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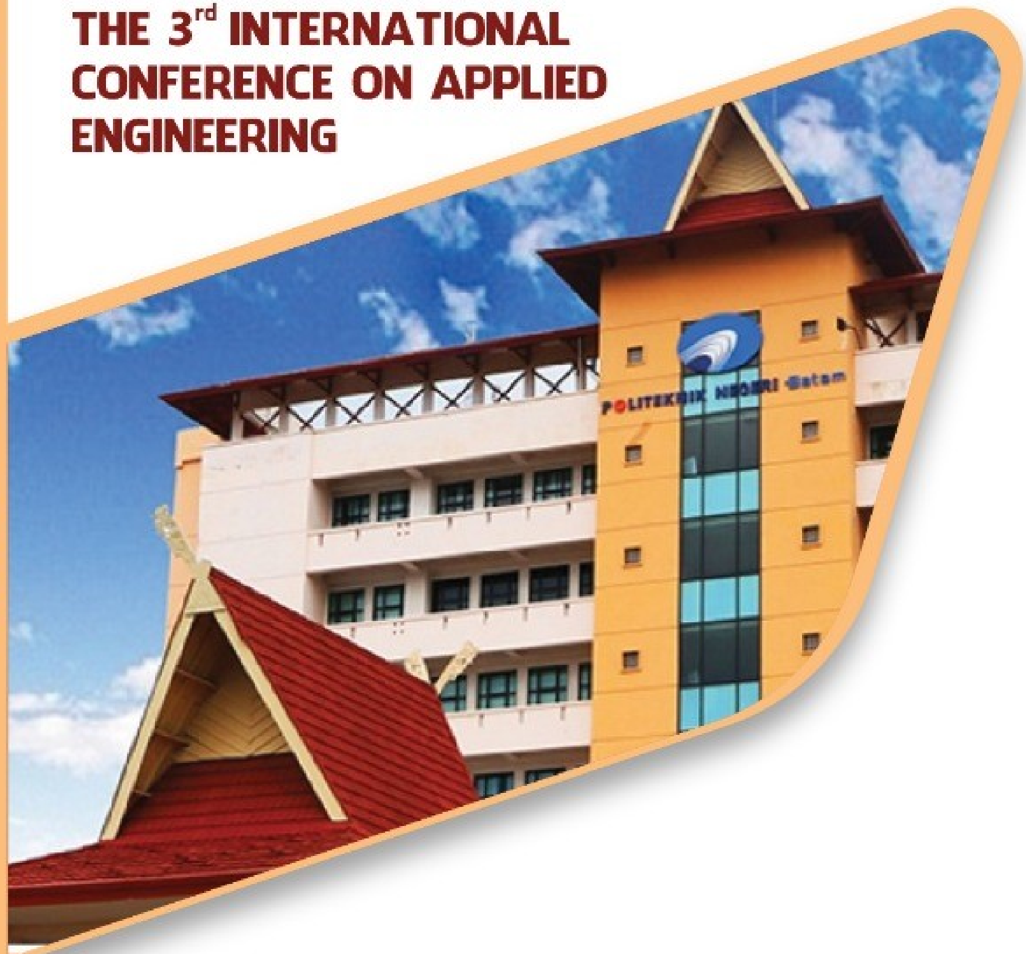

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Foreword

This volume contains a collection of papers that constitute the 3rd International Conference on Applied Engineering (ICAE 2020), held in Batam, Indonesia, on October 7, 2020. This conference has been held for the third time by Politeknik Negeri Batam.

The technical program for ICAE 2020 included papers addressing a number of current and emerging topics in applied engineering. In response to the call for papers, we received 62 full papers in three tracks, namely informatics, electronics, and machine. The Program Committee provided at least two reviews for each paper, and on the basis of these reviews we selected 19 full papers (an acceptance rate of 23.45%). These papers can be grouped into several topical areas, including information system, data visualization, robotics, modeling, environment engineering, and other related fields.

We express gratitude to all who helped make ICAE 2020 a success. It required the significant efforts of many people to make this conference possible, especially in this time of Covid-19 pandemic and considering that this is the first time we held a virtual conference. We thank the Organizing Committee members along with the numerous reviewers who reviewed and discussed the submitted manuscripts. These reviewers serves to bring a broad set of perspectives to the research arena. We especially thank the authors who took the time to carefully write up the results of their research and submit papers for consideration. The quality of these papers is a tribute to the authors and also to the reviewers who have guided any necessary improvement. Last but not least, we are greatly indebted to the five keynotes speakers: Prof. Shaio Yan Huang of National Chung Cheng University of Taiwan, Ms. Diana Sutanto of Nanyang Polytechnic of Singapore, Ronny Sutarto, Ph.D. of Canadian Light Source, Canada, Ms. Agnes Lesage of Infineon Asia Pacific Pte. Ltd., and Rozaimi Che Hasan of Universiti Teknologi Malaysia of Malaysia for accepting our invitation to address this conference.

November 2020

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ICAE 2020 is organized by Politeknik Negeri Batam in cooperation with Electron Devices Society IEEE Indonesia Chapter and co-hosted by UIIM Malaysia.

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Estimating Vegetation Temperature Condition and Its Impact on Drought for Natural Plantation Areas Using Multi-Band Sensor Remote Sensing Data

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***Abstract*— Drought is closely related to water reserves that are in the soil, both water reserves for land and for everyday human needs. In plantation, drought has a significant impact. Drought can be a barrier to plant production which will have an impact on local economic conditions. However, information about land drought is still lacking at this time. Even though the information is very much needed by various parties. This research uses remote sensing data on Landsat 8 imagery where this research aims to obtain a drought index value using the transformation of Land surface temperature (LST), NDWI and TVDI which will then be performed correlation regression equations and test the interpretation of accuracy of field data on the potential for a drought of plantation land in the research area. The results of data processing showed that the distribution of the most drought potential of plantation areas in Rempang Island was the potential for high drought with the total area of plantations having a high drought potential of 5737.073029Ha. The potential for moderate drought in the plantation area on Rempang Island has an area of 2851,479327 Ha. Low drought potential has the smallest area with a total area of the entire plantation area of 447.271236 Ha.**

Keywords*— *Drought, Vegetation, Plantation, Remote Sensing Data,

I. INTRODUCTION

A drought is an event that can threaten and disrupt human life [5], [7]. Drought is closely related to water reserves that are in the soil, both water reserves for land and for human needs [2]. In plantation, drought has a significant impact. Drought can be a barrier to plant production which will have an impact on local economic conditions [1], [3]. Judging from the visible effects of the drought, it is necessary to take measures to reduce the impact. However, information about land drought is still lacking at this time. Even though the information is very much needed by various parties. Information on land drought can help the surrounding community to know the potential drought in their area so that the community can take actions that can minimize the impact of the drought [4], [9]. Because it could be a drought due to bad habits practiced by the community [8]. [9]. As for the government, this information can be used as a reference for taking action to avoid or reduce the effects of the drought [4].

Remote sensing can be interpreted as a technology to identify an object on the surface of the earth without going through direct contact with the object. With remote sensing, it can facilitate the actual, fast, and efficient data collection process. This research uses remote sensing data on Landsat 8 imagery where this research aims to obtain a drought index value using the transformation of Land surface temperature (LST), NDWI and TVDI which will then be performed correlation regression equations and test the interpretation of accuracy of field data on the potential for a drought of plantation land in the research area.

Drought in plantation land is a significant impact on plants [7] and the sustainability of community income [10]. Information on the drought of plantation land can help the surrounding community to know the potential drought in their area [7] so that the community can take actions that can minimize the impact [4] of the drought.

II. RESEARCH METHOD

A. Research Location

This research is located on Rempang Island. Rempang Island is an island in Batam city, which is the second-largest series of islands in the Riau Islands. Rempang Island is located at 0°42′N 104°13′E which has an area of approximately 165 km2. In this research, the area used as the study area is Rempang Island and currently, Rempang Island is being developed for the plantation area. The research location is shown in Fig. 1.

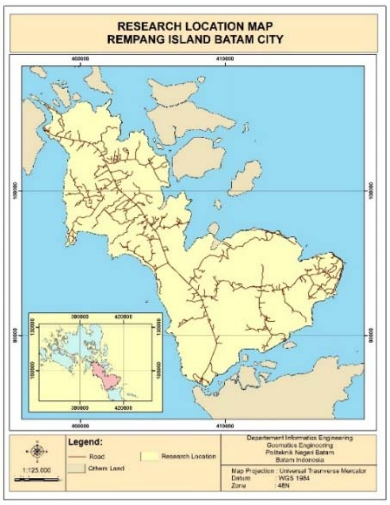

Fig. 1. Location of the research.

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B. Data Collection Techniques

Remote sensing image data collection techniques using Landsat 8 images can be downloaded via www.earthexplorer.usgs.gov, after the data is obtained, then the location is adjusted (cropping) according to the study area. Cropping image is one of the process of taking image slices where image cutting takes only certain areas that are needed. The image that has been cut will produce narrower areas and less information making it easier for data processing and visual interpretation. In this research, the process of cropping uses the administrative map of Riau Islands as a reference.

The next stage is geometric correction and radiometric correction. Geometric correction is a correction caused by the movement of the earth's rotation with the earth's curve so that there is a shift in the position of the reference coordinates [4], [7]. In this case, the transformation of remote sensing imagery is done by correcting the error value that occurs when the movement of the satellite or sensor during the orbit by using several Ground Control Points (GCP) so that the position is the same as on the surface of the earth [1].

Radiometric calibration is carried out to eliminate or minimize atmospheric disturbances during the image recording process and to return the reflectance values of the earth's surface according to the range of reflections. The disturbance in question is the reflection of the recording results that are not in accordance with the existing surface of the earth so that it needs to be done radiometric correction by changing the value of the digital number (DN) into a reflectance value. The radiometric correction processing uses equations [1], [11], [14]:

- Pixel Value to Spectral Radian Value (TOA Radiance)

$$L_\lambda = \left(\frac{L_{max} - L_{min}}{QCAL_{max} - QCAL_{min}}\right) x \ (Q_{cal} - QCAL_{min}) + L_{min} \quad (1)$$

L_λ = Spectral radians on sensors (W/(m2 .sr.μm)

Q_{cal} = Pixel value (DN)

$QCAL_{min}$ = Minimum pixel value that refers to LMINλ (DN)

$QCAL_{max}$ = Maximum pixel value that refers to LMAXλ (DN)

L_{min} = Minimum spectral radian (W/(m2 .sr.μm)

L_{max} = Maximum spectral radian (W/(m2 .sr.μm)

- Radian to reflectance value

$$\rho\lambda = \frac{\pi . L\lambda . d^2}{ESUN\lambda . \cos\theta_s} \quad (2)$$

$\rho\lambda$ = reflectance value

π = mathematical constant (-3,14159)

d^2 = distance of the sun - earth (astronomical unit)

$ESUN\lambda$ = average exoatmospheric solar irradiation (W/m2.sr.μm)

θ_s = sun zenith angel (degree)

- Dark Pixel Substraction

$$RC = R - Rsi \quad (3)$$

RC = surface reflectance

R = TOA reflectance

RSI = spectral value used for offset

The next stage of processing after correction is Multispectral classification. Multispectral classification is the grouping of objects based on the color of the appearance of the image. Multispectral classification aims to classify classes that appear in an image, for example, vegetation, water charts, settlements [2], [3], [5], etc. These classifiers will result in a land cover of an area. In this research, the multispectral classification separates plantation land and non-plantation land [1]. To make a temperature distribution using the transformation of land surface temperature (LST). Land surface temperature (LST) is the radiative surface skin temperature from the ground surface, measured in the direction of the remote sensor [16], [6]. Estimated from the Top-of-Atmosphere brightness temperature of the infrared spectral channel from a geostationary satellite constellation. Temperature calculation uses the formula for converting Pixel Values to TOA (Top of Atmosphere) Radians [14], [15]:

$$\mathbf{L\lambda = MLQcal + AL} \quad (4)$$

Lλ = TOA spectral radiance (watts/ m2 × srad × μm)

ML = Band-specific multiplicative rescaling factor (from the metadata)

Qcal = Digital Number (DN)

AL = Band-specific additive rescaling factor (from the metadata)

This research uses LST to obtain surface temperature in Landsat 8 images with the Brightness Temperature algorithm. The Conversion of Spectral TOA Radians to Kelvins using the formula [7], [14]:

$$\mathbf{T} = \frac{K2}{In(\frac{K1}{L\lambda}+1)} \quad (5)$$

Tb = Brightness Temperature

(K) K1 = Spectral radians calibration constant

K2 = Absolute temperature calibration constant (K)

Lλ = Radian spectral Convert temperature in units Kelvin becomes Celsius: TCelcius = TKelvin - 273

Normalized Different Water Index (NDWI) is a satellite index derived from Near-Infrared (NIR) and Short Wave Infrared (SWIR) channels [12], [13]. The SWIR reflectance reflects changes in both the water content of the vegetation and the structure of the spongy mesophyll in the vegetation canopy, while the reflectance of the NIR is influenced by the internal structure of the leaves and dry leaves but not by the water content [14]. The combination of NIR and SWIR eliminates variations caused by the internal structure of leaves and leaf content of dry matter, increasing accuracy in taking vegetation moisture content. The ratio of NIR and SWIR in NDWI calculations is shown in the following equation [13]:

$$\mathbf{NDWI} = \frac{(\boldsymbol{green} - \boldsymbol{NIr})}{(\boldsymbol{Green} + \boldsymbol{NIr})} \qquad (6)$$

Where Green is Reflectant band 3 on Landsat 8 image and NIr is Reflectant band 5 on Landsat 8 image.

The value of air humidity using the drought index on Rempang Island is obtained through the calculation of empirical parameters from the relationship between surface temperature (LST) and moisture content index (NDWI) [17], [18]. The index is associated with soil moisture and is obtained only based on input from remote sensing Temperature Vegetation Dryness Index (TVDI) satellite information. The TVDI formula is as follows [19]:

$$\mathbf{TVDI} = \frac{LST - LSTmin}{LSTmax - LSTmin} \qquad (7)$$

LST = Surface temperature observed at a pixel

LSTmin = the minimum surface temperature in a triangle, indicates the equation obtained from the wet side

LSTmax = the maximum surface temperature in the triangle, indicates the equation obtained from the dry side (LST max = a + b NDVI)

The parameters a and b are obtained based on the pixel of an area large enough to represent the entire range from wet to dry and from bare soil to fully vegetated surfaces. TDVI values range from 0 to 1. Value 1 represents the dry side (limited water availability) and 0 represents the wet side (unlimited water availability). Drought potential is affected by soil moisture [17], [7].

III. Result and Discussion

Estimation of the distribution of surface soil temperature in relation to the drought of plantation land in this research was obtained from the extraction of remote sensing image data.

A. *Geometric and Radiometric Corection*

Geometric correction in this research was carried out by increasing geometric accuracy by using control points or ground control. The control point or commonly called GCP (Ground Control Point) in question is the point whose coordinates are known precisely and can be clearly seen on satellite imagery. In this research, geometric corrections were carried out by placing GCP scattered throughout the study area. The base map used as a reference is the RBI map of the research area with a scale of 1: 25,000, this basic map was obtained from the official *inageoportal* BIG website (Geospatial Information Agency). The RMSE (Root Mean Square Error) value that meets the requirements is less than 1.

The radiometric correction stage starts from the conversion of a digital number (DN) to radians to dark pixel subtraction. The stages of DN to Radiance are carried out to see the value of light energy from the appearance of an image. Then for the parameter values in the image formula can be obtained from the image metadata, then the next step is to change the Radians to Reflectance to determine the value of the pixels missing from the atmosphere in the image recording. To find the value of reflectance used the value of sun elevation in the image that can be searched in the metadata. The dark subtract process is a process to improve the value of reflectance. This is done because sometimes the value produced by the dark appearance reflectance value has a pixel value of minus (-).

B. *Multispectral Classification*

The multi-spectral classification used in this study is the maximum likelihood of multi-spectral classification. The Maximum Likelihood classification (MLC) uses the assumption that the statistical data from each class in each channel is normally distributed and calculates the probability of a pixel to enter a particular class. The threshold probability of a pixel value (threshold) is determined in the classification process. if the highest probability value of a pixel is lower than the specified threshold value, then the pixel is classified as an unclassified pixel. Multi-spectral classification conducted in this research is to divide the land cover class into plantation land and non-plantation land. The results of the multi-spectral classification in this research are shown in Fig. 2.

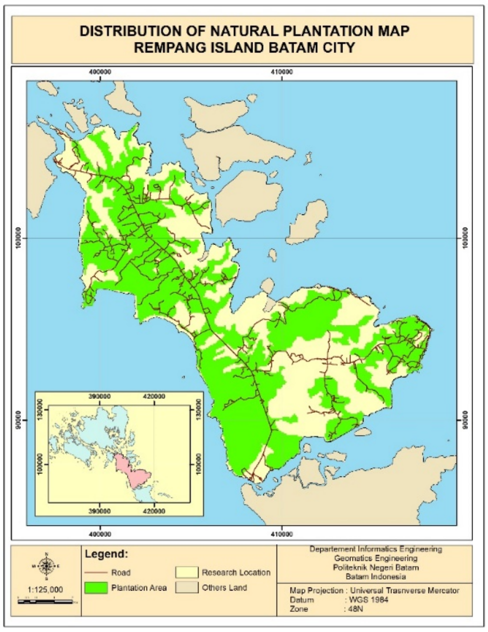

Fig. 2. The results of the multi-spectral classification.

C. *Land Surface Temperatur (LST)*

The extraction results of the remote sensing data for the distribution of ground surface temperature using Land Surface Temperature (LST) transformation showed a temperature range of 18^0c - 27^0c in the Rempang island plantation area. High-temperature distribution can be seen from the results of data extraction found in areas adjacent to the highway. This is made possible because of the influence of human activity which causes high surface temperatures. The distribution of land surface temperature is shown in Fig. 3.

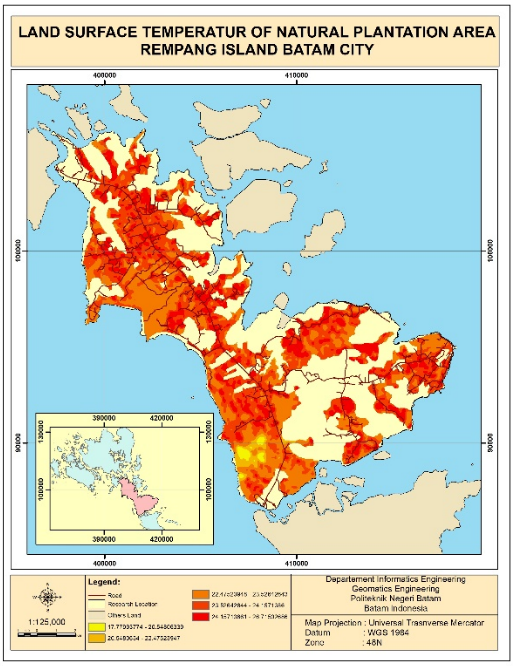

Fig. 3. The distribution of land surface temperature.

D. Normalized Different Water Index (NDWI)

This research uses the Normalized Different Water Index (NDWI) transformation to determine the water content in the plantation area, this is because NDWI is an algorithm used for water body detection. Water bodies have the capacity to absorb strongly the wavelengths of infrared light. The results of remote sensing image data processing using NDWI transformation conducted in this research indicate that the plantation area that has the highest water content is in the seaside area with an NDWI index value of 0.4-0.8, while for low soil content is found in the central area of the island and the area adjacent to the highway. The NDWI distribution results are shown in Fig. 4.

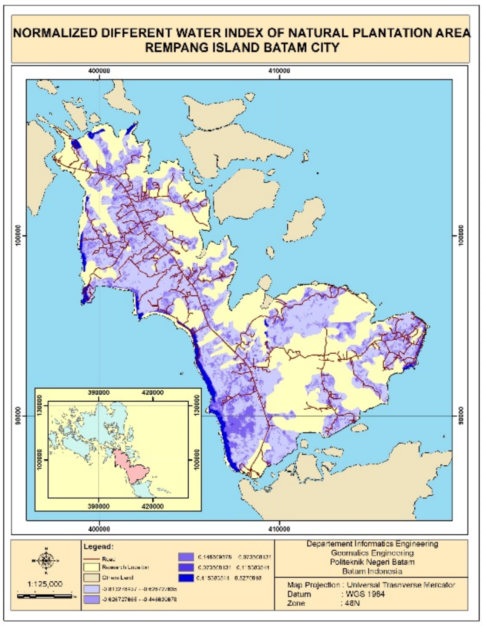

Fig. 4. The NDWI distribution.

E. Temperature Vegetation Dryness Index (TVDI)

The last parameter from the remote sensing image data extraction that is used to find the distribution of drought in the plantation area in this study is the Temperature Vegetation Dryness Index (TVDI). A TVDI transformation utilizes the relationship between vegetation index and land surface temperature (LST). The vegetation index is a good indicator to determine the condition of a plant, but it is unable to provide information on the moisture condition of the soil. While LST can provide information on the amount of heat released by a surface related to the process of transpiration and evaporation. The integration of vegetation index and soil surface temperature into TVDI is able to provide drought information on land. The TVDI values are represented as ratios ranging from 0 to 1. The TVDI values close to 1 indicate limited water availability (dry limit), while TVDI with values close to 0 indicates guaranteed water availability (wet-boundary). The results of data processing in this research produce a range of values of wetness of vegetation index from 0.03-0.7 with the distribution of the wettest vegetation land is at the bottom of the island in the research area with a range of values of 0.03-0.38, while for the distribution of the driest vegetation land are in the middle of the island and around the highway area with a range of values 0.5-0.7. The pattern of distribution of vegetation drought index in the plantation area in the research area is shown in Fig. 5.

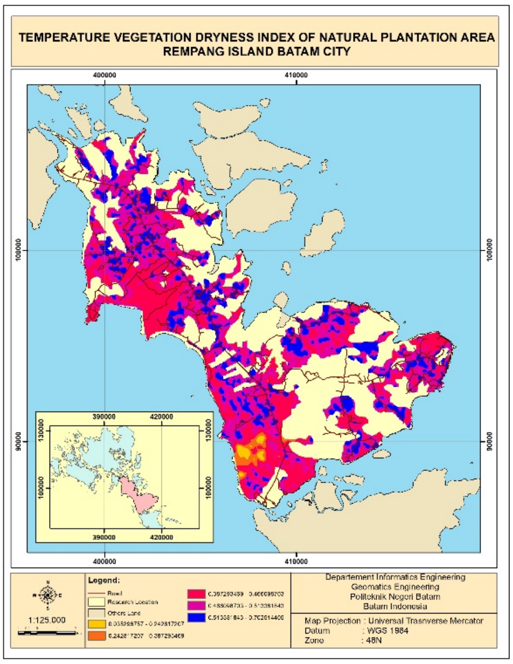

Fig. 5. The pattern of distribution of vegetation drought index in the plantation area.

F. Drought Distribution of Plantation Area

Distribution of plantation land drought in this research was obtained by using the parameters of the extraction of remote sensing image data. The parameters used are LST, NDWI, TVDI, and multispectral classification (to identify plantation and non-plantation land). The four parameters are then overlayed into one unit of analysis which is then used as the basis for the distribution of potential drought in plantation areas in the research area. The resulting analysis unit is also used as a reference for field data validation. Validated data in the field is land surface temperature data which is then performed correlation regression analysis to determine the level of accuracy of the representation of processing results using remote sensing data. The results of data processing showed that the distribution of the most drought potential of plantation areas in Rempang Island was the potential for high drought with the total area of plantations having a high drought potential of 5737.073029Ha. The potential for moderate drought in the plantation area on Rempang Island has an area of 2851,479327 Ha. Low drought potential has the smallest area with a total area of the entire plantation area of 447.271236 Ha. The distribution of drought potential is shown in Fig. 6.

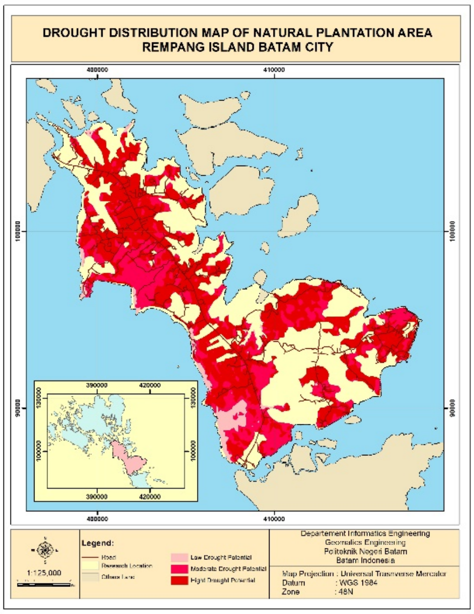

Fig. 6. The distribution of drought potential.

IV. Conclusion

This research uses remote sensing data on Landsat 8 imagery where this research aims to obtain a drought index value using the transformation of Land surface temperature (LST), NDWI and TVDI which will then be performed correlation regression equations and test the interpretation of accuracy of field data on the potential for a drought of plantation land in the research area. The results of data processing showed that the distribution of the most drought potential of plantation areas in Rempang Island was the potential for high drought with the total area of plantations having a high drought potential of 5737.073029Ha. The potential for moderate drought in the plantation area on Rempang Island has an area of 2851,479327 Ha. Low drought potential has the smallest area with a total area of the entire plantation area of 447.271236 Ha.

References

[1] W. Anurogo, M. Z. Lubis, L. R. Sari, M. A. K. Mufida, and W. J. Prihantarto, "Satellite-based estimation of above ground carbon stock estimation for rubber plantation in Tembir Salatiga Central Java," in 2018 4th International Conference on Science and Technology (ICST), 2018, pp. 1-6.

[2] M. Z. Lubis, H. M. Taki, W. Anurogo, D. S. Pamungkas, P. Wicaksono, and T. Aprilliyanti, "Mapping the distribution of potential land drought in Batam Island using the integration of remote sensing and geographic information systems (GIS)," in IOP Conference Series: Earth and Environmental Science, vol. 98 (1), 2017, pp. 012012)

[3] W. Anurogo, M. Z. Lubis, and M. A. K. Mufida, "Modified soil-adjusted vegetation index in multispectral remote sensing data for estimating tree canopy cover density at rubber plantation," JGEET, vol. 3(1), pp. 15-24, 2018.

[4] S. Antoni, R. A. Bantan, H. M. Taki, W. Anurogo, M. Z. Lubis, T. A. Al Dubai, and A.G. Al-Zubeiri, "The extent of agricultural land damage in various tsunami wave height scenarios: Disaster management and mitigation," Intl. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., vol. 42, pp 51-57, 2018.

[5] W. Anurogo, L. R. Sari, M. Z. Lubis, D. S. Pamungkas, M. A. K. Mufida, and A. D. L. Situmorang, "An integrated comparative approach to estimating forest aboveground carbon stock using advanced remote sensing technologies," in 2018 International Conference on Applied Engineering (ICAE), 2018, pp. 1-6.

[6] R. Sari, W. Anurogo, and M. Z. Lubis, "Pemetaan sebaran suhu penggunaan lahan menggunakan citra Landsat 8 di Pulau Batam," Jurnal Integrasi, vol. 10(1), pp. 32-39, 2018.

[7] W. Anurogo, M. Z. Lubis, U. Brajawidagda, M. A. K. Mufida, D. S. Pamungkas, S. Arjasakusuma, and W. J. Prihantarto, "Suitable small farm reservoir development planning for drought disaster risk management of agricultural land using remote sensing and GIS" in Sixth Geoinformation Science Symposium, International Society for Optics and Photonics, 2019.

[8] S. Bachmair, K. Stahl, K. Collins, J. Hannaford, M. Acreman, M. Svoboda, and N. D. Crossman, "Drought indicators revisited: the need for a wider consideration of environment and society," Wiley Interdiscip. Rev. Water, vol. 3(4), pp. 516-536, May 2016.

[9] C. Teutschbein, E. Lundkvist, F. Albrecht, and M. Blicharska, "A culture of proactive drought management? Unraveling the perception and management of droughts in Swedish municipalities," Geophys. Res. Lett., vol. 21, January 2019.

[10] W. Anurogo, M. Z. Lubis, and H. Khoirunnisa, "Factors affecting land transfer function and its impact on farmers' income in Srigading Village, Sanden Sub-district, Bantul Regency," J Pend. Geo., vol. 24(1), pp. 34-41, 2019.

[11] P. Danoedoro, Pengantar Penginderaan Jauh Digital, Yogyakarta: Andi, 2012.

[12] N. P. Robinson, B. W. Allred, M. O. Jones, A. Moreno, J. S. Kimball, D. E.Naugle, and A. D. Richardson, "A dynamic Landsat derived normalized difference vegetation index (NDVI) product for the conterminous United States," Remote Sens., vol. 9(8), pp. 863, 2017.

[13] K. R. Ahmed and S. Akter, "Analysis of landcover change in southwest Bengal delta due to floods by NDVI, NDWI and K-means cluster with Landsat multi-spectral surface reflectance satellite data," Remote Sens. Appl. Soc. Environ., vol. 8, pp. 168-181, 2017.

[14] A. Wicaksono and P. Wicaksono, "Geometric accuracy assessment for shoreline derived from NDWI, MNDWI, and AWEI transformation on various coastal physical typology in Jepara Regency using Landsat 8 OLI imagery in 2018," Geoplanning Journal of Geomatics and Planning, vol. 6(1), pp. 55-72, 2019.

[15] J. M. Galve, J. M. Sánchez, C. Coll, and J. Villodre, "A new single-band pixel-by-pixel atmospheric correction method to improve the accuracy in remote sensing estimates of LST. application to Landsat 7-ETM+," Remote Sens., vol. 10(6), pp. 826, 2018.

[16] I. Dar, J. Qadir, and A. Shukla, "Estimation of LST from multi-sensor thermal remote sensing data and evaluating the influence of sensor characteristics," Annals of GIS, vol. 25(3), pp. 263-281, 2019.

[17] S. Ali, D.Tong, Z. T. Xu, M. Henchiri, K. Wilson, S. Siqi, and J. Zhang, "Characterization of drought monitoring events through MODIS-and TRMM-based DSI and TVDI over South Asia during 2001–2017," Environ. Sci. Pollut. Res., vol. 26(32), pp. 33568-33581, 2019.

[18] L. Du, N. Song, K. Liu, J. Hou, Y. Hu, Y. Zhu and Y. Guo, "Comparison of two simulation methods of the temperature vegetation dryness index (TVDI) for drought monitoring in semi-arid regions of China," Remote Sens., vol. 9(2), pp. 177, 2017.

[19] B. Li, C. Ti, Y. Zhao, and X. Yan, "Supplementary materials: Estimating soil moisture with Landsat data and its application in extracting the spatial distribution of winter flooded paddies," Remote Sens., vol. 8 (38), 2016.