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Utilization of SPOT Image for Settlement Quality Study in Tanjung Harapan District, Solok City

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ABSTRACT: Tanjung Harapan District is the district with the highest population density, which is 1,223 people/km². Thus the total population of the number of residential areas increased. This increase in population has had an impact on increasing the need for land for housing, thus affecting the quality of settlements. This study aims to determine the level of quality of settlements in Tanjung Harapan District, Solok City. The method used is weighting (scoring) and Overlay to combine all settlement quality parameters. The results obtained are a map of the quality level of settlements in Tanjung Harapan District which has three classifications, namely good class with an area of 74 Ha, medium class with an area of 69 Ha, and bad class with an area of 83 Ha.

Keywords: Settlement Quality, Weighting (scoring), Overlay

1. INTRODUCTION

The increasing rate of population growth in urban areas always makes changes, one of which is a change in the level of environmental quality. The high population growth is both caused by natural growth and the migration of people from villages to cities. Rapid population growth causes an increasing need for space for housing, causing the development of uncontrolled settlements, especially squatters or slums which can result in a decrease in the quality of settlements in the city (Bintarto, 1987). Cities are the centers of relatively large settlements and are centers of human activity and offer opportunities to get a better life than in rural areas (Prasetyo et.al, 2013). Therefore we need a method that can overcome these obstacles.

The population of Solok City in 2021 is recorded at 74,968 people. With an area of 5,764 km², the population density of Solok City is 1,301 people/km². Tanjung Harapan District is a sub-district with a fairly high population density of 32,718 people, with an area of 1,445 people/km². In 2018 the population of Tanjung Harapan District is 31,426 people. Thus the population in Tanjung Harapan District will increase from 2018 to 2021 (BPS, 2021). A large population and very rapid population development, cause a high density of settlements in an area and the density of settlements themselves can be a measure of the level of slums of a settlement or the poor quality of settlements.

Advances in information technology make it easier to determine environmental conditions in urban settlements for planning and managing residential areas. Alternatives that can be taken in determining the condition the quality of the residential environment are by utilizing remote sensing technology and Geographic Information Systems (GIS) (Ambarasakti, 2013). One of the remote sensing data that can be used to determine the quality level of settlements is SPOT imagery because it has a high spatial resolution of 2.5 meters - 5 meters in panchromatic mode, and a resolution of up to a range of 10 meters in multispectral mode, so that it can provide data accuracy that is accurate enough to identify indicators of settlement quality well, including settlement layout, settlement density, the width of settlement entrances, condition of settlement access roads, shade trees, and settlement locations used as parameters to determine the environmental quality of settlements. The identification process can be carried out by visual interpretation using a Geographic Information System (GIS) tool, which produces a map of the quality level of the settlement environment.

2. THE METHOD

2.1 Types of research

The type of research used in this research is quantitative, namely the method used to examine an object with systematic or statistical calculations that are appropriate to the object to test a predetermined hypothesis.

2.2 Time and Location of Research

This research was carried out in the even semester of the 2022/2023 school year from January to March. The location of this research was conducted in Tanjung Harapan District, Solok City.

2.3 Tools and materials

The tools and materials used to support the research are as follows:

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No	Description	Touse
1.	Sarcgis software	Wardata processing software
2.	Territory Administration	Administrative boundaries
3.	SPOT-6 image	Solok City PUPR Office

2.4 Data Analysis Techniques

1. Image interpretation

Sehas obtained the 2019 SPOT image, the first step that can be done is to enter the image in the ENVI application to make geometric, atmospheric and radiometric corrections, if you have exported the correction results then open the arcgis application to cut the corrected image using the administrative boundaries of the area to be tested. To cut it, you can do it in the arctoolbox section then select the extract by mask tool. After that, the image interpretation stage by digitizing and other methods to obtain settlement quality parameters.

2. Pescoring and Overlay

Sehas produced several settlement quality parameters, the next stage is grading or scoring, namely by giving a value or weight to each settlement quality parameter. After all parameters have been scored, an overlay is then performed for all settlement quality parameters to produce data.

2.5 Accuracy

The accuracy test used in this study is an accuracy test of interpretation results based on the method performed using the Short method (confusion matrix) (1982). The accuracy of the information in the field is represented by sample points and settlement quality maps. The input results are in the form of images expressed in overall accuracy, which is the number of large pixels from the results of interpretation and field checks divided by the number of samples multiplied by one hundred percent as follows:

$$= \frac{\text{Number of correct samples}}{\text{Total total sample}} \text{ x100}$$

The overall accuracy value is 14% and is considered small (tolerance accuracy) with a maximum of 95%.

3. RESULTS AND DISCUSSION

a. Image accuracy test

The accuracy test is carried out in the post-processing process, namely after obtaining a classification for the quality of settlements. For accuracy, a map of the quality of settlements that are validated is required to compare it with the real conditions in the field. In this study, there were 36 ground-check locations spread across the research area.

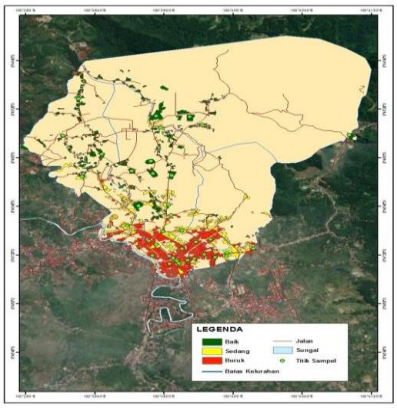

Fig 1. Accuracy test sample point map

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From the results of the ground check, the error/confusing matrix table is obtained as follows:

Table 15. Matrix Table

		Image Interpretation			Total
accuracy	Classification	Good	Currently	Bad	
	Good	13			13
	Currently		8	1	9
	Bad		2	12	14
		Total			36

Source: Interpretation data and field data

The accuracy between information in the field is represented by the ground checkpoint and the 2019 settlement quality map resulting from the SPOT-6 input image which is expressed in overall accuracy, which is the number of large pixels from the results of image interpretation and field checks divided by the number of samples multiplied by one hundred percent as follows:

$$\text{Image accuracy} = \frac{13+8+12}{36} \times 10$$

$$= 91.66\ \%m$$

The results of the accuracy of the image using the confusion matrix in this research sample is 91.66%.

b. Interpretation of settlement quality parameters

1). Residential density map

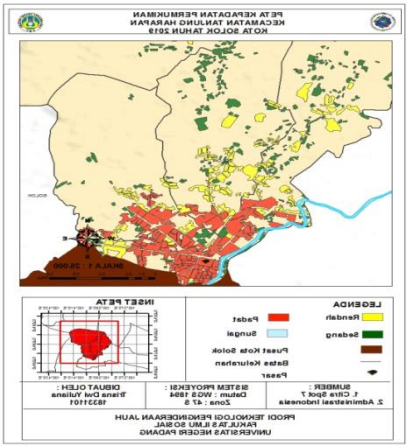

Fig 2. Settlement Density Map

Based on the results of image interpretation for mapping settlement density in Tanjung Harapan District, Solok City, it produces three classifications, namely high, medium and low class. The low-class classification has an area of 78 hectares spread across several sub-districts of Kampung Jawa, Nan Balimo and Laing. In the Tanjung Harapan sub-district, the level of good density is only low because the number of buildings in the settlement block is very rare and the area is dominated by plantations and forests. For the medium density level, it has an area of 81 Ha which is spread over the villages of Kampung Jawa, Nan Balimo, and Laing. While the level of bad density has an area of 108 Ha which is spread over several sub-districts of Koto Panjang, Pasar Pandan Air Mati, and Tanjung Paku.

2). Layout Pattern

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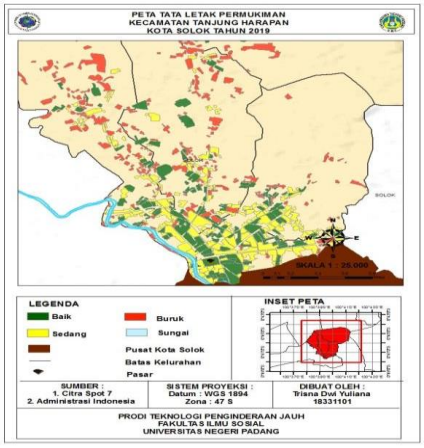

Fig 3. Building Layout Map

From the image interpretation for building layout patterns, it produces three classifications, namely good, medium and bad class. In a good class layout pattern, many residential blocks follow the main road pattern so that they are neatly arranged. Tanjung Harapan District has a good building layout pattern with an area of 98 hectares located in several sub-districts, namely Koto Panjang Village, Pasar Pandan Air Mati Village, and Kampung Jawa Village. The medium-class building layout pattern has an area of 96 Ha which is found in severalsub-districts, namely, Koto Panjang Sub-District, Pasar Pandan Air Mati Sub-District, Kampung Jawa Sub-District and Tanjung Paku Sub-District. The bad class for building layout patterns in Tanjung Harapan District has an area of 93 Ha.

3). Settlement Entrance Width

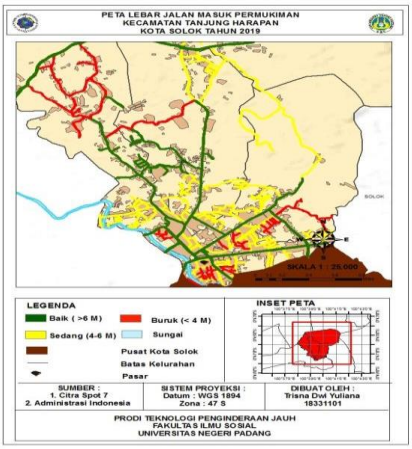

Figure 4. Map of the width of the entrance to the settlement

The road width parameter is a parameter used to determine the accessibility level of a settlement. If many roads can be used to get to a settlement, then the settlement has good accessibility. The width of residential roads in Tanjung Harapan District has a good class classification with an area of 135 hectares, which are spread over Pasar Pandan Air Mati Village, Tanjung Paku, partly in Kampung Jawa Village, and partly in Nan Balimo Village. The width of residential roads with good class has a width of 10 meters, the factor that makes this settlement have a road width of > 6 meters is because the settlements are located along the main arterial road or main road in the city center, this makes access to these settlements easy. The medium class has an average width of 5 meters, on this map the medium class has an area of 60 Ha and is spread over parts of the Kampung Jawa Village, Koto Panjang Village, and parts of the Nan Balimo Village. Settlements with bad class entrances are 2-3 meters wide, and on this map the bad class area is 71 Ha which is spread over parts of the Kampung Jawa Village, a small part of Koto Panjang Village, and some in Laing Village. The density of settlements and houses that tend to have small distances causes the road width to become narrow so that access becomes difficult to enter settlements using 2-wheeled or 4-wheeled vehicles. and on this map the area of the bad class is 71 Ha which is spread over parts of the Kampung Jawa Village, a small part of the Koto Panjang Village, and some of the Laing Village. The density of settlements and houses that tend to have small distances causes the road width to become narrow so that access becomes difficult toenter settlements using 2-wheeled or 4-wheeled vehicles.

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4). Residential Location

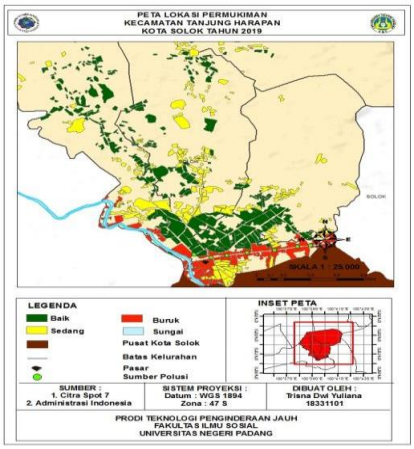

Figure 5. Settlement Location Map

Residential location with the bad class due to the close distance to the city center which is a source of pollution and a source of disaster. The source of pollution here is the main road in the city center and trade area. While the sources of disaster are settlements near rivers because they are at risk of flooding during the rainy season. Tanjung Harapan District has a poor-quality residential location covering an area of 41 hectares spread over Koto Panjang Village, Pasar Pandan Air Mati and Kampung Jawa. The location of the settlement with medium class has an area of 90 hectares which is spread over several sub-districts of Tanjung Paku, Nan Balimo, Kampung Jawa, Pasar Pandan Air Mati and Koto Panjang. The location of the settlement with good class has an area of 136 hectares which is spread over several sub-districts of Pasar Pandan Air Mati, Nan Balimo, Kampung Jawa and Laing.

5). Settlement Protection Tree

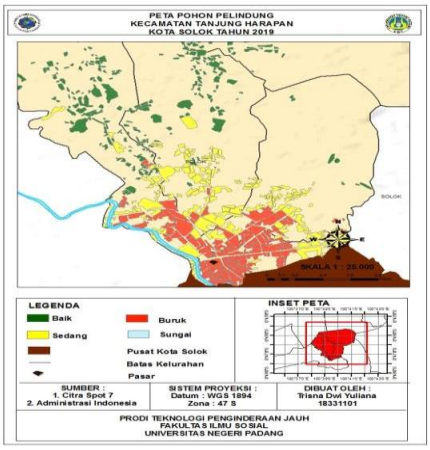

Figure 6. Map of Settlement Protection Trees

Shade trees that are on the side of the road have a function other than to cool pedestrians as well as to reduce air pollution from motorized vehicles which emit dirty air gases, causing the environmental air to become dirty. In other words, if there are more shade trees on the side of the road, it will reduce most of the air pollution from motorized vehicles. Through the application of imagery, the parameter measurements of the shade trees are easier to interpret, because the tree objects appear clear. The sign of a tree object in the image application is a green hue that looks clustered because it is caused by the denseness of the leaves. Tanjung Harapan District has residential shade trees with a moderate class percentage of 34%, a good class of 52%, and a bad class of 23%.

6). Entrance Surface Condition

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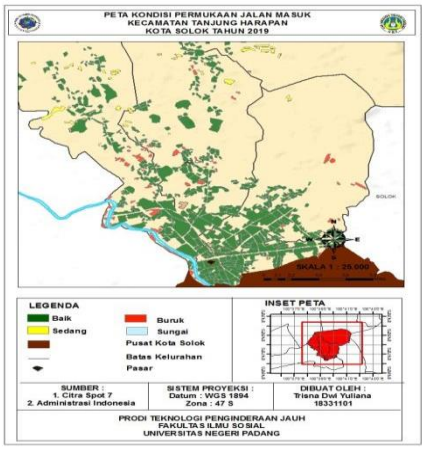

Figure 7. Road condition map

Road condition is the next measuring parameter in which road conditions are classified as good if the road is made of asphalt or block. Roads classified as asphalt make it easier and also make road users feel comfortable. Asphalt roads are generally easy to find in urban areas, compared to village areas where there are asphalt roads but there are still many roads that have not been made of asphalt. The condition of the road that is paved with asphalt shows the quality of the settlement which is classified as good because it helps in facilitating of 234 Ha, the medium class has an area of 20 Ha and the bad class has an area of 12 Ha.

c. Settlement Quality Map in Tanjung Harapan District

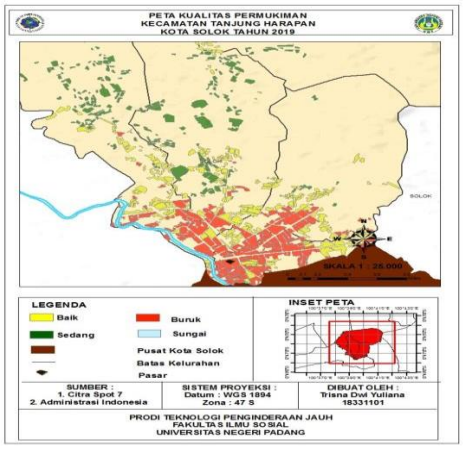

Figure 8. Settlement Quality Map

From the results of data processing based on the interpretation of the six parameters, an overlay or overlapping process is then carried out to obtain the final map in the form of a map of the quality of good, medium and bad settlements in Tanjung Harapan District, Solok City. To determine the resulting class from this overlay, the class interval is calculated using the highest score minus the lowest score divided by the desired number of classes, namely 3 classes. For the highest score the result is 85 while for the lowest score it is 36. After calculating the class interval is 18. So for the good class the score is between 31 – 48, the medium class is 49 – 66, and for the low class it is 67 – 85. For the good quality settlement class with a score of 31 – 48 in Tanjung Harapan District covering an area of 74.53 Ha. Provisions or criteria for good settlement quality, namely having good building density not too dense, lots of dense vegetation or road protection trees, having regular settlement patterns, settlement layouts that are certainly close to the city center or urban facilities and far from air pollution, and having good road access. Medium settlement class with a score of 49 – 66 has an area of 69.01 Ha. The criteria include building density that is not too dense and not too rare, a medium density of shade trees, a road width of 4-6 meters, 25-50% of road conditions have been paved with asphalt, and settlement layout is not too far from the city center, and not too directly affected by air pollution. Low or bad settlement class with a score of 67 – 85 has an area of 83.62 Ha. The criteria include dense building density. The density of shade trees is rare or there are no shade trees at all, the road width is under 4 meters, the condition of the road is still in the form of dirt, the layout of settlements is far from the city center, and is directly affected by air pollution. From the results of

calculating the area of each settlement class, it is known that Tanjung Harapan District has good quality settlements, then bad, and finally moderate.

4. CONCLUSION

The conclusions of this study are:

1. Utilization of spot imagery for the study of settlement quality
   From the results of this study, it can be concluded that SPOT-6 imagery is very well used for the study of settlement quality, because of the high image resolution of 1.5 m – 5 m in a panchromatic mode which makes it easier to recognize objects such as residential buildings, shade trees, markets and river.
2. The quality level of settlements in Tanjung Harapan District
   The quality level of settlements in Tanjung Harapan District has three classifications, namely the bad class with an area of 84 Ha, the medium class with an area of 69 Ha and the good class with an area of 74 Ha. The highest quality of poor-class settlements is found in the Koto Panjang Village. Most of the medium-class settlements are found in Tanjung Paku Village and Kampung Jawa. Most of the quality of good-class settlements is found in the Nan Balimo and Laing Villages.

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