IRSAJ
International Remote Sensing Applied Journal
e_ISSN = 2775-3409
p_ISSN =_____- ____
Vol 2 No 1 | June 2021

IDENTIFICATION OF LAND COVER OF SURFACE TEMPERATURE IN KOTA PARIAMAN USING LANDSAT IMAGERY 8-OLI

Dedek Putri Bungsu[1], Dian Adhetya Arif, S.Pd, M.Sc[2]

[1]Student of the D3 Remote Sensing Technology Study Program, Universitas Negeri Padang, [2]Lecturer Study Program D3 Remote Sensing Technology, Universitas Negeri Padang
email: dedekputri0308@gmail.com

ABSTRACT: Remote sensing is a technology that can overcome data measurement problems for fast and accurate information. This research was carried out in Pariaman City using Landsat 8-OLI imagery with the aim of 1) knowing the identification of land cover based on the classification SNI:7645 (2014) based on Landsat 8-OLI imagery in the Pariaman City area in 2020 2) knowing the identification of surface temperature in the Pariaman City area in 2020. The research was conducted in serval stages, namely pre-processing of image data, selecting band combinations, cutting area studies, image classification, and testing accuracy. At surface temperature using Landsat 8-OLI imagery in 2020, surface temperature values are obtained from the results of thermal band processing. The results of the classification of Landsat 8-OLI images in Pariaman City produce 5 land cover classes, namely water bodies, rice fields, settlements, mixed gardens, and shrubs. This research conducted a classification accuracy test using a confusion matrix accuracy test table. Land cover supervised maximum likelihood method the overall accuracy value is 86.66 %. The results of the surface temperature value in Pariaman City in 2020 obtained the highest temperature value of 30ºC and the lowest surface temperature of 23ºC.

Keywords: *Remote Sensing, Land Cover, Landsat 8-OLI, Surface Temperature*

1. INTRODUCTION

A city is a place that functions as a center of human activity. The growth of various fields in urban areas is very fast compared to other areas. This is closely related to the characteristics of urban areas which have functioned as centers of government, economic activity, tourism, and vehicles for improving the quality of life. The great opportunity to improve the quality of life makes urban areas increasingly crowded with people from suburban areas or people from villages trying their luck in the city.

Land cover is the appearance of physical material on the earth's surface. Land cover can describe the relationship between natural processes and social processes. Land cover is data obtained from remote sensing information that is needed as a basis for the government in determining the direction of development policies, regional development planning, and management of natural energy resources (Nugroho, 2015).

There are various methods of information processing in remote sensing to obtain land cover data. Image classification methods in remote sensing are divided into 3 parts: pixel-based methods, sub-pixel-based methods, and object-based methods. This study uses the maximum likelihood classification method in carrying out land cover classification.

The lack of open space such as parks, forest zones, rivers, and waterways, as well as other non-urban landscapes and the change in the undeveloped land cover into built-up land in urban areas, has led to the formation of the Urban Heat Island (UHI) phenomenon (Aisha, 2013). Urban Heat Island (UHI) is a phenomenon where the temperature in urban areas is higher than the surrounding areas suburban or non-urban areas. This is also caused by the movement of villagers to cities as a phenomenon of urbanization that never stops, which introduces a large number of dense buildings in urban areas (Wicahayani, 2013). Waste heat generated from motorized vehicle emissions and industrial processes, heat conduction through building spaces emitted directly into the atmosphere by air conditioning systems, and metabolic heat generated by humans all combine to cause local air temperatures to increase, especially in urban areas contributing to the formation of the UHI phenomenon.

e_ISSN = 2775-3409
p_ISSN =_____- ____
Vol 2 No 1 | June 2021

Urban Heat Island affects humans and the microclimate of urban areas, but Urban Heat Island hurts urban areas, such as increased energy consumption for cooling such as air conditioners (AC), increased greenhouse gases due to increased demand for electricity in summer originating from fossil fuels, and the main health problems of vulnerable people (the elderly and children) during unusually hot weather (EPA, 2008). Another consequence is that the microclimate of urban areas is affected by the increase in air temperature in cities compared to the study area with the formation of ozone production, local climate changes such as wind patterns, changes in humidity, storms, floods, to changes in local ecosystems.

Pariaman is one of the cities located in West Sumatra Province, Kota Pariaman usually has a tropical climate with quite high air temperatures, according to BPS Kota Pariaman (2019) in 2018 the air temperature for Pariaman City ranged from 22.4ºC - 30.6ºC with humidity ranges from 78 - 87 percent, at in 2019 the temperature of Pariaman City ranged from 23.6ºC - 30.8ºC with humidity ranging from 78 - 85 percent (BPS, 2020). This is not by the standard thermal comfort zone in Indonesia which originates from the effective temperature recommended by the United States (ASHRAE) where the comfortable temperature range is 22ºC - 27ºC (To). Incompatibility of surface temperature with recommended temperature standards for the comfort of the people of Kota Pariaman.

The increase in population can be influenced by 2 things, namely the growth of the city's population and the increase in population movement from villages to cities, and in general, it is understandable that the population increases quickly and easily adapt to conditions otherwise cities are fixed (Fatimah, 2012). Of the 2 aspects that affect the increase in population, it will affect development growth which continues to expand, and the expansion of built-up land.

According to the Central Bureau of Statistics for Kota Pariaman (2019) 2018, the population of Kota Pariaman is 86,618 people. As well as in 2019 increased to 88,501 people (BPS, 2020). Pariaman City has an area of 73.36 km2 (BPS 2020). As a result of high land use, the density of vegetation becomes low, which increases the surface temperature.

Identification of land cover on surface temperature in Kota Pariaman in 2020 is important for the analysis of the survival and sustainability of the area around. Usage methods of remote sensing in identifying land cover and surface temperature in Kota Pariaman make it easy to identify large areas, costs are relatively cheap and time is effective in obtaining accurate and fast spatial data in a relatively short time.

2. THE METHOD

Materials and Methods

The material used in this study is Landsat 8-OLI imagery path/row 127/60 on the date 28-06-2020. The method used in land cover research is the maximum likelihood classification and surface temperature using the band 10 thermal channel method.

3. DATA PROCESSING TECHNIQUES

1. Processing of Land Cover

To carry out land cover processing, the steps that must be tried are:

a. Radiometric Correction
   Radiometric calibration is changing or converting the original image data values downloaded from DN (digital values) to reflectance values (ρ) or radians (L) ToA (Top of Atmospheric).
b. Atmospheric FLAASH Correction Atmospheric corrections were performed for To restore the image, the reflected image value recorded by the sensor on the satellite will be disturbed by various atmospheric conditions so that the reflected pixel value captured by the sensor no longer matches the original object value. The function of atmospheric correction is to restore the condition of the reflected value to an optimal condition close to its original value.

2. Cropping Study Areas
   Image cropping or cropping is attempted to obtain a research area to be able to carry out more focused, detailed, and optimal data processing, image cropping has another utility value, namely reducing the area to be studied according to the zone of interest.

IRSAJ
International Remote Sensing Applied Journal
e_ISSN = 2775-3409
p_ISSN =_____- ____
Vol 2 No 1 | June 2021

Maximum Likelihood Classification Maximum Likelihood Classification Based on density calculations probability for each category of land cover. The probability calculation is known with likelihood. This aims to determine a pixel from a class that can be described from the following equation:

$$P(i \mid x) = \frac{P(xIi)P(i)}{P(X)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

Where :

P (i I x) = conditional probability of class I, which is calculated by the unconditional vector v constant
P (x I i) = conditional probability vector x, which is calculated by the unconditional class
P(i) = probability of class I arising from an image
P(x) = probability vector x

Raster To Polygon

Raster To Polygon and Calculate Geometry, where we will make lines based on the classification we made earlier and immediately find the area by using Calculate Geometry on the attributes in ArcGIS.

Making Accuracy Test Sample Points The ENVI application helps to make a random sampling of points from the classification results, or the ROI of such sampling can be useful in supporting classification accuracy assessment And field exploration expedition.

3. ENVI offers three types of random sampling.
   a. Stratified Random
      This technique also called proportional or quota random sampling, involves dividing the population (all classification images or all ROIs) into homogeneous subgroups (classes of individuals or ROIs) and then taking a simple random sample in each subgroup.
   b. Equalized Random
      This technique also divides the population into homogeneous subgroups (as in Stratified Random) but ensures that each class's sample size (or ROI) is the same. That is, the sample size remains independent of the class size.
   c. Random
      Random sampling does not divide the population into several subgroups but takes random samples from the entire population (heterogeneous). For a fast sample size, the class distribution (or ROI) within the sample will approximate Stratified Random sampling, but classes with small sizes may be missed entirely in a random sample.

4. Accuracy Test (Confusion Matrix)
   An accuracy test or confusion matrix is a calculation to see errors in classification so that the percentage of accuracy is known.

$$MA = \frac{(Xcr\ pixsel}{(Xcr\ pixsel + Xo\ pixsel + Xco\ pixsel)} \quad \ldots\ldots (3.2)$$

Surface Temperature Processing

The digital number conversion into spectral radians is calculated using the formula:

$$L\lambda = MLQCAL + AL \quad \ldots\ldots (3.3)$$

Dimana:

Lλ	: TOA Radian Spektral (watss/(m2*ster*µm)
ML	: Radiance Multiplicative band
AL	: Radiance Add Band
Qcal	: Nilai Piksel Citra Satelit DN

The next step is to change the spectral radian value to a value surface temperature using, convert band radians to satellite brightness temperature using the formula:

IRSAJ
International Remote Sensing Applied Journal
e_ISSN = 2775-3409
p_ISSN =_____- ____
Vol 2 No 1 | June 2021

$$BT = \frac{K_2}{\ln\left(\frac{K_1}{L\lambda}\right)+1} - 273.15 \quad \text{.....(3.4)}$$

Dimana :

BT : Brightness Temperature Satelit (°C)

K1 : Konstanta Kalibrasi 1Landsat OLI

K2 : Konstanta Kalibrasi 2 Landsat OLI

Lλ : TOA Radian Spektral (watss/(m2*ster*µm)

To obtain the Pv value it is necessary to scale the NDVI to minimize the constraints from moist soil conditions and surface energy flux. The vegetation fraction and their respective emissivity are calculated using the formula:

$$Pv = (NDVI - NDVImin / NDVImax - NDVImin)2 \quad \text{.....(3.5)}$$

Dimana:

Pv = Fraksi Penutupan Vegetasi

$$E = 0.004\,Pv + 0.986 \quad \text{.....(3.6)}$$

Dimana:

E = Emisivitas

Das (2015) uses this emissivity value to calculate the surface temperature value using the formula:

$$LST = BT / 1 + w * (BT / p) * \ln(e) \quad \text{.....(3.7)}$$

Dimana:

BT : Temperature Hasil Rekaman Citra Satelit

W : Panjang Gelombang Dari Emitted Radiance (11.5µm)

P : h*c s (1.438*10^-2 m K)

h : Konstanta Planck (6.626 * 10^ -34 Js)

s : Konstanta BBoltzmann (1.38 * 10^ -23 J / K)

c : Velocity Of Light (2.998 * 10^ -8 m /s)

p : 14380

4. RESULTS AND DISCUSSION

The results of the 2020 land cover classification using the supervised maximum likelihood method get the largest area in paddy fields with a percentage of 45.70% covering an area of 2958.03 Ha. The second largest type of land cover with a percentage of 34.50% covering an area of 2232.49 Ha is Mixed Gardens. The third order is the type of residential land cover which has a percentage of 10.71% area 693.43 Ha. The next land cover is shrubs with a percentage of 5.95% covering an area of 385.37 Ha, and land cover with a percentage of 3.13% covering an area of 202.03 Ha is a body of water.

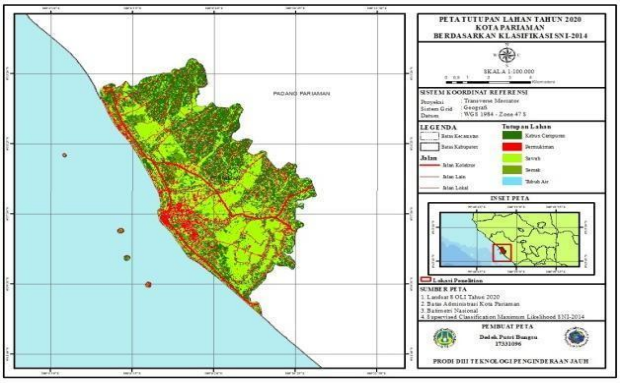

Fig. 1. Land Cover Classification 2020

IRSAJ
International Remote Sensing Applied Journal
e_ISSN = 2775-3409
p_ISSN =_____- ____
Vol 2 No 1 | June 2021

The results of converting the digital number value of the Landsat imagery of Pariaman City in 2020 so that the surface temperature value obtained is a maximum surface temperature value of 30 ºC and a minimum surface temperature of 23 ºC. otherwise the average temperature is 26 ºC.

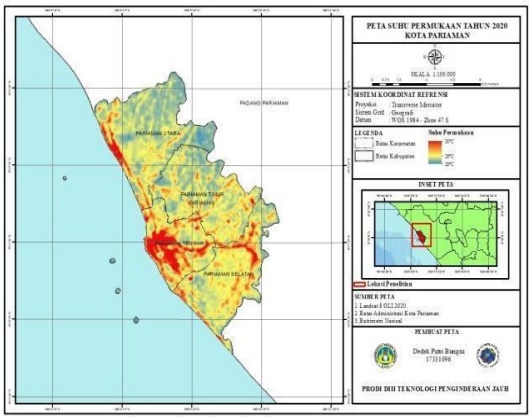

Fig. 2. Surface Temperature Map 2020

1. Accuracy Test

Based on random sample observations made from 30 points distributed in the classification, some points are the same as the results of real observations using Google Earth and there are also The point that is different from the observed results. This error occurs because the land cover types that are classified have colors and hues that are similar to other classes. True and false from the random sample distribution are then entered into the confusion matrix table which is useful for facilitating the process of calculating the accuracy value of a classification process. Table 17 is a presentation of the confusion matrix accuracy test.

Kelas	Tubuh Air	Sawah	Permukiman	Kebun Campuran	Semak	Total (User
Tubuh Air	6	0	0	0	0	6
Sawah	0	6	0	0	0	6
Permukiman	0	0	6	0	0	6
Kebun Campuran	0	0	0	4	2	6
Semak	0	0	0	2	4	6
Total (Producer)	6	6	6	6	6	30

Calculation of overall accuracy or *Overall accuracy*(OA), as follows:

Akurasi Keseluruhan (*Overall Accuracy*)

OA : [(6+6+6+4+4)/30] X 100%

: 86,66 %

Perhitungan *Kappa Accuracy* sebagai berikut :

1. Perkalian Silang

= (6x6)+(6x6)+(6x6)+(6x6)+(6x6)

= (36+36+36+36+36)

=180

2. KA (*Kappa Accuracy*)

KA = [(26X30) – 180] / [(30^2) – 180] X 100%

= (600/720) X 100%

= 83,33 %

IRSAJ
International Remote Sensing Applied Journal
e_ISSN = 2775-3409
p_ISSN =_____- ____
Vol 2 No 1 | June 2021

5. DISCUSSION

1. Yield Area of Land Cover

The percentage of land cover area in paddy fields is 45.70%. Then in mixed garden land cover 34.50%. Bushland covers 5.56%. Furthermore, on-land cover settlements have An area of 10.71%. The last land cover is 3.13%. The percentage of land cover area that is not too far away and almost close to it, namely bush cover area, is 5.96%, while body land cover area is 3.13%.

2. Surface Temperature

The increase in surface temperature in Pariaman City is affected by urbanization, land use and changes in land cover, and the density of buildings in urban areas. The highest temperatures are usually located near urban areas, namely in Central Pariaman District, North Pariaman District, and South Pariaman District with a surface temperature of 30 ºC. On the other hand, the lowest temperatures are located near hilly areas with very dense vegetation, namely in East Pariaman and North Pariaman Districts with a surface temperature of 23 ºC.

The UHI (Urban Heat Island) distribution of Kota Pariaman is wide, the maximum temperature recorded by Landsat imagery is at 30 ºC. then the minimum temperature recorded by Landsat imagery is at 23 ºC. otherwise the average temperature recorded by the image is located at 26 ºC. not only that, but the intensity of UHI will also increase along with the increase in the population urban areas and the conversion of urban land use into built-up land. Urbanization is the main driver of changes in land use which can cause climate change which can form UHI (Zhou, in Fajrin, 2019).

a. Accuracy Test

In the classification of Landsat 8 satellite imagery that was tried in this study, using the guided method with the maximum likelihood algorithm. Produce good classification accuracy results. The total accuracy value of reaching the guideline is not less than 85%. The classification results can be seen previously in the calculation of totality accuracy or overall accuracy (OA). The results of the classification accuracy test show that the accuracy is quite large and meets the requirements set by (USGS) which is 85%. The confusion matrix accuracy test table is in table 17 there are 4 misclassified points out of 30 random sample points that are scattered.

In classifying images, the most important thing is to see the level of accuracy of the classification results. This study looks for various accuracy values, both from overall accuracy, cross-multiplication calculation, and kappa accuracy. Seeing the results of the classification carried out in this study, there were 4 errors, namely mixed gardens which were in shrubs, bushland cover which was in mixed gardens, then mixed gardens which were in shrubs, then shrubs which were in mixed gardens.

In taking temperature samples in this field, a validation process was attempted from the surface temperature processing results. The implementation is based on the Kota Pariaman area, where the sample points match the total land cover sample points 30 sample points. Sampling The temperature of this study uses a source (AccuWeather).

The surface temperature accuracy test in the field in the Pariaman City area found the highest temperature of 29ºC in Central Pariaman District with a land cover of bodies of water, settlements, and shrubs. There is also the highest temperature of 29ºC in East Pariaman District with Covered Paddy Fields. While the lowest temperature is 24ºC in South Pariaman District with land covered with bodies of water, shrubs, and paddy fields.

b. Relationship between Land Cover and Surface Temperature

The surface temperature in built-up land is higher than the surface temperature in unbuilt land. This is because on physically built-up land, the density and direction of the wind decrease, hence the high surface temperature on built-up land, compared to undeveloped land where solar radiation is completely absorbed for the photosynthesis process.

The changing surface temperature is affected by the decreasing vegetation space and the increasing density of buildings in a city due to the increasing population. This can cause problems such as changes in surface temperature.

6. CONCLUSION

1. The results of a land cover classification in Pariaman City using the Supervised Maximum Likelihood method obtained the largest area of paddy field land cover with a percentage of 45.70% covering an area of 2958.03 Ha. The second type of land cover with a percentage of 34.50% covering an area of 2232.49 Ha is mixed gardens and the third type of land cover is settlements that have percentage of 10.71% area 693.43 Ha.
2. The results of the surface temperature of Pariaman City in 2020 obtained the highest surface temperature value near urban areas, namely in South Pariaman District with a surface temperature of 30 ºC. On the other hand, the lowest temperatures are located near hilly areas with dense vegetation, namely in East Pariaman and North Pariaman Districts with a surface temperature of 23 ºC.
3. Classification results of Landsat satellite imagery 8 Oil using the maximum likelihood method obtained an overall accuracy value of 86.66%. Land cover classes are determined in the training area.

7. REFERENCES

[1] Adiningsih, Erna Sri., et al. 2001. Study of Changes in Spatial Distribution of Air Temperature Due to Changes in Land Cover. EIGH.
[2] Adiyanti, S. 1993. Hot Poles in the City of Jakarta, Master's Thesis of the Environmental Science Study Program, Postgraduate Program. Indonesian University.
[3] Aisha, Iztirani Nur and Petrus N. Indradjati. 2013. Adaptation of the Application of Mitigation Forms of Urban Heat Island (UHI) in the Central Area of Bandung City. ITB: Journal of Urban and Regional Planning A SAPPK V3N1.
[4] Central Bureau of Statistics Kota Pariaman Year 2019. Pariaman in Figures 2019. Pariaman: BPS Kota Pariaman.
[5] Central Bureau of Statistics Kota Pariaman 2020. Pariaman in Figures 2020. Pariaman: BPS Kota Pariaman
[6] Becker, F&Z. L.Li. 1990. Towards a Local Split Window Method Over Land Surfaces Int.J. Remote sensing,11:369-293.
[7] Cholik, Rizki Zulkarnain 2016. The Effect of Changes in Land Cover on Changes in Surface Temperature in the City of Surabaya. Surabaya: Department
[8] Urban and regional planning. Faculty of Civil Engineering and Planning ITS. Surabaya
[9] Delarizka, A., Sasmito, B., and Hani'ah. 2016. Analysis of the phenomenon of Pulau Bahang (Urban Heat Island) in Semarang City Based on Relationships Between Land Cover Change With Surface Temperature Using ImageryMultiTemporalLandsat. Journal Undip Geodesy 5, 165–177.
EPA. (2008). Reducing Urban Heat Islands: Compendium of Strategies. United States of America: Perrin Quarles Associates.
[10] Fatimah, Rizki Nurul. 2012. Spatial PatternsCity Surface Temperature Surabaya in 1994, 2000, and 2011. University Indonesia:Depok.
[11] Fariz, Ridho Tridha. 2017. OBIAClassificationAndbuilt-UpLand Indices Ndbi For Estimation Of Settlement Density In Pontianak City. Geography Journal. Vol. 14. No. 2. the year 2017. ISSN: 2549-3094
[12] Lillesand, TM, RW (1994) Remote Sensing*andImage interpretation Image (Translate)*.Gadjah Mada University Press. Yogyakarta.
[13] Lillesand, TM, RW Kiefer and Jonathan WC 2004. Remote Sensing and Image Interpretation. Fifth edition. New York. John Wiley and Sons.
[14] Liu Hua and Qihao Weng. 2011. Enhancing Temporal Resolution of Satellite Imagery for Public Health Studies: A Case StudyofWestNileVirus Outbreak in Los Angeles in 2007. Remote Sensing For Environment.117 (2012) 57-71. June 13, 2017.
[15] Lo, CP 1996. Applied Remote Sensing. Translator: Bambang Purbowaseso, University of Indonesia Press. Jakarta. Translated from Applied Remote Sensing.
[16] Nugroho SA, Wijaya AP, and Sukmono A.2016. Analysis of the Influence of Vegetation Change on Surface Temperature in *the Region RegencySemarang Using the Method Remote Sensing.* Journal GeodesyUndip, Vol. 5, No1(2016),ISSN: 2337 – 845.