	
24	Peat forest vegetation	1
25	Mangrove vegetation	
26	Peat swamp terna vegetation	

Source: Information on National Water Carrying Capacity 2019

Table 5. Land Cover Score

No	Landscape Typology	Score
1	Water body	5
2	Primary swamp forest	4
3	Swamp	
4	Primary dryland forest	3
5	Secondary swamp forest	
6	Secondary dryland forest	2
7	Dryland farming	
8	Mixed shrub dryland farming	
9	Rice field	
10	Scrub	
11	Swamp scrub	
12	Transmigration	
13	Airport/port	1
14	Primary mangrove forest	
15	Secondary mangrove forest	
16	Plantation forests	
17	Open land	
18	Plantation	
19	Settlement/ Built-up land	
20	Mining	
21	Savannah/ Grassland	
22	Ponds	

Source: Information on National Water Carrying Capacity 2019

These values are used to calculate the environmental services index using the following formula (1).

$$\text{IJLH water providers} = (wba \times sba) + (wveg \times sveg) + (wpl \times spl) \quad (1)$$

where:

IJLH = environmental service index water providers
wba = landscape weight
sba = landscape score
wveg = natural vegetation weight
sveg = natural vegetation score
wpl = land cover weight
spl = land cover score

Figure 2. Environmental services performance index water providers (Information on National Water Carrying Capacity, 2019)

In the process of calculating environmental services index water providers, the tool used is ArcGIS Software, overlaying using geoprocessing tools union. after overlaying landscapes, natural vegetation, land cover and grid maps. Next, do weighting and scoring on each parameter to obtain the value of the environmental services index water providers.

The water regulating environmental service index is presented in the form of a grid which is the total of the polygon water regulating environmental service index. In one grid box there are one or more polygons in the water regulation parameter. For example, the overlay process identifies two polygons in one grid as shown in Figure 3.

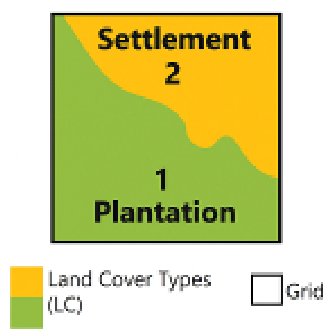

Figure 3. Example of polygon overlay with grid (Information on National Water Carrying Capacity, 2019)

To determine the value of the environmental services index for each polygon and grid, use the following formula (2) & (3).

$$\text{IJLH Polygon} = (\text{Polygon Area})/(\text{Grid Area}) \times \text{IJLH Water Providers} \quad (2)$$

or

$$\text{IJLH Grid} = (\text{Polygon Area})/(\text{Grid Area}) \times \text{IJLH water providers } 1 + n \quad (3)$$

After obtaining the value of the water regulating environmental service index, then find out the water providing environmental service index, by identifying the environmental service index of the watershed area and the availability of surface water in the watershed area on each grid, with the following formula (4).

$$\text{Grid Water Availability} = (\text{IJLH Grid})/(\text{IJLH WAS}) \times \text{Watershed water availability} \quad (4)$$

Where the Grid Water Availability is water regulation environmental service index, IJLH Grid is Grid environmental services index, IJLH WAS is Watershed environmental service index, Watershed Water Availability is Water Availability of Way Sekampung River Basin.

Results and Discussion

Calculation of water availability or water carrying capacity is done through a grid system approach with a resolution of 5“×5”. The use of a grid system is an approach that can present water carrying capacity in the form of spatial information.

Table 4. Grid Numbers

ID Grid								
A7	C9	F7	H7	J2	K2	L2	M3	NS
AB	D10	F8	H8	J3	K3	L3	M4	N6
B10	D7	F9	H9	J4	K4	L4	M5	N7
B6	D8	G10	I10	J5	KS	LS	M6	O4
B7	D9	G6	I6	J6	K6	L6	M7	O5
B8	E10	G7	I7	J7	K7	L7	M8	O6
B9	E7	G8	I8	J8	K8	L8	M9	
C10	E8	G9	I9	J9	K9	L9	N2	
C7	E9	H10	J1	K1	L1	M1	N3	
C8	F10	H6	J10	K10	L10	M2	N4	

The number of grids in Korpri Jaya urban village is 86 grids with grid numbers A7 until O6. The size of one grid box represents an area of 0.150 km × 0.150 km or 2.25 ha.

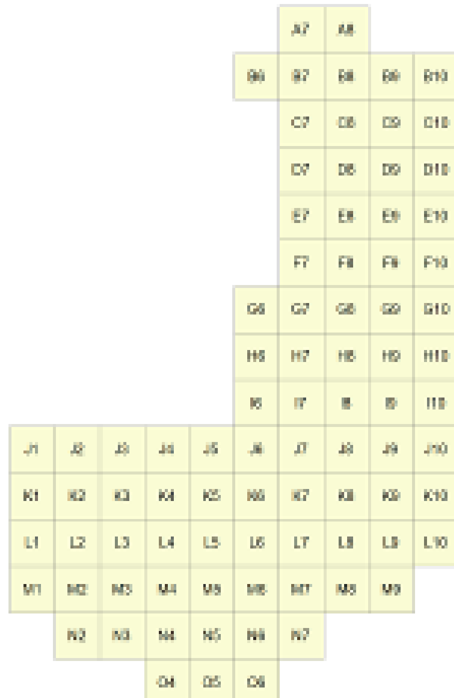

Figure 4. Grid distribution of Korpri Jaya Village

Landscapes

The landscape of Kelurahan Korpri Jaya, which is dominated by undulating volcanic plains with pyroclastic materials, strengthens the water carrying capacity. Materials such as ash, sand and volcanic rock are porous and permeable, effectively absorbing and storing rainwater. The uneven surface structure slows surface flow and increases infiltration. The presence of pamah dipterocarp forests with deep roots and dense crowns also strengthens the hydrological cycle through increased infiltration, reduced runoff and erosion prevention. With a landscape score of 4 and a weight of 20%, this parameter contributes significantly to water carrying capacity.

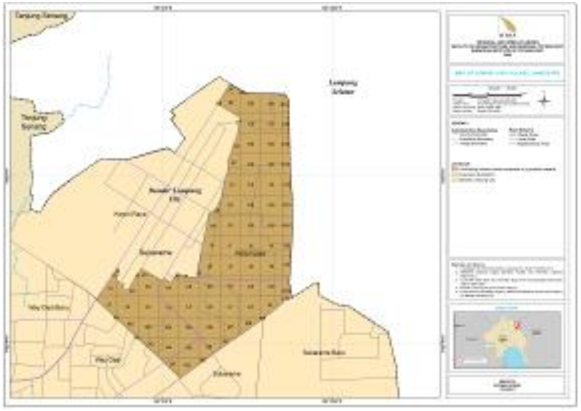

Figure 5. Map of Korpri Jaya Village landscape

Natural Vegetation

The natural vegetation in Kelurahan Korpri Jaya is dominated by pamah dipterocarp forest growing at an altitude of 0-1000 AMSL, with a high canopy and relatively clean forest floor. This type of vegetation contributes significantly to water carrying capacity through increased infiltration, reduced runoff and erosion, and soil stabilization. The dense canopy retains rainfall, while strong roots prevent landslides and sedimentation. Evapotranspiration processes also help maintain moisture and balance the hydrological cycle. With an area of 1.37 km², a score of 4, and a landscape weight of 12% (0.12), this forest is a key element in sustainable water resources management.

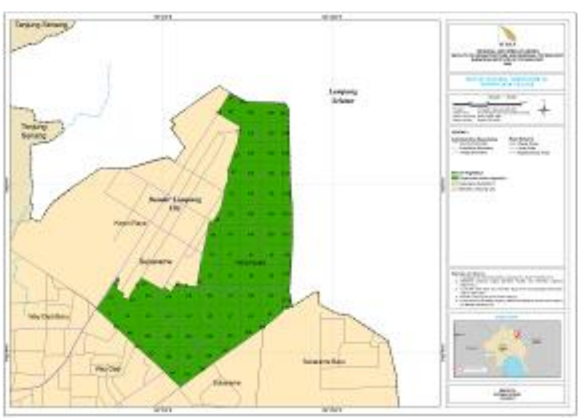

Figure 6. Map of natural vegetation in Korpri Jaya Village

Land Cover

Korpri Jaya Village has three land cover classifications: settlements, open land and paddy fields, with settlements dominating at 1.193 km². This land cover scores 4 with a 60% weighting (0.6), indicating a large influence on water carrying capacity. Land cover influences the hydrological cycle through direct interaction with the soil surface as an infiltration medium. Open land and paddy fields have high permeability that favors water infiltration, while built-up land such as settlements tend to increase runoff and decrease infiltration, potentially causing flooding and reducing groundwater recharge. In addition, land use change and settlement or agricultural activities can degrade water quality. Therefore, land cover composition and management are key factors in maintaining hydrological balance.

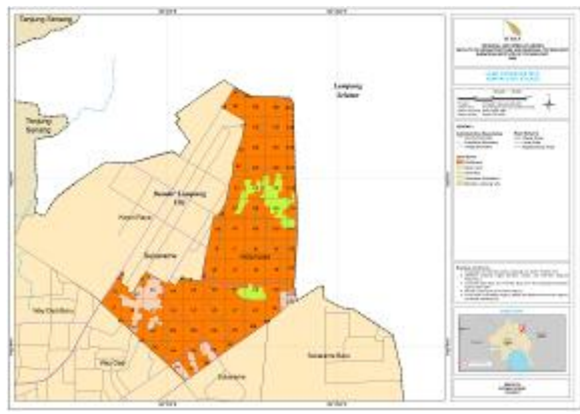

Figure 7. Land cover map of Korpri Jaya Village

Determination of the environmental services index (IJLH) water providers using the formula equation obtained by summing the results of multiplying the weights and scores of each parameter, landscape, natural vegetation and land cover. Example of calculation of environmental services index (IJLH) water provider:

IJLH Water Providers=

$$= (0.28\times4) + (0.12\times4) + (0.60\times1)$$
$$= 2.2$$

The environmental services index (IJLH) water provider presented in the form of a grid is the result of calculations on 3 parameters.

Furthermore, to know the value of IJLH Polygon and IJLH Grid.

Example of polygon IJLH calculation at grid number E8.1:
IJLH Polygon E8.1 = 2.19991/2.25×2.2 = 2.151

Example of IJLH Grid calculation at grid number E8
IJLH Grid E8 = IJLH Polygon E8.1 +IJLH Polygon E8.2
IJLH Grid E8 = 2.15102 + 0.03580
= 2.18682

The results of the calculation of the environmental services index (IJLH) water providers in Korpri Jaya Village show values ranging from 0.014 to 2.631, which are classified as very low to moderate. The highest value is found in grid G9 (2.631). Land cover is the most dominant factor in determining IJLH, with the highest weight of 60%. This shows the importance of green open space to maintain the carrying capacity in regulating water, such as infiltration and periodic release of water. This IJLH value can be used as an indicator of water availability.

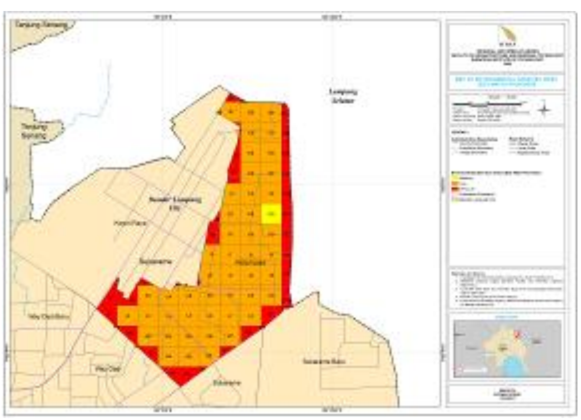

Figure 8. Map of environmental services index (IJLH) water providers

Calculation of grid water availability was carried out by identifying the environmental service index water providers of Bandar Lampung City watershed area. The sum of all environmental service indices as water providers from thousands of grid data within a single Watershed Area (WAS) of Bandar Lampung City, processed using ArcGIS, resulted in an environmental service index (IJLH) value for the WAS, as shown in Figure 4. The obtained IJLH value for the WAS of Bandar Lampung City is 19,224.40. The IJLH value of the WAS is used as a divisor to determine the water availability value in Korpri Jaya Village.

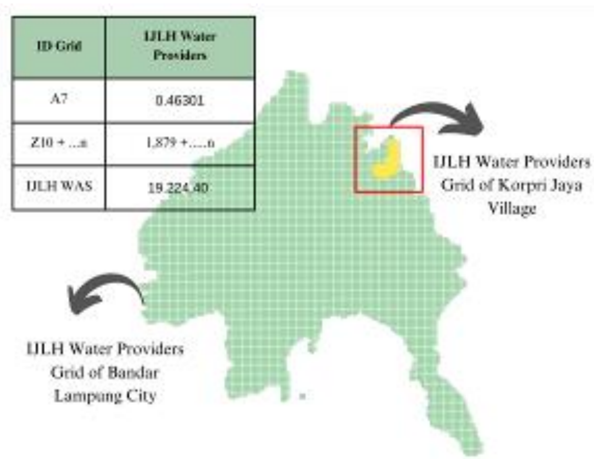

Figure 9. Example of polygon overlay with grid (ArcGIS Processing, 2025)

The value for watershed water availability using the water availability of Way Sekampung River Basin because it is located within the research area at the Korpri Jaya Village. The water availability in the Way Sekampung River Basin is 68,060,000 m^3/year (Way Seputih–Way Sekampung Watershed Management Agency [BPDAS-WSS], 2009).

Example of calculation of Grid Water Availability (G.W.A):
G.W.A A7 = 0.46301/19,224.40 × 68,060,000
= 1,639.19 m3/year

The value of water availability in grid ID A7 is 1,639.19 m3/year, this value is influenced by the environmental services index water providers. The higher the environmental services index (IJLH) grid, the higher the value of water availability on the grid. The results of the calculation of the sum of all water availability in each grid with reference to surface water discharge in the watershed (DAS) in Korpri Jaya Village show that the total water availability in the area reaches 465,466.86 m³ per year.

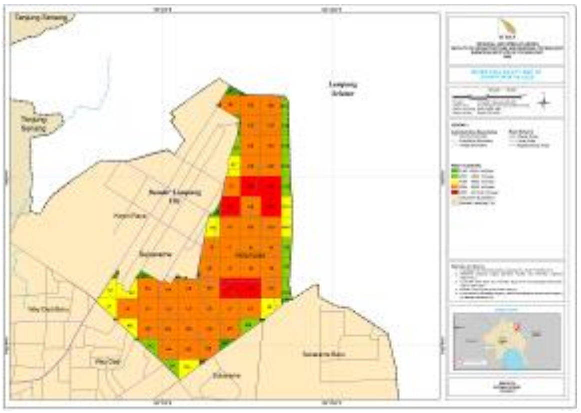

Figure 10. Water availability map of Korpri Jaya Village

This figure reflects the capacity of available water resources and is important information in supporting the spatial planning process. In the context of regional and city planning, this water availability data is one of the main components in determining environmental carrying capacity, which serves to measure the extent to which an area can accommodate development activities without causing damage or degradation of environmental quality. As a reference in the preparation of spatial plans, water carrying capacity information must be used as a basis for determining spatial utilization policies in accordance with the capacity of existing natural resources. This includes the planning of residential areas, industrial areas, educational areas, green open spaces, and other infrastructure that depends on water availability. In addition, this data is also important in the implementation stage, where monitoring and evaluation of spatial utilization must be carried out regularly to ensure that ongoing development remains within the limits of the region's water carrying capacity. Thus, the integration between water carrying capacity and spatial planning policy is crucial in realizing sustainable, environmentally sound and resilient regional development to climate change and future development pressures.

Conclusions

Korpri Jaya Village faces significant challenges related to water carrying and storage capacity. The total available water is approximately 465,466.86 m³ per year. Extensive land-use changes, particularly for residential and economic development, have reduced natural water catchment areas, leading to a decline in water carrying capacity. At the same time, water demand continues to rise, driven by population growth especially among students residing near the Sumatra Institute of Technology (ITERA). These limitations necessitate a more adaptive planning approach to ensure that land use does not exceed the ecosystem's capacity. Spatial utilization must align with efforts to maintain the hydrological cycle by proportionally managing residential, industrial, and open space areas to prevent ecological imbalance and ensure long-term water availability.

Strategic actions in regional and urban planning are required to support sustainable development. This includes strengthening the Regional Spatial Plan (RTRW) by mapping water-carrying capacity to identify and protect catchment areas, as well as integrating thorough Strategic Environmental Assessments and Environmental Impact Assessments. This approach will help to identify and designate critical areas, thereby preventing the overexploitation of regions with low water capacity.

This water carrying capacity calculation that based on Information on National Water Carrying Capacity 2019, only surface water discharge is considered. Calculation for the availability of groundwater sources can be recommendation for future research. Future research can also quantify more details about capacity loss that occurred due to land-use change over time. Continued research about strategic intervention to optimize the water carrying capacity will be great.

Acknowledgement

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References

Government of Bandar Lampung City. (2021). *Regional Regulation of Bandar Lampung City Number 4 of 2021 concerning the Spatial Plan of Bandar Lampung City for 2021–2041.*

Government of Lampung Province. (2023). *Governor of Lampung Regulation Number 46 of 2023 concerning Control of Spatial Utilization in the Way Sekampung Watershed. Bandar Lampung: Government of Lampung Province.*

Indonesia. (2019). Undang-Undang No. 17/ 2019 concerning Water Resources. Jakarta: Pemerintah Republik Indonesia

Institut Teknologi Sumatera. (2013). ITERA's Strategic Plan 2014-2019. Lampung Selatan: ITERA

Ministry of Environment and Forestry (Directorate of Environmental Impact Prevention for Regional and Sectoral Policies). (2019). Guidebook for Determining the Carrying Capacity of the Regional Environment**.** Jakarta: Kementrian KLHK

Ministry of Environment and Forestry. (2019). Decree No. 297/MENLHK/Setjen/PLA.3/4/2019 about National Water Carrying Capacity. Jakarta: Kementrian KLHK

Ministry of Environment and Forestry. (2019). Information on National Water Carrying Capacity. Jakarta: Kementrian KLHK

Nash, Roderick Frazier. (1989). *The Rights of Nature: A History of Environmental Ethics*. Madison, WI: University of Wisconsin Press. 290 hlm. ISBN 0299118401.

Planning Agency of Forest Area Consolidation and Environmental XX, Bandar Lampung City. (2025). SHP of Landscape, SHP of Natural Vegetation, and SHP of Land Cover. Bandar Lampung: BPKHTL

Sari, D. (2020). *Sustainable Development and Regional Spatial Planning*. *Journal of Environmental Development*, 15(2), 45–52.

Strategic Environmental Assessment (KLHS) of the 2021–2026 Regional Long-Term Development Plan (RPJPD) for Bandar Lampung City. Pemerintah Kota Bandar Lampung

Tambunan, S. E. (2022). Identification of environmental carrying capacity based on environmental service functions to support clean water availability in Bandar Lampung City. *Undergraduate Thesis*. Institut Teknologi Sumatera

Virssa, N. & Roh, A. (2018). Study of Water Demand and Availability in Urban Area Development. Journal of Planology, 12(1), 30–38

Way Seputih–Way Sekampung Watershed Management Agency. (2025). *Interview* *with staff BPDAS-WSS* on the Characteristics of the Way Sekampung Sub-watershed. Bandar Lampung: BPDAS-WSS