Formosa Journal of Science and Technology (FJST)
Vol. 4, No. 7, 2025: 2117-2132

Spatial Study of Land and Environmental Capacity for Industrial Development in Widodaren District

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A R T I C L E I N F O
Keywords: Land Carrying Capacity, Environmental Carrying Capacity, Industrial Estate

Received : 14, June
Revised : 28, June
Accepted: 30, July

A B S T R A C T
Widodaren District is oriented as an industrial area based on the results of a coordination meeting on the plan to develop the Widodaren Industrial Estate in East Java Province by the Director General of the Ministry of Agriculture and Land Planning/National Land Agency on July 1, 2021. The Industrial Estate covers an area of 1,079.61 Ha in Widodaen District spread over Widodaren 508, 73 Ha, Walikukun 69.31 Ha, Sidolaju 299.21 Ha, and Karangbanyu 202.22 Ha. This study aims to determine the carrying capacity of land and the environment in the development of the Widodaren Industrial Estate. The method used in this research is spatial analysis with Overlay Union analysis technique. Data collection methods used are observation, agency survey, and literature study. The results obtained from the research are the carrying capacity of land and the environment from the calculation of DDLi is 4.51 Ha or DDLi with SL > DL which means a surplus of industrial land.

DOI prefix: https://doi.org/10.55927/fjst.v4i7.183
ISSN-E: 2964-6804
https://traformosapublisher.org/index.php/fjst

INTRODUCTION

The population of Widodaren District in 2020 was 76,024 people with a population density of 798.64 people/km². Land use in 2020 was in the form of 3186.12 hectares (36%) of built land and 5656.08 hectares (64%) of undeveloped land. Ngawi Regency Regional Regulation No. 10 of 2011 concerning the Spatial Plan of Ngawi Regency for 2010-2020, Widodaren District is directed to become a Local Activity Center (PKL) with a spatial pattern plan in the form of forestry, livestock, industry, transportation, mining, defense and security.

Results of the Coordination Meeting of the Widodaren Industrial Estate Development Plan in East Java Province by the Directorate General of the Ministry of Agrarian and Spatial Planning/National Land Agency on July 1, 2021. The industrial estate in Widodaren District has an area of 1079.61 Ha, which is located in Widodaren Village 508.73 Ha (47%), Walikukun 69.31 Ha (6%), Sidolaju 299.21 Ha (27%) and Karangbanyu 202.22 Ha (18%). In carrying out its activities, the industry urgently needs land to establish factories and supporting facilities. If land is not used according to its capacity, pollution, damage and loss will inevitably occur (Sari et al., 2021). A comparison between land needs and land capabilities called land carrying capacity (Kandiawan et al., 2017). In determining industrial areas, the basis for development is efficiency, spatial planning and the environment (Cahyadi et al., 2018).

Large-scale industries are also important to consider because this type of industry is regulated to be located in an industrial area. This is contained in Government Regulation Number 24 of 2009 concerning industrial estates, therefore in this study it aims to find out how the carrying capacity of the land and environment in the research area. Efforts to ensure the sustainability of future development in integrating environmental interests at the level of strategic decision-making (Azizah et al., 2019), because land use that is not in accordance with its carrying capacity can cause pollution, environmental damage, disasters and losses (Oktorianti et.al, 2014) and disruption of urban planning (Hutomo & Rahayu, 2013).

THEORETICAL REVIEW

Land Carrying Capacity is the ability of a specific area of land to support human life and activities sustainably, considering the availability of natural resources, environmental constraints, land use, and ecological balance. It helps in planning and managing land use to prevent overexploitation and ensure long-term sustainability.

METHODOLOGY

The approach used to determine the carrying capacity of the land and the environment of industrial estates is a spatial approach with a geographic information system (GIS). The ability of land for industrial activities can be determined by using the map overlay method with the Overlay Union technique, while to find out the land use is carried out by interpreting the 2018 Bingmap image using Arcgis 10.4 software There are 5 maps that are overlaid to see the carrying capacity of the land, namely, slope maps, soil type maps, rainfall maps, disaster-prone maps, and land capability maps.

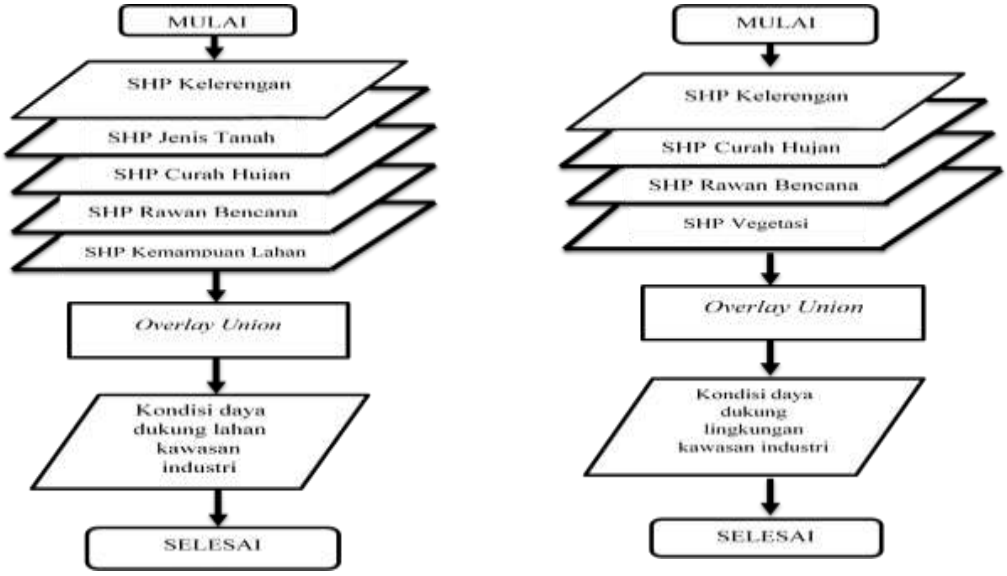

Figure 1. Flow Framework for Land Carrying Capacity and Industrial Estate Environment Analysis
Source : Analysis, 2022

The carrying capacity of the industrial estate environment uses the spatial analysis method with the union overlay technique, there are 4 maps that are overlayed, namely slope maps, rainfall maps, disaster-prone maps and vegetation maps.

To find out the magnitude of the need for large industrial land, it was carried out with an interpretation approach to the use of land with a bingmap image in 2018. The results of the interpretation were then validated through a field survey and confirmed by the Regional Planning and Development Agency (BAPPEDA) Spatial Pattern Plan Map. Land ability data and land use for industrial activities will be compared to see the carrying capacity of the land. Based on the attachment to the Regulation of the Minister of Environment No.17 of 2009 concerning Guidelines for Determining Environmental Carrying Capacity, the carrying capacity of the land is simply formulated as follows (Muta'ali, 2012) Equation (1).

Formula :

$$DDLi = SLi/DLi \quad (1)$$

Information:

DDLi = Land carrying capacity for industry
SLi = Supply of Land for industry
DLi = Land Need for Industry

Based on the above formulation, it can be interpreted as follows (Muta'ali, 2015):

1. DDLi > 1, meaning SLi > DLi, then the potential of land for existing industries has been able to support the land needs for industry. The DDLi value > 1, can be interpreted as a surplus of industrial land.

2. DDLi < 1, meaning SLi < DLi, the existence of potential land for industry is not able to support the needs of industrial land, or there has been a shortage of space for industry so that additional land is needed that can be calculated by reducing the availability with the need for industrial land.

RESULTS AND DISCUSSION

This research contains about the physical condition of industrial estates, the carrying capacity of industrial estates, and the environmental carrying capacity of industrial estates, as follows:

Physical Condition of Industrial Estate

The physical condition in the Widodaren District Industrial Estate uses a quantitative descriptive method between the variables of slope, soil type, rainfall, disaster prone, land ability, and vegetation.

Slope

Secondary data, the slope slope in the Industrial Estate in Widodaren District varies, at a slope of 0 – 8 % means flat, a slope of 8 – 15 % means slope, and a slope of 15 – 25 % means steep. The slope < 8% covers an area of 686.47 Ha, the slope is 8-15% covers an area of 385.12 Ha, and the slope is 15 – 25% with an area of 8.03. The data on industrial estate slopes is described in Table 1.

Tabel 1. Widodaren District Industrial Estate Slopes in 2022

No	Village	Broad (Ha)		
		0 - 8 %	**8 - 15%**	**15 - 25 %**
1	Village Karangbanyu	178,95	31,86	0,31
2	Village Sidolaju	239,07	50,71	0,02
3	Village Walikukun	24,01	47,86	0
4	Village Widodaren	244,44	254,69	7,70
	TOTAL	**686,47**	**385,12**	**8,03**

Source : SRTM Image in 2022

Figure 2. Map of Widodaren District Industrial Estate Slopes in 2022 Source : SRTM Image in 2022

Figure 2 has the most suitable classification to be used as an industrial estate, namely the classification of 0 – 8% with a total area of 686.47 Ha. The use of this classification aims to minimize the occurrence of landslides in industrial estates because they are located in sloping areas.

Soil type

Data on the type of industrial estate in Widodaren District consists of alluvial soil type with an area of 90.60 Ha or 8.39% and grumosol soil type with an area of 989.01 Ha, out of the total area of Industrial Estate 1079.61 Ha or 91.61%. Data on industrial estate land types is described in Table 2.

Tabel 2. Land Types of Industrial Estate in Widodaren District in 2022

No	Village	Klasifikasi	
		JT Alluvial (Ha)	JT Grumosol (Ha)
1	Village Karangbanyu	0	211,12
2	Village Sidolaju	0	289,80
3	Village Walikukun	0	71,86
4	Village Widodaren	90,60	416,23
TOTAL		**90,60**	**989,01**

Source : BAPPEDA Data Processing, 2022

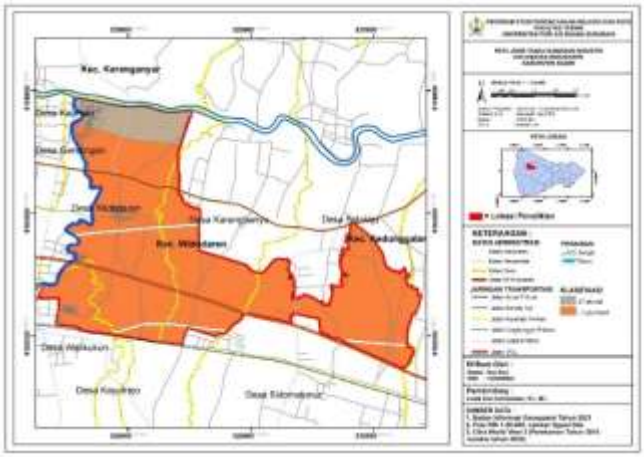

Figure 3. Map of Land Types in Widodaren District Industrial Estate in 2022
Source : BAPPEDA Data Processing, 2022

Figure 3 can be seen The type of soil that dominates is the highest type of grumosol soil in Widodaren Village, this type of soil is not suitable for plants. Because the texture is dry and easily broken, especially during the dry season, the color is neutral to alkaline, so it is suitable for industrial use.

Rainfall

Rainfall in the Widodaren District Industrial Estate. Data based on the Meteorology, Climatology and Geophysics Agency shows a rainfall intensity of

2000-2500 mm, evenly distributed in 4 villages that are used as industrial areas. Rainfall data for industrial areas is described in Table 3.

Tabel 3. Rainfall in the Widodaren District Industrial Area in 2022

No	Village	Rainfall (mm)	Broad (Ha)
1	Village Karangbanyu	2000 - 2500	211,12
2	Village Sidolaju	2000 - 2500	289,80
3	Village Walikukun	2000 - 2500	71,86
4	Village Widodaren	2000 - 2500	506,83
	TOTAL		**1079,61**

Source : BMKG Data Processing, 2022

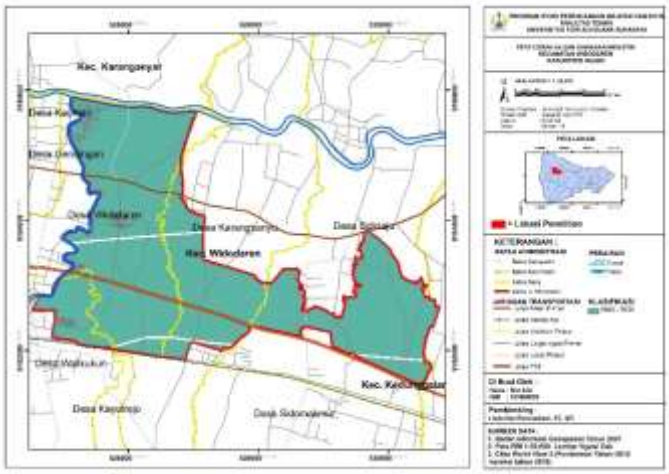

Figure 4. Rainfall Map of Widodaren District Industrial Estate in 2022 Source : BMKG Data Processing, 2022

Figure 4 shows that the climate in the Widodaren Industrial Estate has a fairly high average rainfall condition of 2000 – 2500 mm, so that every year it experiences a long rainy season. The cause of flooding is triggered by long rain duration and flooding from upstream rivers, in addition to rob (Shofwan et al., 2021). Prevention in anticipating the overflow of water flows due to high rainfall requires maintenance or repair of drainage channels, especially in industrial areas in order to accommodate rainwater discharge every year.

Disaster-prone

Flood-prone data in the Widodaren District industrial estate based on the results of data processing from the Regional Disaster Management Agency, has a low classification because it has a depth of < 1 m, which is spread evenly in 4 villages used as industrial estates with a total area of 1079.61 Ha. Flood-prone areas of industrial estates are described in Table 4.

Tabel 4. Flood-prone Area of the Widodaren District Industrial Estate in 2022

No	Village	Depth	Klasifikasi	Broad (Ha)
1	Village Karangbanyu	< 1 m	Low	211,12
2	Village Sidolaju	< 1 m	Low	289,80
3	Village Walikukun	< 1 m	Low	71,86
4	Village Widodaren	< 1 m	Low	506,83
	TOTAL			**1079,61**

Source : BPBD Data Processing, 2022

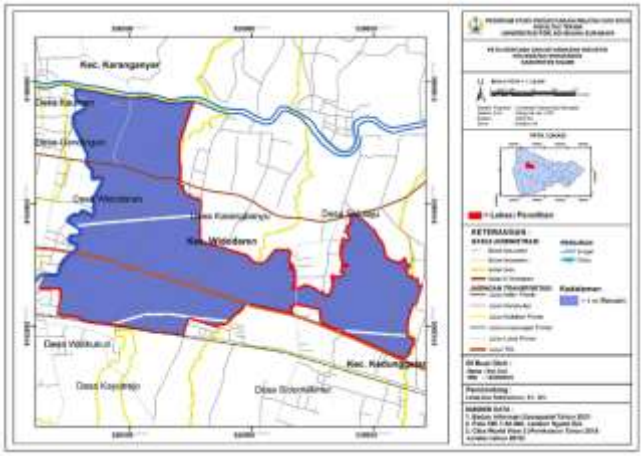

Figure 5. Flood Prone Map of Widodaren District Industrial Estate in 2022
Source : BPBD Data Processing, 2022

Figure 5 can be seen that the depth of flooding in industrial estates has a depth of < 1 m which means it is relatively low and in industrial estates it is included in safe conditions for flood disaster levels. This condition can increase opportunities for the establishment of industrial estates in the area.

Land Capability

Land capacity in the Widodaren District industrial estate based on data processing from the Geospatial Information Agency has 4 classifications, namely good development ability with a total area of 916.43 Ha, somewhat good development ability with a total area of 50.26 Ha, medium development ability with a total area of 98.66 Ha, and somewhat poor development ability with a total area of 14.26 Ha. Data on industrial estate land capacity is described in Table 5.

Table 5. Land Capacity of the Widodaren District Industrial Area in 2022

No	Village	Area of Development Capability (Ha)			
		Good	Pretty Good	Keep	Somewhat Bad
1	Village Karangbanyu	208,57	0,03	2,53	0
2	Village Sidolaju	264,86	3,74	21,20	0
3	Village Walikukun	69,27	2,03	0,14	0,41
4	Village Widodaren	373,73	44,46	74,80	13,85
	TOTAL	**916,43**	**50,26**	**98,66**	**14,26**

Source : BIG Data Processing, 2022

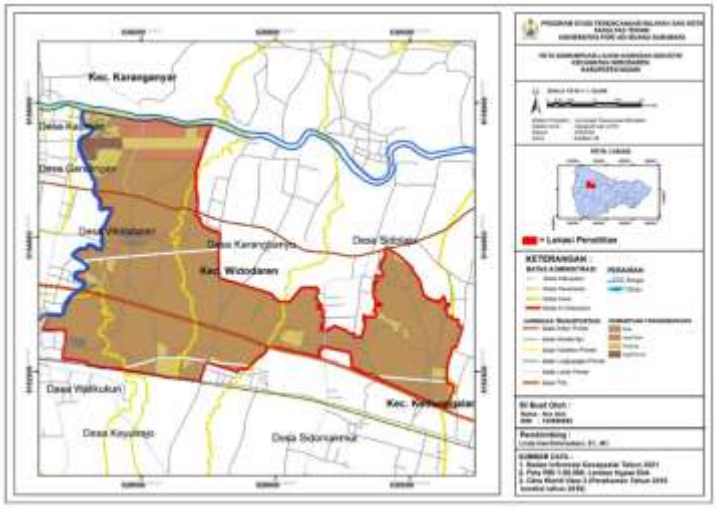

Figure 6. Map of Land Capacity of Widodaren District Industrial Estate in 2022

Source : BIG Data Processing, 2022

Figure 6 shows that the land ability class with good classification is very dominating in industrial estates in Widodaren District. This class has few obstacles that limit its use or can be said to be appropriate if it is intended as an industrial area in Widodaren District. The second classification is rather good, this class has some obstacles or results in requiring moderate soil conversion measures. The appropriate land capability to be designated as an industrial area is a good and somewhat good classification of the 5 existing classifications.

Vegetation

The data used to determine vegetation density is using NDVI (Normalize Difference Vegetation Index) data obtained from landsat 8 imagery (band 5 and band 4) obtained from the USGS. Vegetation cover from the results of NDVI (Normalize Difference Vegetation Index) data analysis is known that the Widodaren District industrial estate has 4 classes, namely, high greenery, medium greenery, low greenery, and very low greenery. The vegetation density data of industrial estates is described in Table 6.

Tabel 6. Vegetation Cover of Widodaren District Industrial Estate in 2022

No	Village	Broad(Ha)			
		High Greenery	Medium Greenery	Low Greenness	Very Low Greenness
1	Village Karangbanyu	3,38	30,27	151,85	25,77
2	Village Sidolaju	0	0,67	263,57	24,48
3	Village Walikukun	14,13	57,81	0,21	0
4	Village Widodaren	153,50	188,40	156,48	8,26
TOTAL		**171,01**	**277,15**	**572,03**	**59,42**

Source : Analysis Results, 2022

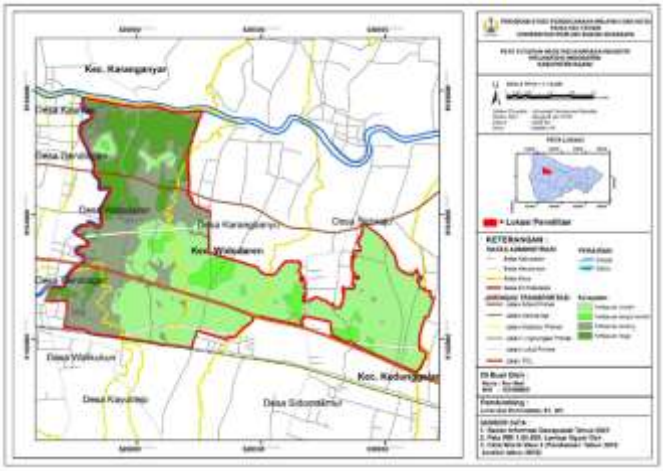

Figure 7. Vegetation Cover Map of Widodaren District Industrial Estate in 2022
Source : Analysis Results, 2022

Figure 7 shows that the most dominant vegetation under existing conditions has a low level of vegetation, such as clouds, water, vacant land, buildings, and other non-vegetation elements. The low value of vegetation is not only due to the condition of vegetation that has been greatly reduced due to fires and forest logging, but also due to the influence of clouds that cover part of the existing location of the Widodaren Industrial Estate. The condition shows that the area is suitable for use as an industrial area, namely in the classification of high and medium greenery (Suheri, 2019), because to prevent a decline in environmental quality caused by reduced vegetation space in urban areas as well as industrial activities and vehicles passing through the Widodaren District Industrial Estate.

Land Carrying Capacity of Industrial Estates

The analysis of the carrying capacity of industrial estate land in Widodaren District uses *the Overlay Union method* between the map of the slopes, soil type, rainfall, prone to disasters, and land capability maps. Classification and area of land carrying capacity in Table 7 and Figure 8.

Tabel 7. Land Carrying Area of Widodaren Industrial Estate in 2022

No	Village	Broad (Ha)				
		Highly Appropriate	Appropriate	Quite Appropriate	Less Suitable	Inappropriate
1	Village Karangbanyu	117,36	65,50	27,31	1,87	0,19
2	Village Sidolaju	249,68	22,73	9,80	2,92	4,67
3	Village Walikukun	69,37	1,94	0,40	0,16	0
4	Village Widodaren	268,26	68,01	102,46	42,63	24,35
	TOTAL	**704,67**	**158,17**	**139,96**	**47,59**	**29,21**

Source : Analysis Results, 2022

Table 7 data is known that the classes obtained for the development of industrial estates are 5 classes, from these classes there are 2 classes whose land carrying capacity is good for the development of industrial estates, namely the class is very suitable, with a total area of 704.67 Ha, which is spread across Karangbanyu Village with an area of 117.36 Ha, Sidolaju Village with an area of 249.68 Ha, Walikukun Village with an area of 69.37 Ha, Widodaren Village with an area of 268.26 Ha. Most of the use of this class is still in accordance with the ability of the land because it has a classification of land ability based on the results of overlays and interval calculations (Putra et al., 2019). The supporting factors in the existing conditions are located in the flat topography (slope slope < 3%), erosion sensitivity is very low to low, generally well drained, has a type of soil that is easy to cultivate, has a good water holding capacity, fertile or responsive to fertilization, is not threatened by flooding so it is very suitable to be used as an industrial area. The second class is suitable, with a total area of 158.17 Ha, which is spread across Karangbanyu Village with an area of 65.50 Ha, Sidolaju Village with an area of 22.73 Ha, Walikukun Village with an area of 1.94 Ha, Widodaren Village with an area of 68.01 Ha. Most of the use of this class is still in accordance with the ability of the land because it has a classification of land ability both based on the results of overlays and interval calculations. The existing condition has several supporting factors, namely having a flat topography (slope slope < 3%), carrying capacity holding water well, fertile or responsive to fertilization, not threatened by flooding so it is very suitable to be used as an industrial area.

The availability of land in the Widodaren Industrial Estate with a total area of 1079.61 Ha. The land needs, obtained from the results of image interpretation, are known to have an existing industrial land area of 238.91 Ha. The data is compared between the ability of the land and the use of the land is as follows:

Known:
SLi = 1,079.61 Ha
Dli = 238.91 Ha
Formula:
DDLi = SLi/DLi (1)
= 1,079.61/ 238.91
= 4.51 Ha

The result of the comparison of 4.51 Ha indicates that the availability of land (SL) is still greater than the land use (DL) for industry, meaning the carrying capacity of the land in the research area of industrial land surplus (Muta'ali, 2015). Previous research (Oktorianti et al., 2014) if the DDLi value is > 1, then the land potential has been able to support the need for land for industry.

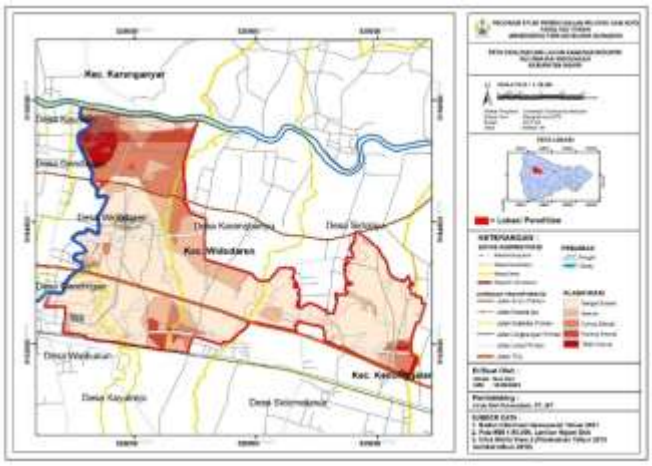

Figure 8. Map of Land Carrying Capacity of Widodaren Industrial Estate in 2022
Source : Analysis Results, 2022

Data in Figure 8 can be seen that there are 5 classifications, there are only 2 classifications that are suitable to be used as industrial estates, namely the classification is very suitable for an area of 704.67 Ha and the classification is suitable for an area of 158.17 Ha. This classification is suitable land for all types of land use without the need for special soil preservation measures, including for industrial land use (Widiatmaka et al., 2015).

Analysis of the Environmental Carrying Capacity of Industrial Estates

The analysis of the environmental carrying capacity of industrial estates in Widodaren District uses *the Overlay Union* method between marble maps, rainfall, disaster-prone and vegetation maps. The land needs, obtained from the results of image interpretation, are known to have an existing industrial land area of 238.91 Ha. The data is compared between the ability of the land and the use of the land is as follows (Muta'ali, 2015):

Known:
SLi = 1,079.61 Ha
Dli = 238.91 Ha
Formula:
DDi = SLi/DLi (1)
= 1,079.61/ 238.91
= 4.51 Ha

The results of the comparison of 4.51 Ha indicate that the availability of land (SL) is still greater than the land use (DL) for industry, meaning that the environmental carrying capacity in the research area of industrial land surplus (Muta'ali, 2012) is declared surplus because the natural environment capacity and resources are able to support industrial estate development activities (Pratiwi et al., 2021). Previous research (Oktorianti et al., 2014) found that DDi > 1 potential land has been able to support the needs of industrial land. Classification and area of land environmental power in Table 8 and Figure 9.

Tabel 8. The Area of Environmental Carrying Capacity of the Widodaren

No	Village	Clarification (Ha)				
		Highly Appropriate	**Appropriate**	**Quite Appropriate**	**Less Suitable**	**Inappropriate**
1	Village Karangbanyu	170,00	40,65	0,44	0	0
2	Village Sidolaju	218,10	70,50	1,20	0	0
3	Village Walikukun	90,77	0,48	0,56	0,06	0
4	Village Widodaren	441,46	38,00	2,12	1,13	4,13
	TOTAL	**920,34**	**149,62**	**4,32**	**1,19**	**4,13**

Source : Analysis Results, 2022

Table 8 data based on the Overlay Union analysis there are only 2 classes that are good for the development of industrial estates, namely the most suitable class of 920.34 Ha or 85.25%, which is spread across Karangbanyu Village with an area of 170.00 Ha, Sidolaju Village with an area of 218.10 Ha, Walikukun Village with an area of 90.77 Ha, Widodaren Village with an area of 441.46 Ha. This class has supporting factors on this land, including drainage, namely primary and secondary network drainage with good conditions, the distance of the main road from 0 – 500 m, and the distance to the river. The second class is the classification according to an area of 149.62 Ha or 13.86%, which is spread across Karangbanyu Village with an area of 40.65 Ha, Sidolaju Village with an area of 70.50 Ha, Walikukun Village with an area of 0.48 Ha, Widodaren Village with an area of 38.00 Ha. This classification has supporting factors on this land, including drainage, namely the drainage of primary and secondary networks with good conditions, the distance of the main road 0 – 500 m, and the distance to the river 0 – 50 m from the Bengawan Solo River which has a length of 1936.13 m, the Bibis River which has a length of 2602.03 m, and the Kedungprawan River which has a length of 1860.04 m.

Figure 9. Main Roads in Widodaren District
Source : Personal Documentation, 2022

The existing conditions in the Widodaren Industrial Estate are as shown in Figure 9. The distance between the location of the industrial estate and the main road of the primary artery is only 0 – 500 m. This condition shows one of the supporting factors of the classification of environmental carrying capacity with the appropriate classification if it is used as an industrial estate.

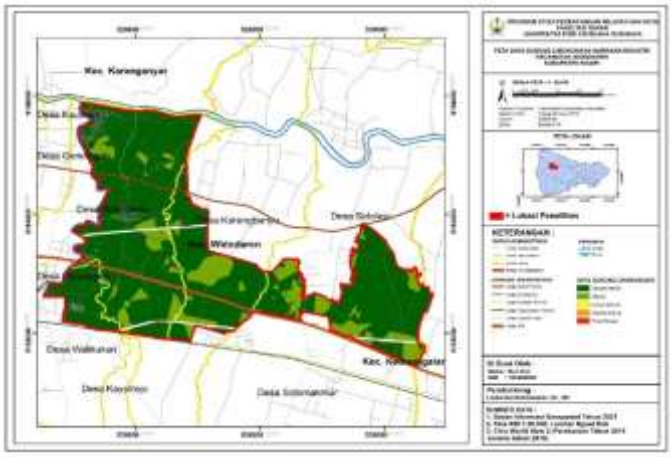

Figure 10. Map of the Environmental Carrying Capacity of the Widodaren Industrial Estate in 2022
Source : Analysis Results, 2022

Data in Figure 10 If related to the data above the results of the environmental carrying capacity overlay of industrial estates in Widodaren District, from the results of the 5 classifications, there are only 2 classifications that are suitable to be used as industrial estates, namely the very appropriate classification covering an area of 920.34 Ha and the corresponding classification covering an area of 149.62 Ha. This classification is suitable for all types of land use without the need for special soil preservation measures, including to be used as an industrial area (Widiatmaka et al., 2015). Environmental carrying capacity is defined as the ability of the environment to provide a prosperous and sustainable life for the population that inhabits an area (Muta'ali, 2012).

CONCLUSION AND RECOMMENDATION

Spatial analysis with the Overlay Union technique in industrial estate development obtained 5 classes, namely very appropriate classes, suitable classes, fairly appropriate classes, less suitable classes, and non-suitable classes. There are only 2 classes in this class that can be used as an industrial estate, namely very suitable classes and suitable classes. This classification is suitable land for all types of land use without the need for special soil preservation actions, including to be used as an industrial area. The result of the calculation of DDLi of 4.51 Ha or DDLi has a value of SL > DL which means a surplus of industrial land. Previous research (Oktorianti et al., 2014) has shown that DDi > 1 potential land has been able to support the needs of industrial land.

FURTHER STUDY

Further studies are recommended to assess the long-term sustainability and environmental impact of the identified suitable and very suitable land classes for industrial estate development. Future research should incorporate dynamic spatial modeling, land use change projections, and environmental risk assessments to ensure responsible development. Additionally, socio-economic factors such as community acceptance, infrastructure readiness, and policy support should be evaluated to optimize land utilization. Comparative studies with other regions can also provide insights into best practices for sustainable industrial land management.

REFERENCES

Azizah, S. A., Widiatmono, B. R., & Wirosoedarmo, R. (2019). Evaluasi Pemanfaatan Kawasan Strategis Kota Palangkaraya Berdasarkan Kemampuan Lahan. *Jurnal Sumberdaya Alam Dan Lingkungan*, *6*(1), 1–8. https://doi.org/10.21776/ub.jsal.2019.006.01.1

Cahyadi, A. I. B., Suprayogi, A., & Amarrohman, A. (2018). Penentuan Lokasi Potensial Untuk Pengembangan Kawasan Industri Menggunakan Sistem Informasi Geografis Di Kabupaten Sukoharjo. *Jurnal Geodesi Undip*, *4*(1), 1–9.

Kandiawan, U. F., Hani'ah, & Subiyanto, S. (2017). Penentuan Kawasan Peruntukan Industri Menggunakan Analytical Hierarchy Process (Ahp) Dan Sistem Informasi Geografis (Studi Kasus : Kabupaten Sragen). *Jurnal Geodesi Undip*, *6*(4), 1–9.

Muta'ali, L. (2012). *Daya Dukung Lingkungan Untuk Perencanaan Pengembangan Wilayah*. Badan Penerbit Fakultas Geografi (BPFG). www.geo.ugm.ac.id

Muta'ali, L. (2015). *Teknik Analisis Regional*. Badan Penerbit Fakultas Geografi (BPFG). www.geo.ugm.ac.id

Oktorianti, R., Purwanto, & Budiono. (2014). Analisis Daya Dukung Lahan Untuk Kegiatan Industri Besar Dengan Pen- Dekatan Sistem Informasi Geografi (Sig) Di Kecamatan Ungaran Timur Dan Ungaran Barat Kabupaten Semarang. *Seminar Nasional Matematika Dan Pendidikan Matematika*, *1*, 2–7. https://pgpaud.unirow.ac.id/prosiding/index.php/snmpm/article/view/57

Putra, M., Juhadi, & Tjahjono, H. T. (2019). Dampak Spasial Berdirinya Kawasan Industri Candi Terhadap Penggunaan Lahan di Wilayah Kecamatan Ngaliyan Kota Semarang. *Geo-Image*, *8*(1), 22–28. https://doi.org/10.15294/geoimage.v8i1.29660

Sari, P. P., Makarau, V. H., & Lakat, R. M. S. (2021). Analisis Daya Dukung & Daya Tampung Lahan Di Kecamatan Girian Kota Bitung Untuk Pengembangan Permukiman. *Spasial*, *8*(1), 89–100.

Shofwan, M., Rahman, N. A., Prasakti, Y., Fitria, N. N., & Azmi, L. (2021). Mitigasi Bencana Pada Masyarakat Tradisional Kampung Air Kelurahan Mantuil Kota Banjarmasin. *Geografika*, *2*(2), 79–90.

Widiatmaka, W., Ambarwulan, W., Purwanto, M. Y. J., Setiawan4, Y., & Effendi, H. (2015). Daya Dukung Lingkungan Berbasis Kemampuan Lahan Di Tuban, Jawa Timur (Land Capability Based Environmental Carrying Capacity in Tuban, East Java). *Jurnal Manusia Dan Lingkungan*, *22*(2), 247. https://doi.org/10.22146/jml.18749