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ANALYSIS OF TSS VALUE CHANGES IN 2020-2023 USING SENTINEL-2A IMAGES IN KUTA WATER AREA OF SOUTH LOMBOK

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ABSTRAK

Pemantauan kualitas air sangat penting dilakukan untuk mengetahui sejauh mana aktivitas manusia mempengaruhi kualitas air yang digunakan untuk menunjang kehidupan manusia. Keberadaan Sirkuit Mandalika yang kini menjadi sirkuit MotoGP Indonesia mendongkrak pariwisata di kawasan Kuta Lombok Selatan. Kualitas perairan di kawasan Kuta Lombok Selatan dipastikan akan menurun akibat aktivitas wisata ini. Menggunakan metode penginderaan jauh untuk mengukur kualitas air, penelitian ini mengkaji tingkat pencemaran dan perubahan kualitas air di Kuta, Lombok Selatan, sebelum perhelatan MotoGP 2020 dan setelah perhelatan MotoGP 2023. Menggunakan algoritma TSS dari citra Sentinel-2A tahun 2020 dan 2023, penelitian ini menentukan perubahan kualitas air. Terjadi peningkatan yang signifikan kandungan TSS di perairan Kuta, Lombok Selatan dari tahun 2020 dan 2023. Pencemaran yang memenuhi baku mutu tahun 2020 adalah 0,027mg/L l yang berada di bawah batas deteksi (Batas deteksi = 0,5 mg/L) , namun meningkat pada tahun 2023 sebesar 21,79 mg/L. Selanjutnya, klasifikasi tingkat pencemaran menggunakan indeks pencemaran yang dikeluarkan oleh Menteri Negara Lingkungan Hidup Nomor 1 Tahun 2010 bahwa perairan Kuta Lombok Selatan masih bersih dan terjaga.

***Kata kunci**: Kualitas air, kawasan Kuta Lombok Selatan, citra Sentinel-2n*

ABSTRACT

It is very important to monitor water quality to find out the extent to which human activities affect the quality of water used to support human life. The existence of the Mandalika Circuit, which is now the Indonesian MotoGP circuit, has boosted tourism in the Kuta area of South Lombok. The quality of the waters in the Kuta area of South Lombok will undoubtedly decline due to this tourism activity. Using remote sensing methods to measure water quality, this research examines the level of pollution and changes in water quality in Kuta, South Lombok, before the 2020 MotoGP event and after the 2023 MotoGP event. Using the TSS algorithm from Sentinel-2A imagery in 2020 and 2023, this study determines changes in water quality. There was a significant increase in the content of TSS in the waters of Kuta, South Lombok from 2020 and 2023. Pollution meeting quality standards in 2020 was 0.027mg/L l which is below the detection limit (Detection limit = 0.5 mg/L), but increased in 2023 by 21.79 mg/L. Furthermore, the level of pollution is classified using the pollution index issued by the State Minister for the Environment Number 1 year 2010 that the waters of Kuta, South Lombok are still clean and awake.

***Keywords:** Water quality, Kuta area of South Lombok, Sentinel-2n image*

INTRODUCTION

Kuta Beach, Lombok is a tourist spot on Lombok Island, West Nusa Tenggara Province, Indonesia. This beach with white sand like peppercorns is located in the Mandalika Special Economic Zone in Kuta Village. Kuta Beach is starting to be known and developed as a tourist destination for Indonesia, especially NTB in the Mandalika MotoGP event. With this activity it is hoped that it will advance the tourism sector if it is managed properly. One of the problems of concern is water pollution because there is a lot of material sedimentation due to activities on land, causing a decrease in the quality level of the waters, both by the bad habits of the people who dispose of garbage and overflow of material due to the high development that has occurred due to the construction of facilities and infrastructure for the Mandalika circuit.

The sediments carrying many particles flowing into the waters of Kuta, South Lombok are suspended solids. Suspended solids (total suspended solids) are solids that cause water turbidity, are not dissolved, and cannot settle directly. Suspended solids consist of particles that are smaller in size or weight than sediment, for example clay,

organic matter certain microorganisms, cells, and so on (Fardiaz, 2011). Environmental conditions can be assessed in terms of water quality through identification of Total Suspended Solid (TSS) concentrations.

The TSS monitoring process can be simplified by using remote sensing technology. Apart from requiring a lot of time, direct monitoring is also inefficient because it requires a lot of money which is quite large. Remote sensing is a solution that provides information about the earth's surface with ever-expanding spatial and temporal coverage. Remote sensing applications in waters have been used as an effective alternative to monitor water quality without spending a lot of time and money. The color of the waters captured by remote sensing applications provides information about the optical properties of the waters (Liu, J. et al. 2017).

This study uses remote sensing satellite imagery data from Sentinel-2A in 2020 and 2023. These images are used to determine the distribution value of TSS in Kuta waters, South Lombok, before and after MotoGP activities in 2020 and 2023 using the NDWI and NDTI algorithms. TSS values for 2020 and 2023 are compared to find out changes in TSS values in pixel values through raster value calculations.

The final results of the 2020 and 2023 TSS values are converted into pollution index values so that the level of water pollution in 2020 and 2023 is known. This research is expected to become a standard for determining the quality of waters in Kuta waters, South Lombok.

Formulation of the Problem

How to assess the level of pollution and changes in water quality in Kuta, South Lombok, before the 2020 MotoGP event and after the 2023 MotoGP event using the TSS algorithm from Sentinel-2A imagery in 2020 and 2023

Research Aim and Significance

This study uses remote sensing satellite imagery data from Sentinel-2A in 2020 and 2023. These images are used to determine the distribution value of TSS in Kuta waters, South Lombok, before and after MotoGP activities in 2020 and 2023 using the NDWI and NDTI algorithms. TSS values for 2020 and 2023 are compared to find out changes in TSS values in pixel values through raster value calculations.

RESEARCH METHOD

The research location is in Kuta waters, South Lombok at a geographical position of 8.895° S dan 116.306 ° E.

Figure 1. Research location

The Sentinel-2A data used is Sentinel-2A image data on August 25 2020 and April 22 2023 where this data is data that has low cloud cover at the research location. Sentinel-2A image data processing using SNAP. The stages of data processing can be seen in Figure 2, where data processing can be broadly divided into four to get suggestions and conclusions.

Figure 2. Stage of image data processing

The algorithms used in generating the TSS are the NDTI, NDWI algorithms. Normalized difference water index (NDWI) is a satellite based index used for mapping and detecting the surface water bodies. Water absorbs electromagnetic radiation in visible to infrared spectrum, that is why Green and Near Infrared bands are used to detect the water bodies. In the current study, band 3 (green) and band 8 (NIR) of Sentinel-2 are used for generating NDWI raster (Gao, 2996; Xu, 2006; Brockmann, 2016):

$$NDWI = \frac{(Green - SWIR1)}{(Green + SWIR2)}$$

Visual or digital interpretation of the output image/raster: -1 to 0 - Bright surface with no vegetation or water content, +1 - represent water content. < 0.3 - Non-water and >= 0.3 – Water, in urban area.

The Normalize Difference Turbidity Index (NDTI) which is estimated using the spectral reflectance values of the water pixels is used to estimate the turbidity in water bodies. It uses the phenomenon that the electromagnetic reflectance is higher in green spectrum than the red spectrum for clear water. Hence, with increase in turbidity the reflectance of red spectrum also increases (Lacaux et al., 2007)

$$NDTI = \frac{(Red - Green)}{(Red + Green)}$$

Total suspended solids (TSS) concentration is an important biogeochemical parameter for water quality management and sediment-transport studies. Accurate and quantitative assessment of the impact of natural environmental changes and human activities on total suspended solids (TSS) concentration is one of the important components of water environment protection.

$$TSS = 2950\ x\ B7^{1.375}$$

Based on the TSS results for 2020 and 2023, a classification is then determined to group TSS concentrations into several categories to indicate certain TSS concentrations. From the table 1 it show for the distribution of TSS concentration categories according to the Regulation of the Minister of Environment of the Republic of Indonesia Number 1 of 2010.

Table 1. Distribution of TSS categories TSS (mg/L)

Categories	TSS Concentration Range (mg/L)
Low	0 -100
Medium	100 - 220
High	220 - 350

RESEARCH FINDING AND DISCUSSION

After processing satellite images in 2020 and 2023 it was found that the lowest TSS value in 2020 was 0.005 mg/L and the highest was 0.027 mg/L. Whereas in 2023 the lowest TSS value is 0.000 mg/L and the highest is 21.786 mg/L.

Table 2. TSS value max. (mg/L) in year 2020 and 2023

TSS Result			
2020		2023	
Color	Value Max. (mg/L)	Color	Value Max. (mg/L)
	0.005		0.000
	0.005		3.442
	0.007		2.673
	0.008		4.210
	0.010		5.881
	0.012		7.552
	0.015		13.767
	0.024		19.006
	0.027		21.786

Based on the TSS value in the table below, it can be seen that the TSS value tends to be stable in 2020 at 0.027 mg/L and significant increase in 2023 of 21,786 mg/L, shown in the Table 1.

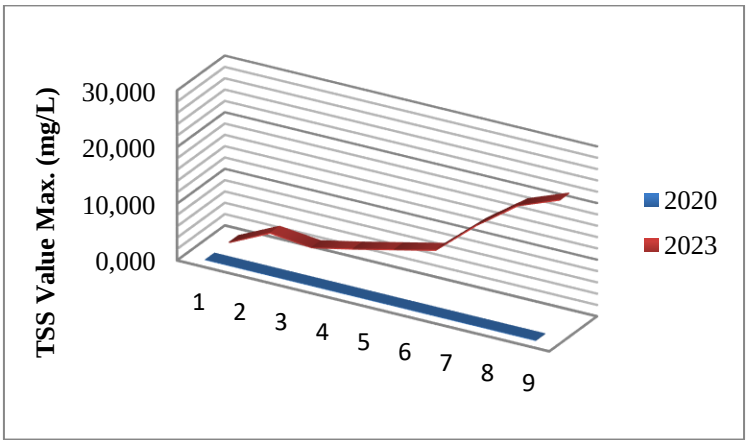

Figure 3. TSS graph comparison between 2020 and 2023

From the graph in 2020 (Figure 3) it can be seen that the highest concentration of TSS is 0.027 mg/L which is below the detection limit (Detection limit = 0.5 mg/L). In 2023 (Figure 3) the highest concentration of TSS is 21,876 mg/L. When compared to 2020 and 2023 (Figure 4), the concentration of TSS in 2020 is generally below the detection limit, while in 2023 there is an increase in the concentration of TSS in the area which has caused pollution to begin. In addition, the high concentration of TSS is also affected by some parameters.

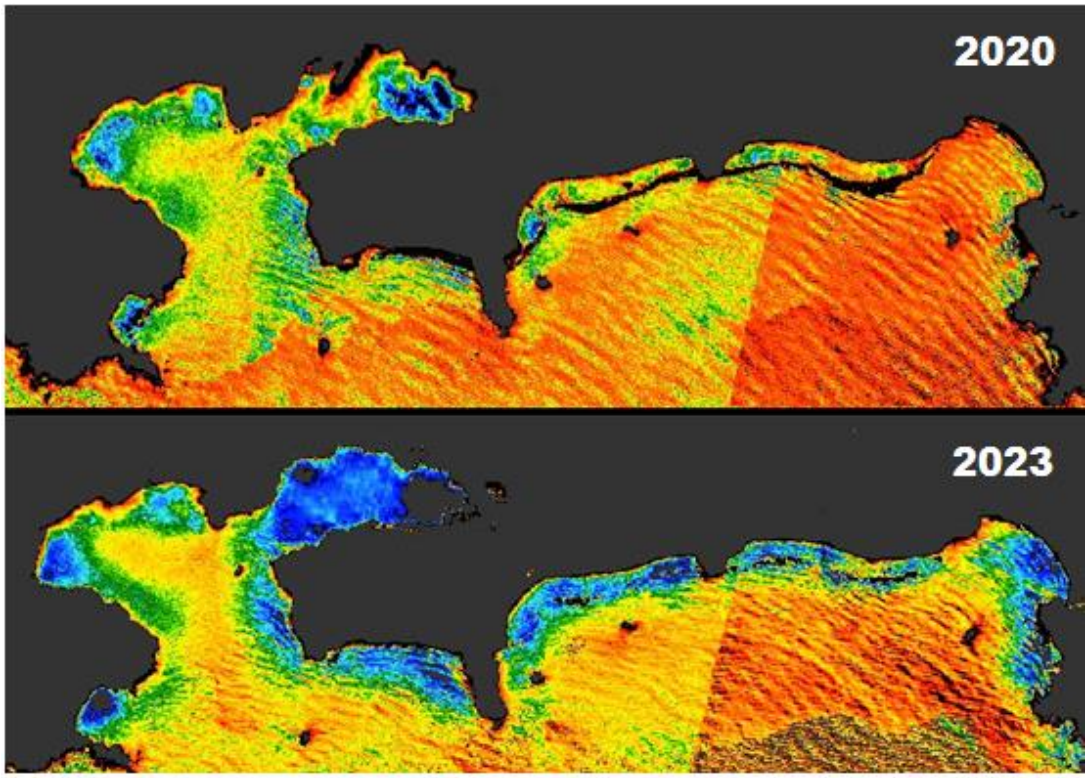

Figure 4. TSS 2020 compare with 2023

From the picture above it can be seen that TSS in 2020 has a low concentration (<100 mg/L) based on the classification of Regulation of the Minister of Environment of the Republic of Indonesia Number 1 of 2010. So from these results it is known that the waters of Kuta, South Lombok are still clean and awake. The concentration of TSS near the mainland is higher because it is influenced by human activities and the type of water in Kuta, South Lombok is a bay. In addition, currents and waves also affect the transport of materials from land to the sea.

Discussion

The distribution of TSS in Kuta waters, South Lombok is caused by:

- The current speed in the waters of Lombok Island is at a speed of 0.070 – 0.351 cm/second. Seawater flow rate is the main factor in changing TSS concentrations. Fast flowing water carries larger particles and sediment. When there is heavy rain, sand, silt, clay and other organic particles can be carried from land to sea. If the speed or direction of the water increases, particles from the sediment can be suspended (Dwi, H, 2013).
- - Decay of marine plants and animals. The presence of dead and decaying plants and animals in the sea will release suspended organic particles which can contribute to increasing or decreasing the value of TSS concentrations (Indeswari, 2018).
- Disposal of building materials. The development of the South Lombok area with the Mandalika circuit has increased the pace of development. There is a possibility of material being dumped into the waters which will increase the water content. The increase in suspended solids content causes turbidity which can interfere with the penetration of light into the waters. The presence of suspended sediments in the waters can affect water quality and aquatic organisms, both directly and indirectly, such as death and decreased production. The suspended particles in the water mass can limit the value of the primary productivity of the waters as a result of inhibiting the penetration of light into the water body (Huovinen et al, 2019).
- Oceanographic conditions. Fluctuations in TSS concentrations from 2020-2023 occurred allegedly because the Southern Waters were more influenced by the conditions of the vast waters in the Indian Ocean and the waters were relatively deeper and conditions in the southern waters between Java Island and the Nusa Tenggara islands where there was a lot of upwelling phenomenon, causing a decrease in temperature conditions. sea level in the southern waters. The low SST value in the waters south of Lombok is directly related to the Indian Ocean which is the most intensive upwelling area. The upwelling phenomenon that occurs in Lombok waters is due to differences in the pattern of direction and wind speed from changes in the seasonal wind cycle. Tidal currents affect the distribution of sediments, if the currents are strong then the suspended sediments will move with the currents, but if the currents are weak then the sediments will tend to be deposited. (emiyati et al., 2014). According to Susanto et. al (2006) seasonal variations occur due to the

Asia-Australia monsoon wind system, where the east monsoon from July to September is colder in the Banda Sea, Arafura, Java and Nusa Tenggara compared to the west monsoon. The changes experienced by the waters of Lombok will be the same as those experienced by the Indian Ocean, where during the east monsoon there is a process of increasing the mass of water rich in nutrients. Wyrtki (1962) in Wudianto (2001) also mentions that in the east monsoon there is a process of increasing water mass along the southern coast of Java, Bali to Sumbawa.

CLOSING

Conclusion

Using remote sensing methods to measure water quality, this research examines the level of pollution and changes in water quality in Kuta, South Lombok, before the 2020 MotoGP event and after the 2023 MotoGP event. Using the TSS algorithm from Sentinel-2A imagery in 2020 and 2023, this study determines changes in water quality. There was a significant increase in the content of TSS in the waters of Kuta, South Lombok from 2020 and 2023. From the result that the highest concentration of TSS in 2020 is 0.027 mg/L which is below the detection limit (Detection limit = 0.5 mg/L). And the highest concentration of TSS in 2023 is 21,876 mg/L. Furthermore, the level of pollution is classified using the pollution index issued by the State Minister for the Environment Number 1 year 2010 that the waters of Kuta, South Lombok are still clean and awake. For further research, it is expected to be able to collect field data (ground truth) which has a timeframe that is not too far away or in accordance with the time of satellite imagery so that a better level of accuracy of results is obtained and is equipped with a validation test between satellite imagery data and field data to obtain a relationship strong correlation.

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Conflicts of Interest

Declare conflicts of interest or state “The authors declare no conflict of interest." Authors must identify and declare any personal circumstances or interest that may be perceived as inappropriately influencing the representation or interpretation of reported research results. Any role of the funding sponsors in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript, or in the decision to publish the results must be declared in this section. If there is no role, please state “The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results”.

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