Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 9 ~ Issue 4 (2022) pp: 40-47
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Land Potential Index Analysis In Samarinda's Agricultural Areas Using Geographic Information Systems

Nurul Puspita Palupi[1] Surya Darma[2] Maulidah[3] Abdul Rahmi[4]
[1, 2,, 3] *Agroecotechnology, Mulawarman University, Samarinda, 75119, East Kalimantan, Indonesia.*
[4] *Agrotechnology, 17 Agustus 1945 University, Samarinda, 75124, East Kalimantan, Indonesia.*

ABSTRACT
The Land Potential Index is one way to know the value of land potential. Land Potential has an important function in land cultivation and how to use it. Land use should be appropriate for the land potential. If the land potential is high, the yield is high otherwise if the land potention is low, the yield is low as well. Inappropriate land use causes damaged soil and land degradation. The goal of this study is to determine the distribution of the Land Potential Index on agricultural land use in Samarinda City. The research was conducted from December 2020 to March 2021 in Samarinda City.
The method used in this research is scoring and overlay to the analysis of land potential index on agricultural land use in Samarinda City and the distribution of each class. This research used 5 parameters to arrange the land potential index, which are slope, lithology, soil, rainfall, and flood risk.
The Land Potential Index in Samarinda City for the area of agricultural use has an area of 10,383.60 Ha of the total area based on urban spatial design pattern in 2014-2034. The results of land analysis obtained in the agricultural area obtained 3 classes, were as follows very low class, the low class, and medium class. Overall in the city of Samarinda the very low class has an area of 9,569.15 Ha or 13.10% , the low class has a total area of 60,050.15 Ha or about 81.46%, and the medium class has an area of 4,008.74 Ha or around 5.44%. After overlapping with agricultural areas obtained the very low class has an area of 1,284.82 Ha or about 12.37%, the low class has an area of 8,923.85 Ha or about 85.94%, and the medium class area was 174.94 Ha or 1.68%. The agricultural landuse in the Samarinda city yields positive results in every class. This is based on the assessment of land potential in general. These area, in particular, can be used due to limited land capacity.
KEYWORDS:* *Land Potential Index, Geographic Information System, Agriculture

Received 02 Apr, 2022; Revised 16 Apr, 2022; Accepted 18 Apr, 2022 © The author(s) 2022. Published with open access at ***www.questjournals.org***

I. INTRODUCTION

One method of determingung a land's potential is to use a land potential index. This information is useful for determining how to manage land sustainably and according to it's potential. The most important factors in determining the land's potential are slope, lithology, soil type, hydrology, and disaster vulnerability, by examining the geophysical appearance with the parameters utilized. These criteria can be used to determine the potential distribution.

The land potential index can be used to estimate the relative potential of land for various uses. The ability value is regarded high if the land potential index value is high. A high number shows that physical shape are good and have a lot of potential, which may be used to make plans and recommendations.

Land potential information is critical for the community in carrying out land use and management so that maximum outcomes are achieved in accordance with the land's capacity. Land degradation and environmental impact will be reduced if land usage is based on land capabilities (Andini, 2017).High-quality products and better results will arise from the use of land with high potential applicability.

If the land potential index is presented in a spatial format, it is simple and quick to calculate. Variations in agricultural activities above ground level can be described and explained using spatial forms. Using a geographic information system to process spatial data makes it easier and more effective. Geographic information systems can process data by combining, storing, and evaluating data and distributions found on the surface of the globe.

Making an examination of land potential is one of the measures to solve land problems so that it can be used according to its classification. Land potential can be used to make forecasts for acceptable land use recommendations, and later on, it can be used to gather more information about the challenges and constraints that each piece of land has.

II. LITERATUR REVIEW

The Land Potential Index is a method of evaluating land in order to adjust its potential. Land with a high IPL has the potential to provide excellent quality and yields. IPL is a numerically expressed procedure related to land for general public use, where IPL can state the worth of the potential level of land in a certain location.

The rating with five calculation factors (Hamranani, 2014), namely:

$$\mathbf{IPL = (R + L + T + H) . B}$$

Information :

IPL = Land Potential Index
R = Slope Scoring
L = Lithology Scoring
T = Soil Type Scoring
H = Hydrology Scoring
B = Disaster vulnerability scoring

1. Slope

The topographical form of an area with the potential for erosion that might alter land usage and land cover is referred to as a slope. The percentage ratio of vertical distance (land height) to horizontal distance (flat land length) is known as slope (Mahmudi, Sawitri S. and Yuwono, Bambang Darmo, 2015).

Table 1. Slope Scoring

No.	Slope (%)	Scoring
1.	Flat (0-5)	5
2.	Wavy (5-15)	4
3.	Low Hills (15-25)	3
4.	Hills (25-45)	2
5.	Mountain (>45)	1

(Hamranani, 2014)

2. Lithology

Lithology is a classification system based on rock type. Lithology is a rock's physical attribute. Lithology is a term used to describe the features of rocks found in outcrops, such as color, mineral composition, and particle size(Nugroho, J. A., Sukoho, B. M., and Sari, I. L., 2009).

Table 2. Lithology Scoring

No.	Rock Types	Scoring
1.	Alluvium/colluvium	10
2.	Pyroclastic rock	8
3.	Limestone	5
4.	Massive igneous rock	5
5.	Coarse grained clastic sediment	5
6.	Limestone and metamorphic sediments	3
7.	Fine grained clastic sediment	2

(Hamranani, 2014)

3. Soil Type

Soil type refers to the top layer of the earth's surface, where soil fertility and capability are determined. Soil can be seen of as a thing or a location for plants to grow, depending on whether it is fertile or arid. Soil can be thought of as an object that can be weighed or measured in volume. Land can be thought of as a unit of measurement for area (Delianto, B., Winata, A., Rusdiyanto, E., and Wardiati, M. A., 2014).

Table 3. Soil Type Scoring

No.	Soil Type	Scoring
1.	Brown Alluvial, Mediteran	5
2.	Podsolik, Andosol	4

3.	Glei Humus, Rensina, Podsol	3
4.	Grumusol, Latosol, Gray Alluvial	2
5.	Regosol, Litosol, Organosol	1

(Hamranani, 2014)

4. Rainfall

Rainfall is the volume of water that falls at a specific area over a period of time. Rainfall has an impact on the index of land potential. This is due to the need to determine the degree of water content in a land potential assessment. Rainfall is also linked to soil conditions and impediments, both of which can affect land use activities. High rainfall will have a significant impact on a location, and both high and low rainfall can have an impact on land quality.

Table 4. Rainfall Scoring

No.	Rainfall (mm/year)	Scoring
1.	>4.000	4
2.	3.000-4.000	3
3.	2.000-3.000	2
4.	1.000-2.000	1

(Sari, 2014)

5. Disaster Vulnerability

The flood vulnerability is one of the catastrophic vulnerabilities that has become a benchmark. Flood vulnerability is a state that describes whether or not an area is affected by a disaster caused by natural forces. Flood susceptibility can be determined using a variety of methods, one of which is a geomorphological approach that examines characteristics such as land slope, elevation, and landform(Dahlia, S., Tricahyono, N. H., and Wira, F. R., 2014).

Table 5. Disaster Vulnerability Scoring

No.	Flood Vulnerability	Scoring
1.	Without	1.0
2.	Light	0.8
3.	Medium	0.7
4.	Weight	0.6
5.	Very Heavy	0.5

(Hamranani, 2014)

The Land Potential Index (IPL) depicts a piece of land's potential for widespread use. The greater the IPL value, the better the land's ability to offer optimal results when it's employed for land use activities. classifies land potential as follows:

$$\text{ITK} = \frac{\text{Max Value} - \text{Min Value}}{\text{Total Class}}$$

III. METHODS

A. Instruments

The Asus Vivobook A412D AMD Ryzen 3 laptop and ArcGIS 10.7 software were used in this study. The data used to analyze the agricultural land potential index in this study included the Samarinda City slope map, Samarinda City lithology map, Samarinda City soil type map, Samarinda City rainfall map, Samarinda City flood vulnerability map, and Samarinda City spatial plan map.

The slope characteristics, lithology, soil type, rainfall, and disaster vulnerability were all used in this study. These parameters are ranked according to their level of impact on land potential, and their values are calculated to give a land potential value.

B. Data Analysis

The data was analyzed using descriptive quantitative analysis, which included the use of dignity and overlaps. Slope, lithology, soil type, rainfall, and disaster vulnerability are all evaluated based on their importance. The data was then compared and evaluated using a tiered quantitative method, in which the sum of the supporting elements, such as slope slope, lithology, soil type, and hydrology, was multiplied by the limiting factor. The assessment's results will be used to create a land potential index class, which will be classified into very low, low, medium, high, and very high categories. In addition, the data from the land potential index is intersected to account for the distribution of agricultural land usage.

IV. RESULTS AND DISCUSSION

A. Results

In the spatial design, the agricultural area is a spatial pattern. The Land Potential Index study of agricultural regions is supposed to aid in determining the land's carrying capacity. The agricultural sector is one of the economic backbones of a region's economy, helping it meet the requirements and demands of its residents.

The spatial design of Samarinda City was analyzed using overlapping.The results of the regional study in agriculture are divided into three categories: very low, low, and medium.The very low area covers 1,284.81 hectares, or around 12.37 percent of the total area.The low-income area covers 8,923.85 hectares, or 85.94 percent of the total land area.The medium class area covers 174.94 hectares, or about 1.68 percent of the total area (Table `6).

Table 6. Land Potentian Index in Agriculture Area

No	Land Potential Index	Area (Ha)	%
1.	Low	8,923,85	85,94
2.	Very Low	1.284,82	12,37
3.	Medium	174,94	1,68
	Total	**10.383,60**	**100,00**

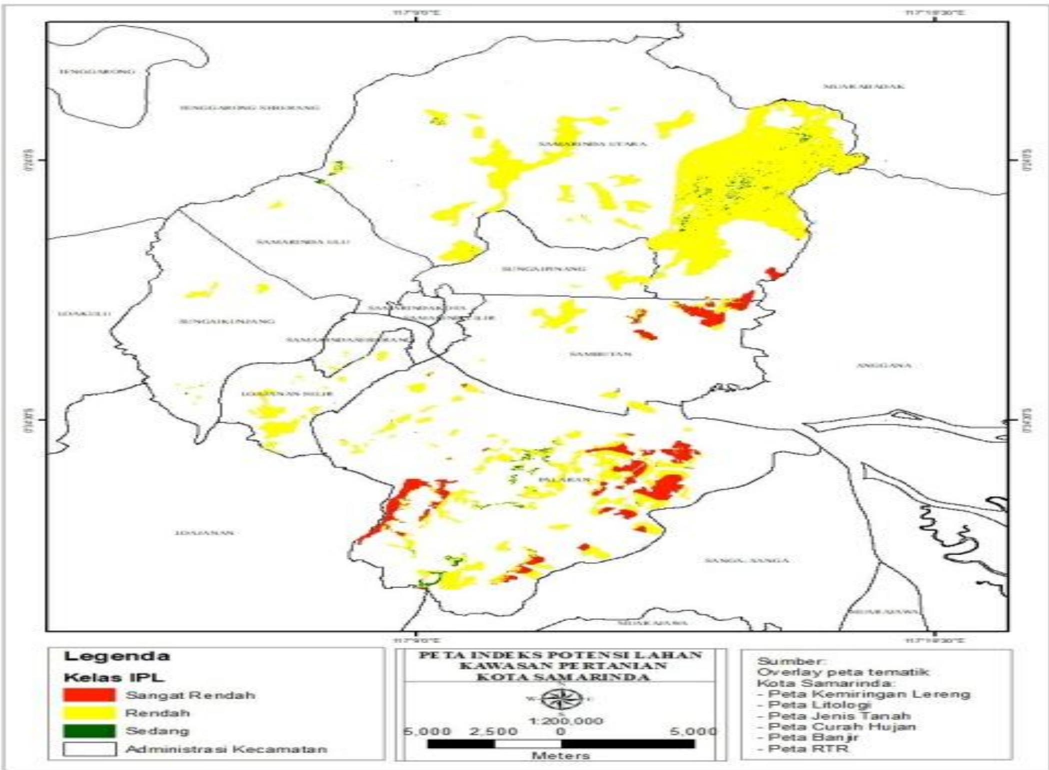

Figure 1. Land Potential Index Maps in Agriculture Area

The extremely low class region in the Palaran sub-district has the largest area, covering945.0808 Ha or around 9,0857 percent of the total area. North Samarinda District has the greatest low-class IPL with an area of 6,087,8017 ha, or around 58,5261 percent. The North Samarinda area has the greatest medium IPL class, with an area of 90.0423 Ha or 0.8656 percent.

The northern and southern regions, including the districts of Samarinda Ulu, North Samarinda, Sungai Kunjang, Loa Janan Ilir, and Palaran, are home to the middle class. This area is utilized for agricultural, although it has a number of challenges, including the land's contour, which ranges from sloping to hilly, the risk of erosion in hilly places, and slow soil permeability. Farmers solve this challenge by relying on organic fertilizers to boost nutrition levels. Because the area being cultivated is dominated by vegetable crops, the land is normally cultivated by plowing, but if the land area is small, hoeing is attempted to loosen the soil and restore the texture to be good in processing. Regular farm care aids in the production of high-quality veggies.

Figure 2. The Medium Class Sample

The poor class is evenly dispersed and has the most area in the Samarinda sub-district. All slopes, from gentle to low hills, are included in this area. Growing vegetables takes up a lot of land, and some of it is used for rice fields. For its low potency, the low-grade area yields a decent crop production. This is bolstered by land improvements made by farmers and the government to address issues such as nitrogen provision and intense soil maintenance.

Figure 3. The Low Class Sample

The very poor are generally found in the eastern and southern parts of the country. There is a steep to moderate hilly slope in this location. Because the land is inundated, low locations are more frequently observed when paddy fields are used. Rice yields are high when field grades are low. This is because the area has been selected expressly for plants that can thrive within the constraints of existing difficulties, and excellent farmer care and maintenance yields acceptable outcomes.

Figure 4. The Very Low Sample Class

Areas of flooding and basins in flat relief have low and very low potential, but areas of exploitation in areas prone to erosion have wavy relief. Observing the field, the plants planted in the areas of low and very low class potential are good and healthy plants. This is due to the fact that farmers consider plant maintenance. Soil care helps agricultural products in Samarinda City achieve superior results by aiding soil permeability and providing nutrients. Areas in the low and very low class have inadequate water absorption, which can be aided by irrigation by farmers to speed up the process of water absorption into the soil.

B. DISCUSSION

The slope of the slope is calculated using slope analysis findings from DEM (Digital Elevation Model) data with an 8-meter height. The findings of the slope analysis of the agricultural area, which covers a total area of 10,383.60 hectares. A flat-sloping relief area with a slope of 0-5 percent dominates the slope in the Samarinda City area. has a total size of 5,495.72 ha, or 52.93 percent of the total area. Wavy areas with a slope of 5-15 percent cover 4,198.87 hectares, or around 40.44 percent of the land. Low hilly terrain with a 15-25 percent slope. The low hilly area covers 675.20 hectares, or around 6.50 percent of the total land area. The hilly section, which has a slope of 25-45 percent, encompasses 13.81 ha, or roughly 0.13 percent of the study area's total area (Table 7).

Table 7. Slope in Agriculture Area

No.	Slope	Area (Ha)	%
1.	0-5% (low land)	5.495,72	52,93
2.	5-15% (wavy)	4.198,87	40,44
3.	15-25% (low hills)	675,20	6,50
4.	25-45% (hills)	13,81	0,13
	Total	**10.383,60**	**100,0**

Table 8. Lithologi in Agriculture Area

No	Lithology	Area (Ha)	%
1.	Alluvium clastic	3151,10	1,46
2.	Sandstone Sediments	6.660,48	64,14
3.	Clastic Sediments Flish	1.249,00	12,03
4.	Claystone fine clastic sediments	2.323,03	22,37
	Total	**10.383,60**	**100,00**

Because lithology, or rock type, can alter land capabilities, it is a determining element for land potential. Lithology is thought to be capable of supporting potential since it is the first step in the development of soil, and soil fertility is regulated by the type of soil rock. The higher the value, the better the lithology in supporting the potential; on the other hand, if the lithology is poor, the value is low and may impact the land's soil type.

Alluvial soil, cambisol, gleisol, oxysol, and podzolic soils are found in the agricultural area of Samarinda City. With an area of 6,054.96 ha, or around 58.31 percent, the cambisol area is the greatest. The gleisol area covers 2,626.32 acres, or around 25.29 percent of the total area. The podzolic area covers around 398.64 hectares, or 3.84 percent of the total area. The alluvial soil area covers 548.70 hectares, or 5.28 percent of the total land area. The Oxysol soil area covers 754.97 hectares, or around 7.27 percent of the research area (Tabel 8 and Table 9).

Table 9. Soil Type in Agriculture Area

No	Equivalent	Soil Type	Area (Ha)	%
1.	Entisol	Alluvial	548,70	5,28
2.	Inceptisol	Kambisol	6.054,96	58,31
3.	Inceptisol	Gleisol	2.626,32	25,29
4.	Oxisol	Oxisol	754,97	7,27
5.	Ultisol	Podzolik	398,64	3,84
	Total		**10.383,60**	**100,00**

Samarinda's rainfall is calculated by adding all of the wet days in a year. The rainfall during the known year divided by the number of years of rainfall yields the average value for Samarinda rainfall for each location. The rainfall intensity in agricultural areas is 2,000-3,000 mm/year, with an area of 10,383.60ha, according to the results of the rainfall analysis.

The flood susceptibility of a site is calculated by combining many geomorphological characteristics as parameters. Slope, height, and landform are all factors in determining flood susceptibility. The highest point in the Samarinda area is 265 meters, and the landforms are in line with land use restrictions.

According to the findings, the majority of the floodplain areas in Samarinda City are vulnerable. The area of high flood vulnerability is 4,207.58 acres, or around 40.52 percent. The medium prospective area covers 5,432.46 acres, or 52.38 percent of the total area. Low potential covers 737.56 acres, or around 7.10 percent of the land area (Table 10).

Table 10. Flood in Agriculture Area

No	Flood	Area (Ha)	%
1.	Low	737,56	7,10
2.	Medium	5.438,46	52,38
3.	High	4.207,58	40,52
	Total	**10.383,60**	**100,00**

Flooding is a possibility in Samarinda City due to meteorological and environmental causes. The intensity of rain, as measured by climatic parameters, is medium to high in Samarinda City throughout the year. The sprawling city of Samarinda is dominated by plains, which require greater water absorption as a result of urbanization. Because the Samarinda City region is higher up on the river than the surrounding area, it is prone to flooding. This flood poses a major threat to farmers since, in addition to harming crops and soil, places that have been inundated for an extended period of time might attract pests and diseases due to the humid environment.

V. CONCLUSION

Several conclusions may be taken based on the findings of the study and research, such as the Land Potential Index in Samarinda City for agricultural regions has an area of 10,383.60 Ha of the total area based on the 2014-2034 Samarinda City Spatial Plan. The results of the land study in agricultural areas yielded three classes: very low, low, and medium. Overall, the extremely low class has a total area of 9,569.15 ha (or 13.10%), the low class has a total area of 60,050,15 ha (or about 81.46%), and the middle class has a total area of 4,008.74 ha (or about 5.44%) in Samarinda City. After overlapping with agricultural regions, the very low class has an area of 1,284.82 Ha(12.37%), the low class has an area of 8,923.85 Ha(85.94%), and the medium class has an area of 174.94 Ha (1.68%). In Samarinda City, agricultural use yields positive outcomes in each class. This is based on a land potential evaluation, which is a physical assessment of land that may be used for agricultural crops in general. The region, in particular, can be utilised in accordance with the limited land capacity.

REFERENCES

[1]. Alivia, F. 2020. Pemanfaatan Melalui Sistem Infromasi Geografis (SIG) Dalam Bidang Pendidikan. Universitas Negeri Surabaya. Surabaya. https://www.researchgate.net/publication/345503072_PEMANFAATAN_DATA_SPASIAL_MELALUI_SISTEM_INFORMASI_GEOGRAFIS_SIG_DALAM_BIDANG_PENDIDIKAN

[2]. Andini, D. M. 2017. Analisis Indeks Potensi Lahan (IPL) terhadap Produktivitas Lahan Pertanian di Kabupaten Sragen. Skripsi. Universitas Muhammadiyah Surakarta, Surakarta.

[3]. BPS. 2019. Produktivitas Padi Menurut Kabupaten/Kota, 2018 - 2019. Badan Pusat Statistik Kalimantan Timur. Samarinda. https://bit.ly/3pFCfya. 17 November 2020.

[4]. Dahlia, S., Tricahyono, N. H., and Wira, F. R. (2014). Analisis Kerawanan Banjir Menggunakan Pendektan Geomorfologi di DKI Jakarta. Alami.

[5]. Delianto, B., Winata, A., Rusdiyanto, E., and Wardiati, M. A. (2014). Manajemen Lahan. In Pengenalan Lahan (pp. 1-35). Jakarta.

[6]. Hamranani, G. (2014). Analisis Potensi Lahan Pertanian Sawah berdasarkan Indeks Potensi Lahan (IPL) di Kabupaten Wonosobo. Universitas Muhammadiyah Surakarta.

[7]. KLHK. 2010. Klasifikasi Penutup Lahan. SNI 7645:2010. BSN. Jakarta.

[8]. Kusumaningrat, M. D., Subiyanto, S., dan Yuwono, B. D. 2017. Analisis Perubahan Penggunaan Lahan Terhadap Rencana Tata Ruang Wilayah Tahun 2009 dan 2017. Jurnal Geodesi Undip. Vol. 6(4). 2337-845X. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwit3bLZvqDuAhUMA3IKHRHTCGUQFjAAegQIAhAC&url=https%3A%2F%2Fmedia.neliti.com%2Fmedia%2Fpublications%2F201818-analisis-perubahan-penggunaan-dan-pemanf.pdf&usg=AOvVaw2JDAvEZf0me-DUvTFgP7iB

[9]. Mahmudi, Sawitri S. and Yuwono, Bambang Darmo. (2015). Analisis Ketelitian DEM ASTER GDEM, SRTM, dan LIDAR untuk Identifikasi Area Pertanian Tebu Berdasarkan Parameter Kelerengan. Vol 04 (01).

[10]. Nugroho, J. A., Sukoho, B. M., and Sari, I. L. (2009). Pemetaan Daerah Rawan Longsor dengan Penginderaan Jarak Jauh dan Sistem Informasi Geografis.

[11]. Permentan. 2009. Kriteria Teknis Kawasan Peruntukan Pertanian. Nomor 41/Permentan/OT.14/9/2009.

[12]. Suryantoro, A. 2013. Integrasi Aplikasi Sistem Informasi Geografis. Yogyakarta: Ombak.