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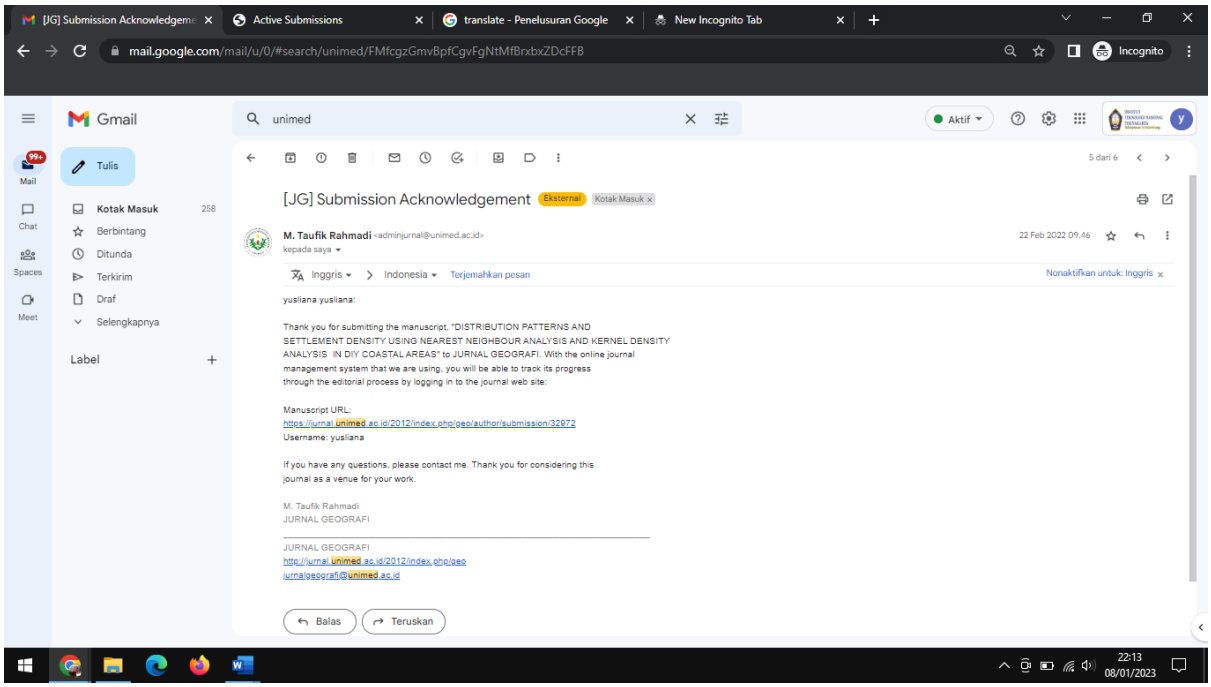
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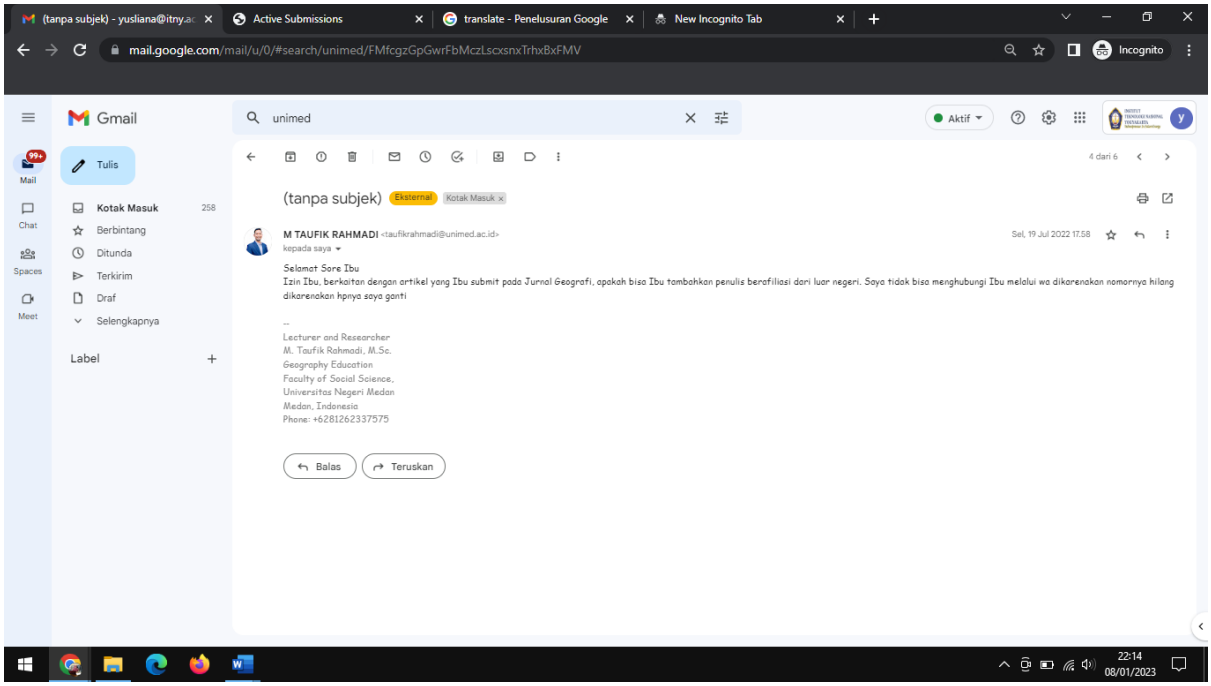
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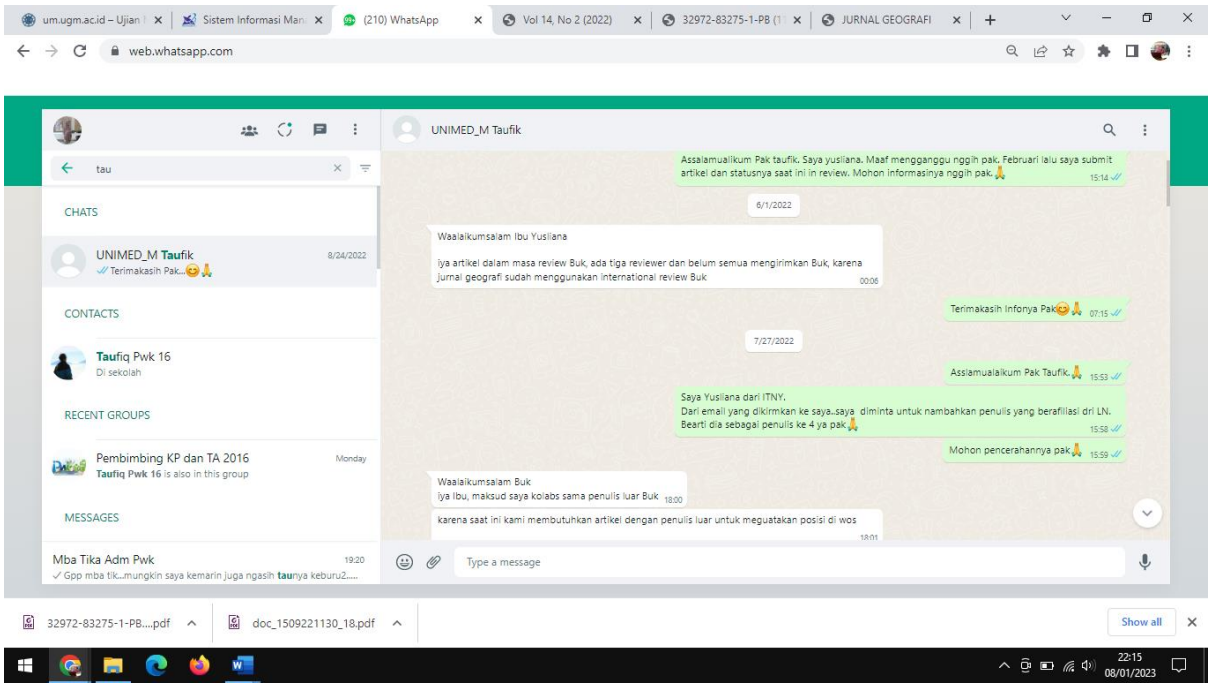
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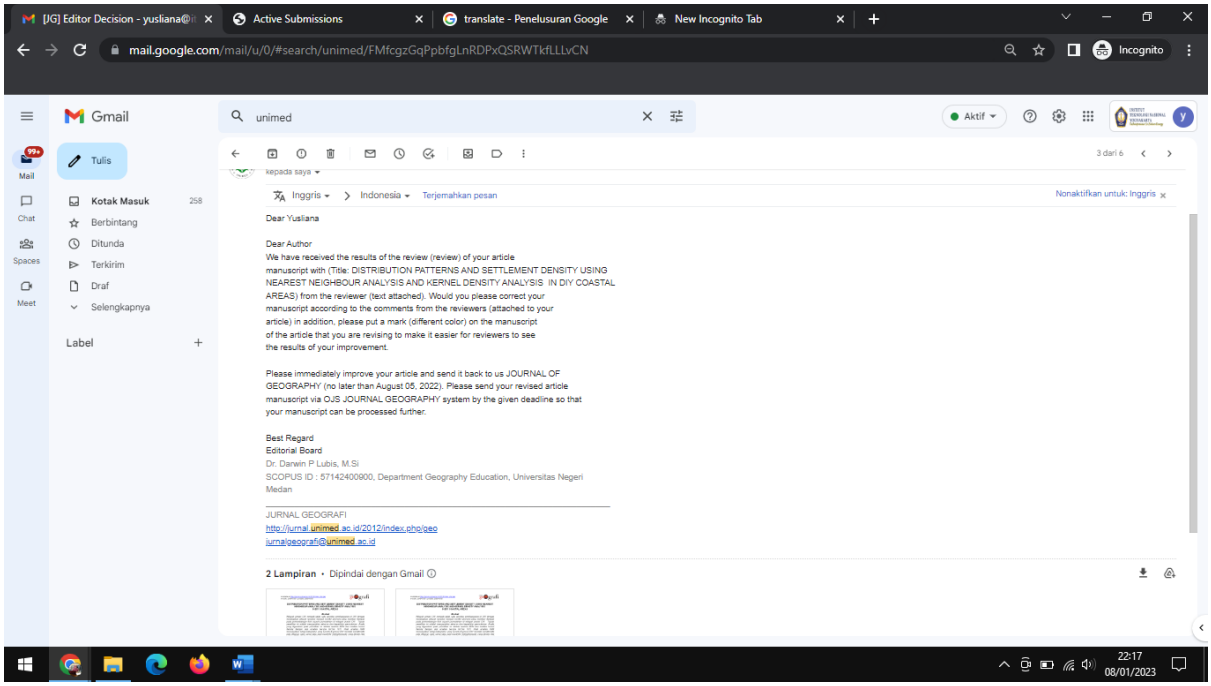
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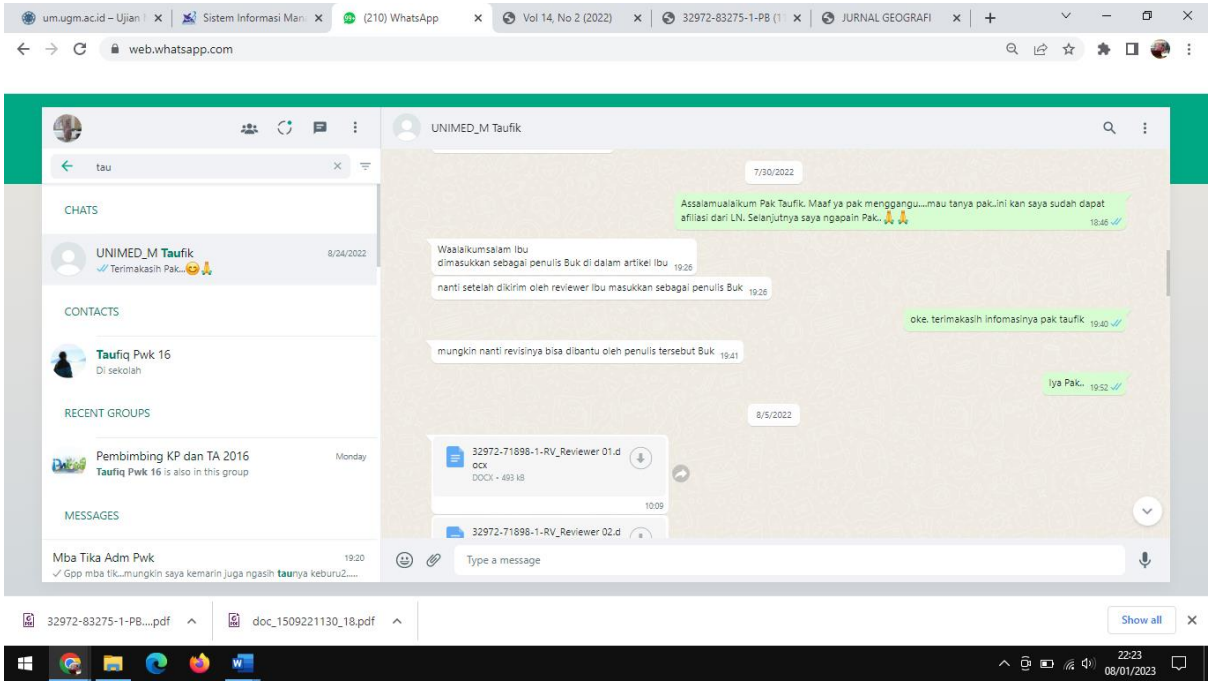
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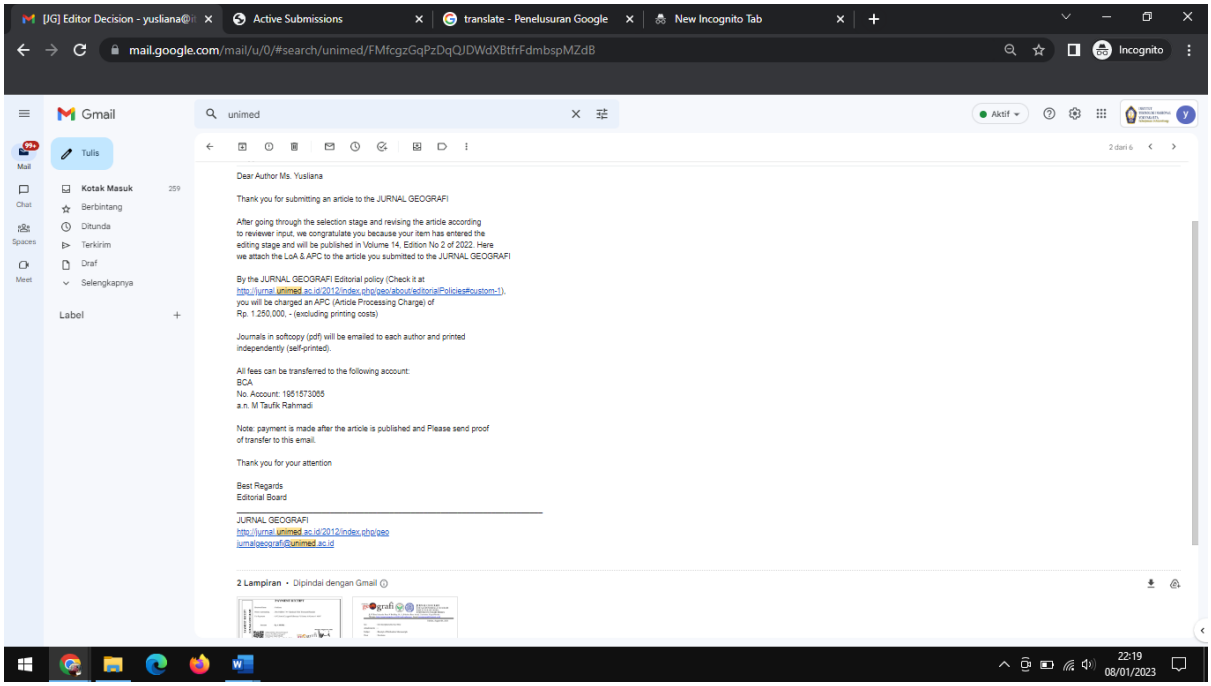
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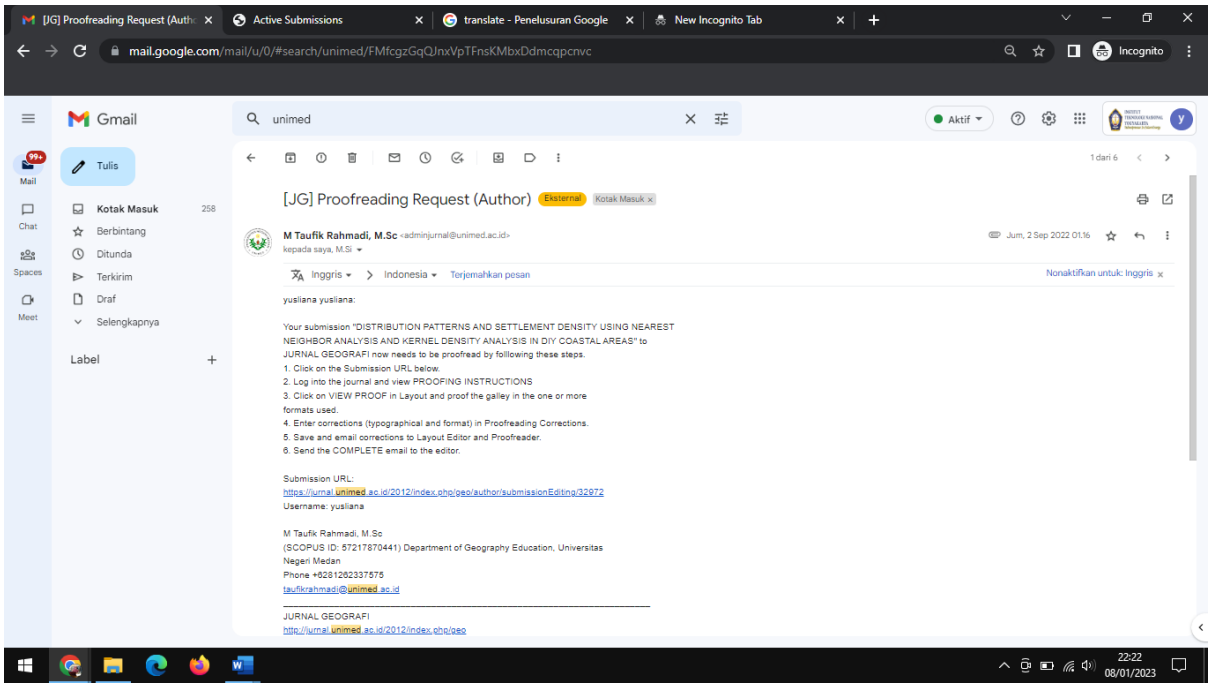
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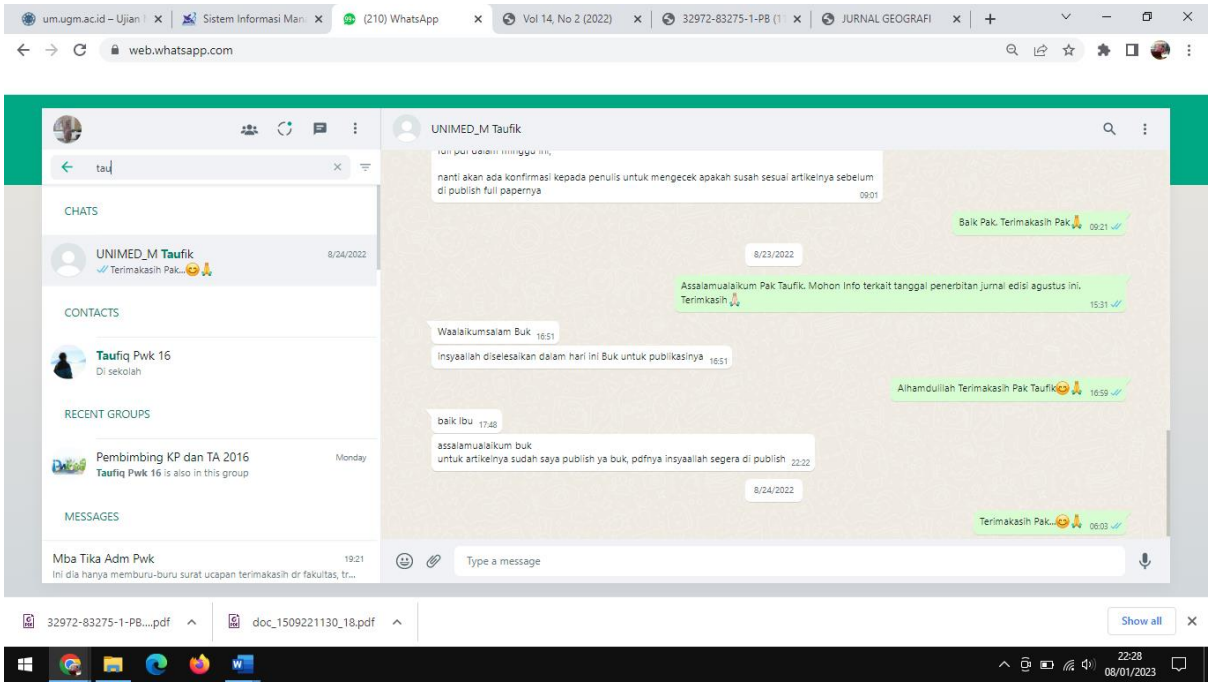
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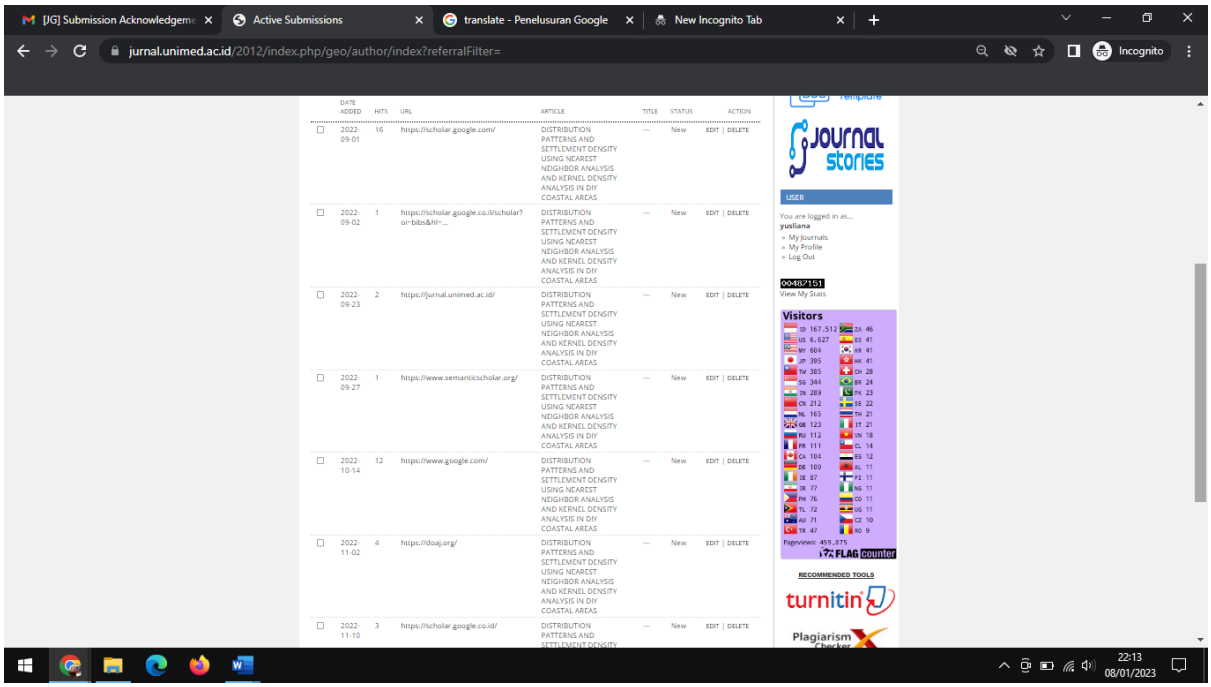
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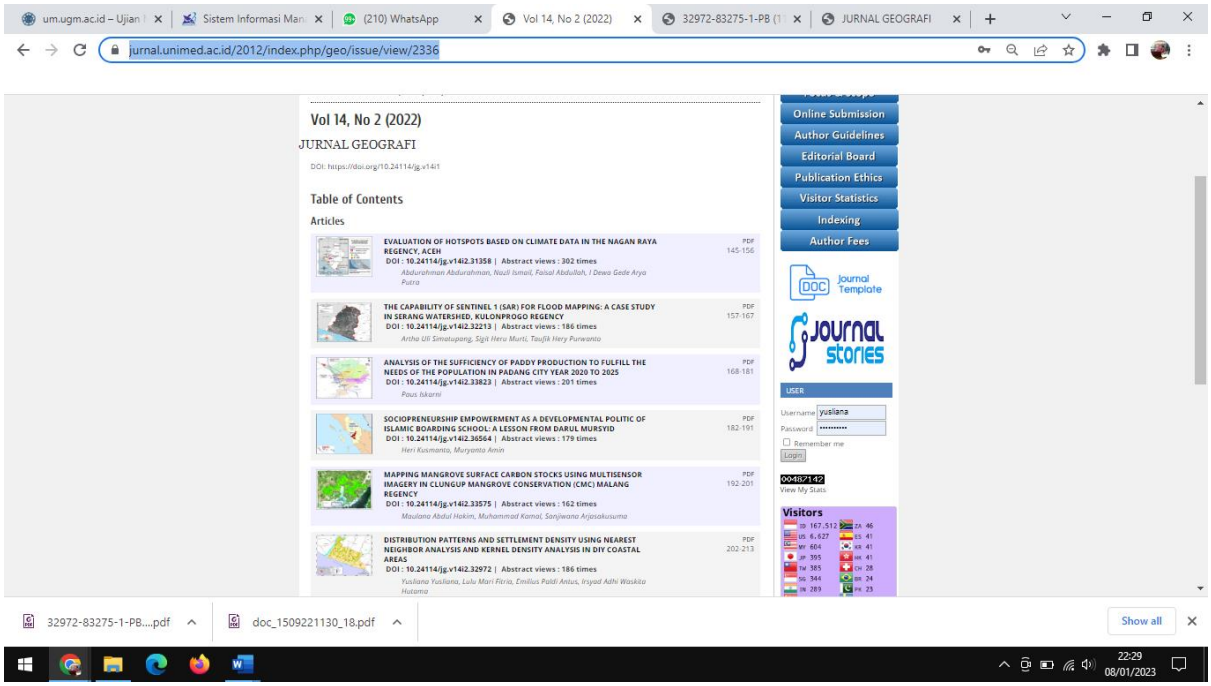
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DISTRIBUTION PATTERNS AND SETTLEMENT DENSITY USING NEAREST NEIGHBOUR ANALYSIS AND KERNEL DENSITY ANALYSIS IN DIY COASTAL AREAS

Abstrak

Wilayah pesisir DIY menjadi salah satu prioritas pembangunan di DIY dengan menetapkan wilayah tersebut menjadi koridor ekonomi yang memberi dampak pada perkembangan fisik seperti permukiman di wilayah pesisir DIY. Tujuan penelitian ini adalah menganalisis sebaran dan kepadatan permukiman .Analis yang digunakan pada penelitian ini adalah analisis ANN dan analisis kernel density dengan alat analisis berupa ArcGis 10.5. Hasil analisis ANN menunjukkan ketiga kabupaten yang berada di pesisir DIY memiliki karakteristik pola sebaran yang sama yaitu pola clustered (mengelompok) yang berarti nilai indeks ANN <1 atau nilai T berkisar antar 0-0.80. Hasil dari analisis kernel density menunjukkan bahwa kepadatan yang paling signifikan terdapat di Kabupaten Kulon Progo tepatnya berada di Kecamatan Wates dan Kabupaten Bantul tepatnya di Kecamatan Srandakan, sedangkan untuk Kabupaten Gunung Kidul kurang signifikan dan kepadatanya tidak merata/hanya berpusat pada 1 titik kepadatan. Beberapa faktor penyebab kepadatan permukiman, antara lain faktor fisik (Topografi, kemiringan lereng, jenis tanah, dan sumber air bersih), aksesibilitas (kedekatan dengan jalur transportasi dan kedekatan dengan pusat kota), ketersediaan sarana dan prasarana (jaringan listrik, fasilitas pendidikan, dan kesehatan), dan faktor lingkungan (sumber daya alam, maupun manusia).

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Kata kunci: *Permukiman, Pesisir, NNA, Kernel Density*

Abstract

The coastal area of DIY is one of the development priorities in DIY by establishing the area as an economic corridor that impacts physical development, such as settlements in the coastal area of DIY. This study aims to analyze the distribution and density of settlements. The analysis used in this study is Nearest Neighbour Analysis (NNA) and Kernel Density Analysis with an analysis tool in ArcGIS 10.5. The results of the NNA show that the three districts located on the coast of DIY have the same distribution pattern characteristics, namely, the clustered pattern, which means the NNA index value is <1 or the T value ranges from 0-0.80. The results of the kernel density analysis show that the most significant density is found in Kulon Progo Regency, precisely in Wates District, and Bantul Regency, precisely in Srandakan District. At the same time, for Gunung Kidul Regency, it is less significant, and the density is only centered on one density point. Several factors cause settlement density, including physical factors (topography, slope, soil type, and clean water sources), accessibility (proximity to transportation routes and proximity to the city center), availability of facilities and infrastructure (electricity network, educational facilities, and health), and environmental factors (natural and human resources).

Keywords: Settlements, Coastal, NNA, Kernel Density

INTRODUCTION

The Coast of Java Island is one of the dynamic areas due to land, sea, and climatic processes that dominate one another (Ekosafitri, Rustiadi, & Yulianda, 2017). The diversity and complexity of the coastal area, both physically, biologically, chemically, and inhuman dimensions makes this area

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vulnerable to various changes (Brand, Ramaekers, & Lodder, 2022).

The coastal waters of DIY are in the open sea category with a coastal horizon directly opposite the Indian Ocean, so the wave energy towards the coast is very influential on the dynamics of the coast (Purwantara, Sugiharyanto, & Khotimah, 2013). Meanwhile, the increasing number of residents every year also affects development activities on the coast, such as settlements, fisheries, ports, tourism, road networks, increasing ecological pressure on coastal ecosystems. (Gupta & Bavinck, 2017). The use of space in these activities does not pay attention to disaster aspects so that there is overlapping between disaster-prone areas with residential areas and other areas. (Astjario, Harkinz Prabowo, 2012).

On the other hand, the world's coastal areas continue to experience increased development, marked by the increase in the number of settlements (Dawson, Hunt, Shaw, & Gehrels, 2018). If settlements tend to develop in urban areas, settlements are starting to develop in several coastal areas of the world, both formally and informally (Venerandi, Iovene, & Fusco, 2021).

This dynamic also occurs in the DIY Coastal area, located in 3 regencies and 13 sub-districts that currently function as a place of concentration of activities, be it settlements, trade, or other activities. DIY Vision 2017-2022 to meet the "Indian Ocean Century." Through this vision, the development of the DIY region leads to efforts to develop social and economic activities in the southern coastal area of DIY. Through this vision, the growth of the DIY Coastal area continues to occur and has increased activity encouraging the emergence of new activity centers(Yusliana & Devi, 2020).

The new activity centers are in the form of distribution or increase in activities carried out by individuals and communities, called settlement developments that cause a pattern of distribution in coastal areas (Lakshmi & Shaji, 2016). The law No. 1 of 2021 defines that settlements are part of the residential environment in the form of several housing units with complete infrastructure, facilities, and public utilities that have functioned as supporting activities in urban and rural areas. In addition, settlements also consist of 5 elements: nature, humans, society, networks, and the environment.

Generally, coastal settlements have the same shape and tendency so that the balance between the resources in the coastal area can be managed properly (Rempis, Alexandrakis, Tsilimigkas, & Kampanis, 2018). The settlements have an essential role in land development in urban and rural areas (Boone, Lukalo, & Joireman, 2021). On the other hand, essential issues related to the condition of the development of residential areas need serious attention so that the development of coastal areas can be more focused and sustainable (Jiang, Liu, & Su, 2015). Several studies that have been carried out related to settlements state that residents who live in residential areas in coastal areas tend to occupy illegal areas and are vulnerable to conflicts of interest from various parties. On the other hand, research was conducted by (Setioko, Pandelaki, & Murtini, 2013).

Based on the background of the distribution of settlements that occur on the coast, it must be considered regarding its control and supervision so that it is by the DIY coastal spatial planning regulations. The formulation of the problem from this research is how the distribution and density of settlements spatially in the coastal area of DIY; this study aims to identify and analyze the distribution and density of settlements spatially in the coastal area DIY.

RESEARCH METHODS

The method used in this research is descriptive qualitative-quantitative descriptive analysis with secondary data analysis base. The method used in this research with the Nearest Neighbor Analysis (NNA) analysis technique used to determine the pattern of settlement distribution and Kernel Density analysis used to determine

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display a map of the location of the research area so that readers clearly know the condition of the area geographically

the density of settlements in the coastal area of DIY.

This research covers the coastal area of DIY which consists of 3 regencies, namely Kulon Progo Regency, Bantul Regency, and Gunung Kidul Regency, which includes 13 sub-districts specifically in the coastal area, including Wates, Temon, Panjatan, Galur, Srandakan, Sanden, Kretek, Panggang, Purwosari, Saptosari, Tanjungsari, Tepus, and Grisubo sub-districts

Data Analysis

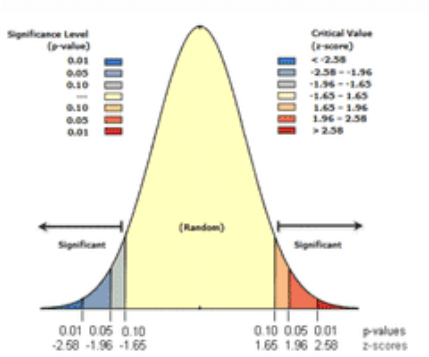
a. Settlements Distribution Pattern

Analysis of settlement distribution patterns using ANN. ANN (Average Nearest Networks) is the tool ArcGIS to calculate the nearest neighbor index based on the average distance from each feature to its nearest neighbor feature (ArcGis Help, 2017).

The observed mean distance, expected mean distance, nearest neighbor index, z-score, and p-value. on the graph above, if the z-score <-1.65 and a significant p value> 0.01, the settlement pattern formed is in groups./clustered and if not spread.

b. Settements Density

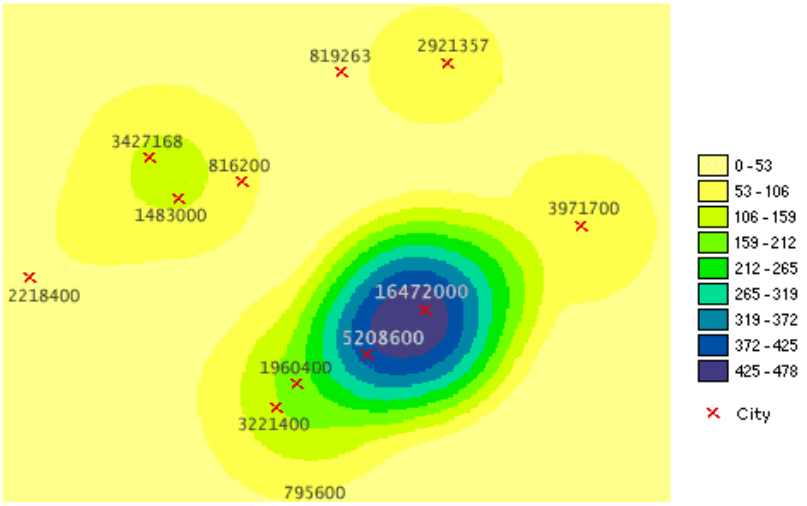
Settlements density using analysis Kernel Density is a statistical approach to estimate the probability distribution function (Setiawan, Murfi, & Satria, 2017). The form of data distribution is not used as a problem that needs to be considered (Handayani & Rudiarto, 2011). Calculate The Kernel Density using ArcGIS is raster-based, so the size of the grid will significantly affect the level of detail in the calculation results because of the quality of the data. The area and the distance between reference points and the combined volume of each reference point early affect the accuracy and depth of the calculation results (Cai, Wu, & Cheng, 2013)



Source: *ArcGis Help, 2017*

Figure 1. Nearest Naighbour Analisys Value Chart

The data has clustered values based on the z-score and p-vain the figure 1. These values are generated from the calculation of the nearest neighbor to identify the nearest neighbor that has a clustered or spread pattern. The data has clustered values based on the z-score and p-vain the figure 1. Based



Source: Arc.Gis Map Desktop Help Topic, 2021

Figure 2. Illustration of Expected Results/Output

The variables used in this study identify action data on the distribution of settlements (Persil) and administrative boundary data. The data aims to produce polygon parcel data into data described in the form of data points. Expected output/result in Kernel Density analysis performed in ArcGis 10.5. The following illustration is expected the figure 2.

RESULTS AND DISCUSSION

a. Distribution of Residential Areas in Coastal DIY

Identification of the distribution of residential areas in 3 coastal districts of DIY, was carried out by digitizing the distribution of settlements through satellite imagery. The digitization process is carried out by digitizing parcel data from the Google Street folder obtained from the 2020 terra incognita application. In addition, building parcel data is obtained through automatic digitization results from OSM (Open Street Map) where the digitized data is in the form of building parcel polygon data.

Because the analysis process requires data in the form of points, the data on the distribution of settlements in polygons were converted into point form through the ArcGis 10.5 application with the Feature to Point tool. To further clarify, it can used from several images of digitized maps in the 13 sub-districts.

The map depiction of the distribution points of settlements has obtained from digitizing the image map of the built-up area on the coast of DIY in 2020. The intended digitization is to obtain secondary data from the terra incognita application. The application provides an overview of the area in raster form, then digitizes the data for the settlement area, converted into vector data (shapefile) in the ArcGis 10.5 application. With this digitization method, researchers obtain data on residential areas/built-up land, which can then be used as material to analyze the distribution pattern of settlements using the ANN method and settlement density analysis using the kernel density method.

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add comparisons of research results of international repute to your results

Figure 3. Map of the Distribution of Settlements in Bantul Regency

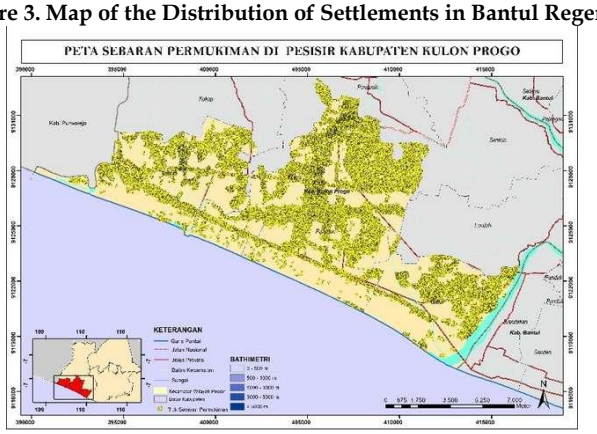
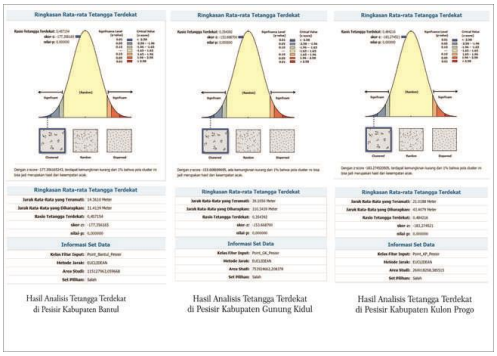


Figure 4. Map of the Distribution of Settlements in Kulonprogo Regency

Figure 5. Map of the Distribution of Settlements in Gunungkidul Regency

b. Distribution of Settlement Patterns in the DIY Coastal Area

In calculating the distribution of settlements automatically in the coastal areas of DIY, the data used is from data from the identification of the distribution of settlements (data on building parcels). The output is in the form of statistical data that shows whether the distribution pattern of settlements on the coast of DIY is clustered, random, or scattered. The results of the distribution pattern of settlements on the coast of DIY can be seen in the following figure 6:



Source: Research Results, 2021

Figure 6 Results of Analysis Tools Average Nearest Neighbor (ANN)

From the results of the ANN analysis, it is known that:

1. The distribution pattern of settlements on the coast of Bantul Regency is Cluster. The value obtained in the calculation shows that the value of T or NNRatio (Nearest Neighbor Ratio) is 0.457154. This value shows that the value of T or NNRatio belongs to the category of 0.00-0.70 or ANN <1. This clustering pattern resulted from the observed mean distance (observed average distance) of 14.36 meters and the expected mean distance value of 31.41 meters. It can also be strengthened by the significance level of the z-score value of -177.36 and p-value of 0.00, where the Critical Value (Z-score) less than <-2.58 is significant to the significant value level. (P-value) which is less/equal to 0, 01, which means a pattern of settlement distribution in a clustered form. This clustered settlement pattern comprises house buildings spread over a certain distance.
2. The pattern of distribution of settlements on the coast of Kulon Progo Regency is clustered. This is based on the value obtained in the calculation showing the value of T or NNRatio (Nearest Neighbor Ratio) is 0.484216. This value can be seen that the value of T or NN Ratio belongs to the category of 0.00-0.70 or ANN <1. This clustering pattern resulted from the observed mean distance value (observed average distance) of 21.01 meters and the expected mean distance value of 43.40 meters. This can also be strengthened by the significance level of the results of the z-score value of -183.27 and p-value of 0.00, where the Critical Value (Z-score) which is less than <-2.58 is significant to the significant value level. (P-value) which is less/equal to 0, 01 which means that there is a pattern of settlement distribution in a clustered form. This clustered settlement pattern is composed of house buildings spread over a certain distance.

3. The pattern of distribution of settlements on the coast of Gunung Kidul Regency is clustered. This is based on the value obtained in the calculation shows the value of T or NNRatio (Nearest Neighbor Ratio) is 0.354392. This value can be seen that the value of T or NNRatio belongs to the category of 0.00-0.70 or ANN <1. This clustering pattern resulted from the observed mean distance value (observed average distance) of 39.10 meters and the expected mean distance value (expected average distance) of 110.34 meters. This can also be strengthened by the significance level of the results from the z-score value of -153.67 and p-value of 0.00, where the Critical Value (Z-score) which is less than <-2.58 is significant to the significant value level. (P-value) which is less/equal to 0,

c. Analysis of Settlement Density in the DIY Coastal Area

The analysis used to measure the density of settlements in the coastal area of DIY is kernel density analysis, one of the tools in the ArcGIS application. The data used is the data from the identification of the distribution of building parcels in the coastal area of DIY, where the building parcels data in the form of polygon data is converted into data points. Then the results obtained are divided into high and low classes.

The results of the Kernel Density analysis shows that:

1. The settlement density level in Bantul Regency is significant in Srandakan District, and the density distribution is evenly distributed. This shows that almost all of the land in the area is used for settlements. In addition, it can be proven based on population density data on the coast of Bantul Regency that it is explained that Srandakan District has a settlement density of 1,705 people/km2. Meanwhile, the Sanden Subdistrict with a density value of 1,380 people/km2 has an uneven density distribution, followed by the Kretek Subdistrict with a total settlement density of 1,152 people/km2 with an uneven distribution of settlement density/only concentrated in one point.
2. The settlement density level in the Kulon Progo Regency looks significant in Wates District. On the other hand, the distribution of settlement density is uneven/only concentrated in one area, which shows the northern part of the Wates District is an area with significant density. In addition, based on population density data in 2020, the highest population density in Kulon Progo Regency is in Wates District, which is 1540 people/km2. Wates District also influences this as the capital of Kulonprogo Regency followed by Galur District area with a settlement density of 1005 people/km2, Panjatan subdistrict 877 people/km2, and Temon subdistrict 811 people/km2. The description of the kernel density map above explains

3. Tepus District with a total density of 352 people/km2, the density is significant towards the west opposite the northern part of Tanjungsari District, then Panggang District with a total settlement density of 297 people/km2 with a significant density distribution towards the center and followed by Purwosari District with a total density of settlement of 293 people/km2 with a significant distribution of density towards the center and the north. Based on the results of settlement density data obtained from BPS, the density level on the coast of Gunung Kidul Regency is still below the value of 1000 people/km2 compared to areas in Kulon Progo and Bantul Regencies. The settlement density level in Gunung Kidul Regency shows that the distribution of settlement density is uneven/only centered on one point, and the density value is less significant. In this case, the highest density level in Gunung Kidul Regency is in Saptosari District, with 450 people/km2. From the map image from the kernel density analysis above, the density distribution in Saptosari District is significant. There are only 3 points, followed by the

Tanjungsari District area of 411 inhabitants/km2, whose distribution is more concentrated at the northern part. Meanwhile, for Girisubo District, with a total density of 273 people/km2, the density level is more significant centrally, or there is 1 point of settlement density. Then Panggang District with a total settlement density of 297 people/km2 with a significant distribution of density towards the center, followed by Purwosari District with a total settlement density of 293 people/km2 with a significant distribution of density towards the center and north. Meanwhile, for Girisubo District, with a total density of 273 people/km2, the density level is more significant centrally, or there is 1 point of settlement density.

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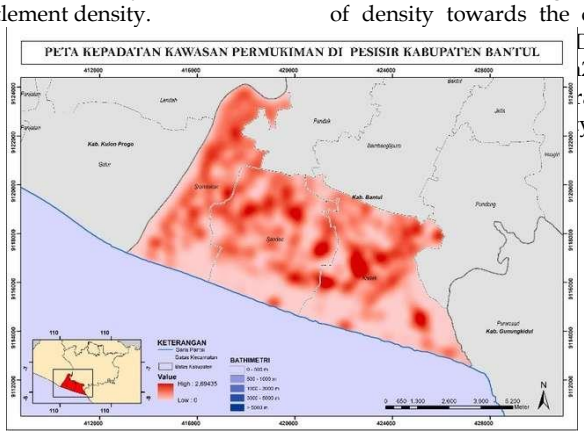

Figure 7 Settlements Density in Bantul Regency

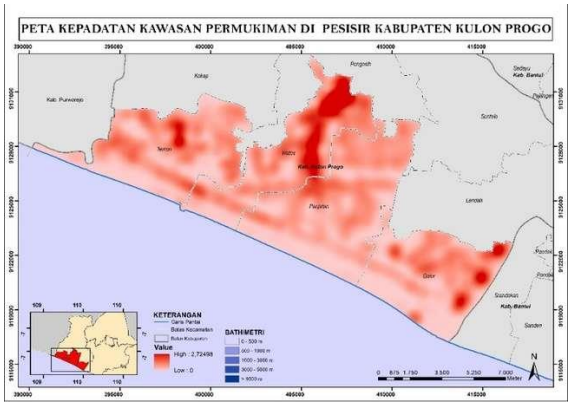

Figure 8 Settlements Density in Kulonprogo Regency

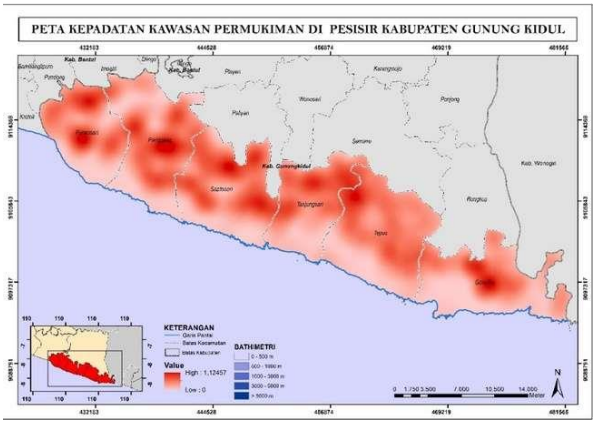

Figure 9 Settlements Density in Gunungkidul Regency

CONCLUSION

The ANN analysis shows that the overall pattern of settlement distribution in Coastal DIY has the same characteristics as the distribution of settlements, namely the clustered distribution pattern. This result is obtained because the calculation of the ratio (ANN) or index (T) value obtained is less than the significance value, which is at the ANN value <1, or the T value is in the range of 0-0.8.

The results of the kernel density analysis show that the most significant density is found in Kulon Progo Regency, precisely in Wates Subdistrict and Bantul Regency, precisely in Srandakan District. At the same time, for Gunung Kidul Regency it is less significant, and the density is uneven/only centered on 1 point of density.

Several factors cause settlement density, including physical factors (topography, slope, soil type, and clean water sources), accessibility (proximity to transportation routes and proximity to the city center), availability of facilities and infrastructure (electricity network, educational facilities, and health), and environmental factors (natural and human resources). The factor of the occurrence of clustered settlement patterns and the development of settlement density which is relatively linearly beaded on the coast of DIY, is the same as the settlement density level.

The occurrence of settlement patterns will affect the level of settlement density in the coastal areas of DIY itself. Therefore, it is necessary to plan the development of other areas so that the growth of settlement density can be spread evenly in the coastal areas of DIY.

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DISTRIBUTION PATTERNS AND SETTLEMENT DENSITY USING NEAREST NEIGHBOUR ANALYSIS AND KERNEL DENSITY ANALYSIS IN DIY COASTAL AREAS

Abstrak

Wilayah pesisir DIY menjadi salah satu prioritas pembangunan di DIY dengan menetapkan wilayah tersebut menjadi koridor ekonomi yang memberi dampak pada perkembangan fisik seperti permukiman di wilayah pesisir DIY. Tujuan penelitian ini adalah menganalisis sebaran dan kepadatan permukiman .Analis yang digunakan pada penelitian ini adalah analisis ANN dan analisis kernel density dengan alat analisis berupa ArcGis 10.5. Hasil analisis ANN menunjukkan ketiga kabupaten yang berada di pesisir DIY memiliki karakteristik pola sebaran yang sama yaitu pola clustered (mengelompok) yang berarti nilai indeks ANN <1 atau nilai T berkisar antar 0-0.80. Hasil dari analisis kernel density menunjukkan bahwa kepadatan yang paling signifikan terdapat di Kabupaten Kulon Progo tepatnya berada di Kecamatan Wates dan Kabupaten Bantul tepatnya di Kecamatan Srandakan, sedangkan untuk Kabupaten Gunung Kidul kurang signifikan dan kepadatanya tidak merata/hanya berpusat pada 1 titik kepadatan. Beberapa faktor penyebab kepadatan permukiman, antara lain faktor fisik (Topografi, kemiringan lereng, jenis tanah, dan sumber air bersih), aksesibilitas (kedekatan dengan jalur transportasi dan kedekatan dengan pusat kota), ketersediaan sarana dan prasarana (jaringan listrik, fasilitas pendidikan, dan kesehatan), dan faktor lingkungan (sumber daya alam, maupun manusia).

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Kata kunci: *Permukiman, Pesisir, NNA, Kernel Density*

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Abstract

The coastal area of DIY is one of the development priorities in DIY by establishing the area as an economic corridor that impacts physical development, such as settlements in the coastal area of DIY. This study aims to analyze the distribution and density of settlements. The analysis used in this study is Nearest Neighbour Analysis (NNA) and Kernel Density Analysis with an analysis tool in ArcGIS 10.5. The results of the NNA show that the three districts located on the coast of DIY have the same distribution pattern characteristics, namely, the clustered pattern, which means the NNA index value is <1 or the T value ranges from 0-0.80. The results of the kernel density analysis show that the most significant density is found in Kulon Progo Regency, precisely in Wates District, and Bantul Regency, precisely in Srandakan District. At the same time, for Gunung Kidul Regency, it is less significant, and the density is only centered on one density point. Several factors cause settlement density, including physical factors (topography, slope, soil type, and clean water sources), accessibility (proximity to transportation routes and proximity to the city center), availability of facilities and infrastructure (electricity network, educational facilities, and health), and environmental factors (natural and human resources).

Keywords: Settlements, Coastal, NNA, Kernel Density

INTRODUCTION

The Coast of Java Island is one of the dynamic areas due to land, sea, and climatic processes that dominate one another (Ekosafitri, Rustiadi, & Yulianda, 2017). The diversity and complexity of the coastal area, both physically, biologically, chemically, and inhuman dimensions makes this area

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vulnerable to various changes (Brand, Ramaekers, & Lodder, 2022).

The coastal waters of DIY are in the open sea category with a coastal horizon directly opposite the Indian Ocean, so the wave energy towards the coast is very influential on the dynamics of the coast (Purwantara, Sugiharyanto, & Khotimah, 2013). Meanwhile, the increasing number of residents every year also affects development activities on the coast, such as settlements, fisheries, ports, tourism, road networks, increasing ecological pressure on coastal ecosystems. (Gupta & Bavinck, 2017). The use of space in these activities does not pay attention to disaster aspects so that there is overlapping between disaster-prone areas with residential areas and other areas. (Astjario, Harkinz Prabowo, 2012).

On the other hand, the world's coastal areas continue to experience increased development, marked by the increase in the number of settlements (Dawson, Hunt, Shaw, & Gehrels, 2018). If settlements tend to develop in urban areas, settlements are starting to develop in several coastal areas of the world, both formally and informally (Venerandi, Iovene, & Fusco, 2021).

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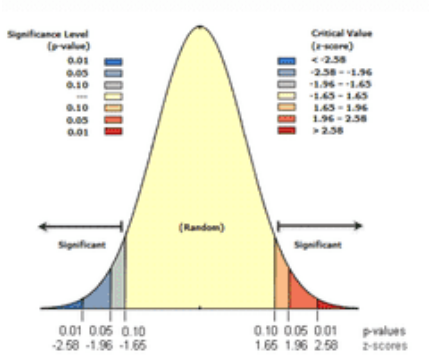
Analysis of settlement distribution patterns using ANN. ANN (Average Nearest Networks) is the tool ArcGIS to calculate the nearest neighbor index based on the average distance from each feature to its nearest neighbor feature (ArcGis Help, 2017).

The observed mean distance, expected mean distance, nearest neighbor index, z-score, and p-value.



Source: *ArcGis Help, 2017*

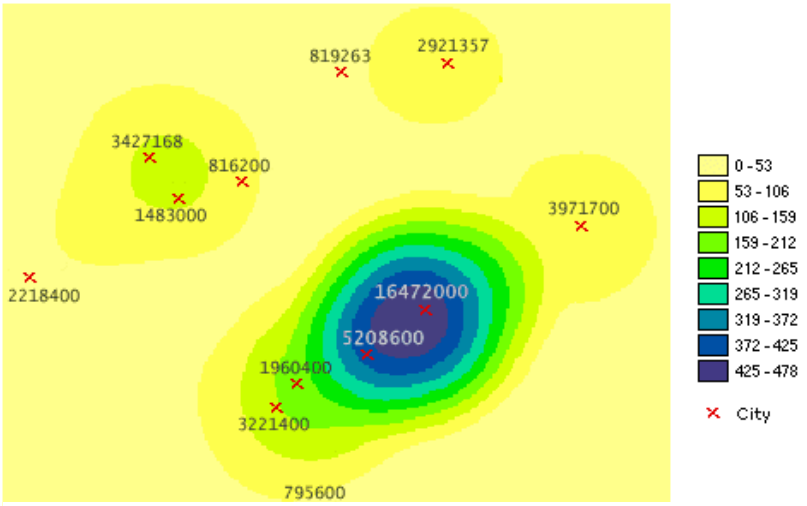
Figure 1. Nearest Naighbour Analisys Value Chart

The data has clustered values based on the z-score and p-vain the figure 1. These values are generated from the calculation of the nearest neighbor to identify the nearest neighbor that has a clustered or spread pattern. The data has clustered values based on the z-score and p-vain the figure 1. Based on the graph above, if the z-score <-1.65 and a significant p value> 0.01, the settlement pattern formed is in groups./clustered and if not spread.

b. Settements Density

Settlements density using analysis Kernel Density is a statistical approach to estimate the probability distribution function (Setiawan, Murfi, & Satria, 2017). The form of data distribution is not used as a problem that needs to be considered (Handayani & Rudiarto, 2011). Calculate The Kernel Density using ArcGIS is raster-based, so the size of the grid will significantly affect the level of detail in the calculation results because of the quality of the data. The area and the distance between reference points and the combined volume of each reference point early affect the accuracy and depth of the calculation results (Cai, Wu, & Cheng, 2013)

Commented [TR4]: Buat peta lokasi penelitian dan tampilkan diagram alir penelitian yang digunakan



Source: Arc.Gis Map Desktop Help Topic, 2021

Figure 2. Illustration of Expected Results/Output

The variables used in this study identify action data on the distribution of settlements (Persil) and administrative boundary data. The data aims to produce polygon parcel data into data described in the form of data points. Expected output/result in Kernel Density analysis performed in ArcGis 10.5. The following illustration is expected the figure 2.

RESULTS AND DISCUSSION

a. Distribution of Residential Areas in Coastal DIY

Identification of the distribution of residential areas in 3 coastal districts of DIY, was carried out by digitizing the distribution of settlements through satellite imagery. The digitization process is carried out by digitizing parcel data from the Google Street folder obtained from the 2020 terra incognita application. In addition, building parcel data is obtained through automatic digitization results from OSM (Open Street Map) where the digitized data is in the form of building parcel polygon data.

Because the analysis process requires data in the form of points, the data on the distribution of settlements in polygons were converted into point form through the ArcGis 10.5 application with the Feature to Point tool. To further clarify, it can used from several images of digitized maps in the 13 sub-districts.

The map depiction of the distribution points of settlements has obtained from digitizing the image map of the built-up area on the coast of DIY in 2020. The intended digitization is to obtain secondary data from the terra incognita application. The application provides an overview of the area in raster form, then digitizes the data for the settlement area, converted into vector data (shapefile) in the ArcGis 10.5 application. With this digitization method, researchers obtain data on residential areas/built-up land, which can then be used as material to analyze the distribution pattern of settlements using the ANN method and settlement density analysis using the kernel density method.

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Figure 3. Map of the Distribution of Settlements in Bantul Regency

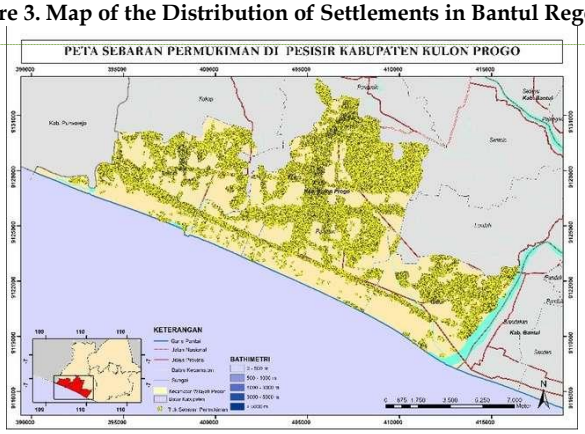

Figure 4. Map of the Distribution of Settlements in Kulonprogo Regency

Figure 5. Map of the Distribution of Settlements in Gunungkidul Regency

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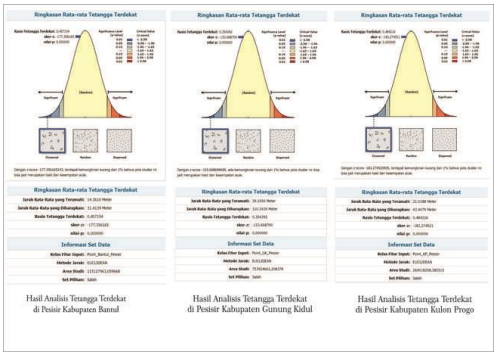
b. Distribution of Settlement Patterns in the DIY Coastal Area

In calculating the distribution of settlements automatically in the coastal areas of DIY, the data used is from data from the identification of the distribution of settlements (data on building parcels). The output is in the form of statistical data that shows whether the distribution pattern of settlements on the coast of DIY is clustered, random, or scattered. The results of the distribution pattern of settlements on the coast of DIY can be seen in the following figure 6:



Source: Research Results, 2021

Figure 6 Results of Analysis Tools Average Nearest Neighbor (ANN)

From the results of the ANN analysis, it is known that:

1. The distribution pattern of settlements on the coast of Bantul Regency is Cluster. The value obtained in the calculation shows that the value of T or NNRatio (Nearest Neighbor Ratio) is 0.457154. This value shows that the value of T or NNRatio belongs to the category of 0.00-0.70 or ANN <1. This clustering pattern resulted from the observed mean distance (observed average distance) of 14.36 meters and the expected mean distance value of 31.41 meters. It can also be strengthened by the significance level of the z-score value of -177.36 and p-value of 0.00, where the Critical Value (Z-score) less than <-2.58 is significant to the significant value level. (P-value) which is less/equal to 0, 01, which means a pattern of settlement distribution in a clustered form. This clustered settlement pattern comprises house buildings spread over a certain distance.
2. The pattern of distribution of settlements on the coast of Kulon Progo Regency is clustered. This is based on the value obtained in the calculation showing the value of T or NNRatio (Nearest Neighbor Ratio) is 0.484216. This value can be seen that the value of T or NN Ratio belongs to the category of 0.00-0.70 or ANN <1. This clustering pattern resulted from the observed mean distance value (observed average distance) of 21.01 meters and the expected mean distance value of 43.40 meters. This can also be strengthened by the significance level of the results of the z-score value of -183.27 and p-value of 0.00, where the Critical Value (Z-score) which is less than <-2.58 is significant to the significant value level. (P-value) which is less/equal to 0, 01 which means that there is a pattern of settlement distribution in a clustered form. This clustered settlement pattern is composed of house buildings spread over a certain distance.

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3. The pattern of distribution of settlements on the coast of Gunung Kidul Regency is clustered. This is based on the value obtained in the calculation shows the value of T or NNRatio (Nearest Neighbor Ratio) is 0.354392. This value can be seen that the value of T or NNRatio belongs to the category of 0.00-0.70 or ANN <1. This clustering pattern resulted from the observed mean distance value (observed average distance) of 39.10 meters and the expected mean distance value (expected average distance) of 110.34 meters. This can also be strengthened by the significance level of the results from the z-score value of -153.67 and p-value of 0.00, where the Critical Value (Z-score) which is less than <-2.58 is significant to the significant value level. (P-value) which is less/equal to 0,

c. Analysis of Settlement Density in the DIY Coastal Area

The analysis used to measure the density of settlements in the coastal area of DIY is kernel density analysis, one of the tools in the ArcGIS application. The data used is the data from the identification of the distribution of building parcels in the coastal area of DIY, where the building parcels data in the form of polygon data is converted into data points. Then the results obtained are divided into high and low classes.

The results of the Kernel Density analysis shows that:

1. The settlement density level in Bantul Regency is significant in Srandakan District, and the density distribution is evenly distributed. This shows that almost all of the land in the area is used for settlements. In addition, it can be proven based on population density data on the coast of Bantul Regency that it is explained that Srandakan District has a settlement density of 1,705 people/km2. Meanwhile, the Sanden Subdistrict with a density value of 1,380 people/km2 has an uneven density distribution, followed by the Kretek Subdistrict with a total settlement density of 1,152 people/km2 with an uneven distribution of settlement density/only concentrated in one point.
2. The settlement density level in the Kulon Progo Regency looks significant in Wates District. On the other hand, the distribution of settlement density is uneven/only concentrated in one area, which shows the northern part of the Wates District is an area with significant density. In addition, based on population density data in 2020, the highest population density in Kulon Progo Regency is in Wates District, which is 1540 people/km2. Wates District also influences this as the capital of Kulonprogo Regency followed by Galur District area with a settlement density of 1005 people/km2, Panjatan subdistrict 877 people/km2, and Temon subdistrict 811 people/km2. The description of the kernel density map above explains

3. Tepus District with a total density of 352 people/km2, the density is significant towards the west opposite the northern part of Tanjungsari District, then Panggang District with a total settlement density of 297 people/km2 with a significant density distribution towards the center and followed by Purwosari District with a total density of settlement of 293 people/km2 with a significant distribution of density towards the center and the north. Based on the results of settlement density data obtained from BPS, the density level on the coast of Gunung Kidul Regency is still below the value of 1000 people/km2 compared to areas in Kulon Progo and Bantul Regencies. The settlement density level in Gunung Kidul Regency shows that the distribution of settlement density is uneven/only centered on one point, and the density value is less significant. In this case, the highest density level in Gunung Kidul Regency is in Saptosari District, with 450 people/km2. From the map image from the kernel density analysis above, the density distribution in Saptosari District is significant. There are only 3 points, followed by the

Tanjungsari District area of 411 inhabitants/km2, whose distribution is more concentrated at the northern part. Meanwhile, for Girisubo District, with a total density of 273 people/km2, the density level is more significant centrally, or there is 1 point of settlement density. Then Panggang District with a total settlement density of 297 people/km2 with a significant distribution of density towards the center, followed by Purwosari District with a total settlement density of 293 people/km2 with a significant distribution of density towards the center and north. Meanwhile, for Girisubo District, with a total density of 273 people/km2, the density level is more significant centrally, or there is 1 point of settlement density.

Then Panggang District with a total settlement density of 297 people/km2 with a significant distribution of density towards the center and followed by Purwosari District with a total settlement density of 293 people/km2 with a significant distribution of density towards the center and north.

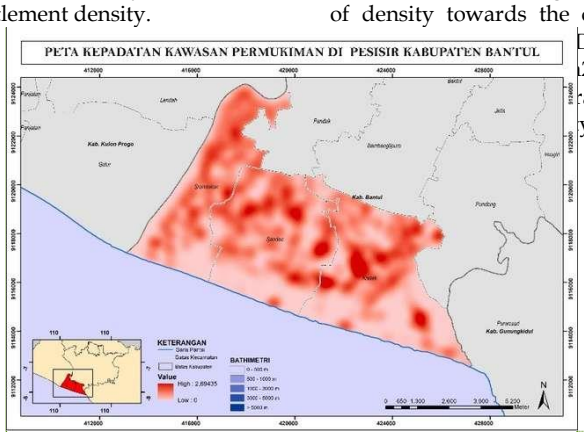

Figure 7 Settlements Density in Bantul Regency

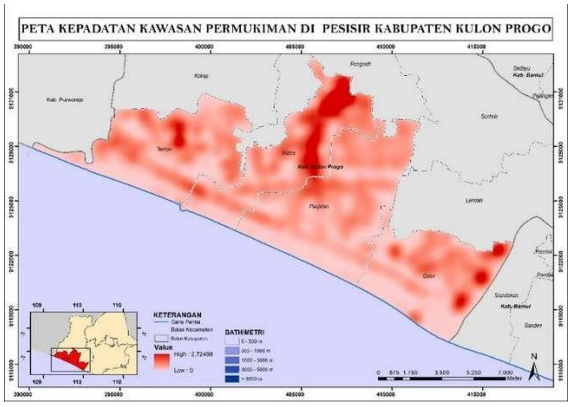

Figure 8 Settlements Density in Kulonprogo Regency

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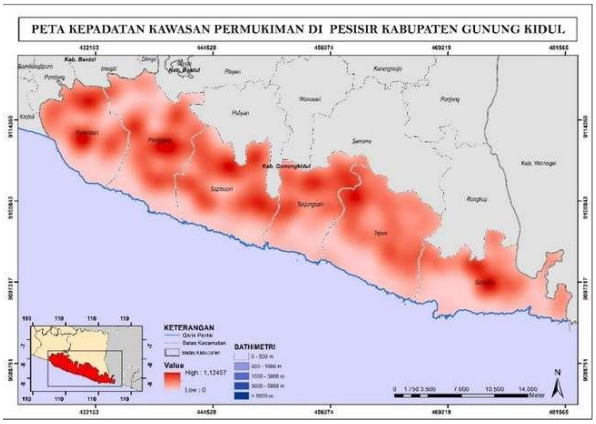

Figure 9 Settlements Density in Gunungkidul Regency

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CONCLUSION

The ANN analysis shows that the overall pattern of settlement distribution in Coastal DIY has the same characteristics as the distribution of settlements, namely the clustered distribution pattern. This result is obtained because the calculation of the ratio (ANN) or index (T) value obtained is less than the significance value, which is at the ANN value <1, or the T value is in the range of 0-0.8.

The results of the kernel density analysis show that the most significant density is found in Kulon Progo Regency, precisely in Wates Subdistrict and Bantul Regency, precisely in Srandakan District. At the same time, for Gunung Kidul Regency it is less significant, and the density is uneven/only centered on 1 point of density.

Several factors cause settlement density, including physical factors (topography, slope, soil type, and clean water sources), accessibility (proximity to transportation routes and proximity to the city center), availability of facilities and infrastructure (electricity network, educational facilities, and health), and environmental factors (natural and human resources). The factor of the occurrence of clustered settlement patterns and the development of settlement density which is relatively linearly beaded on the coast of DIY, is the same as the settlement density level.

The occurrence of settlement patterns will affect the level of settlement density in the coastal areas of DIY itself. Therefore, it is necessary to plan the development of other areas so that the growth of settlement density can be spread evenly in the coastal areas of DIY.

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