

# Investigating the relationship between population growth and temperature change in Nabire and Paniai Regencies

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## ABSTRACT

Regional development is a priority programme of the government of the Republic of Indonesia. The region that has received significant development is the province of Papua. The form of development in Papua Province is the division of a new autonomous region (DOB). The formation of new autonomous regions encourages development in newly created areas, especially in urban areas. Cities that are increasingly developing can trigger the flow of urbanization so that the population increases. Increasing population affects climate parameters, especially air temperature. Temperature is expected to increase as a result of an increase in the number of urban residents and the imbalance of energy in and out of the earth. This study aims to determine the effect of population on variations in temperature in Nabire and Paniai Regencies. The data used are annual average, minimum, and maximum temperature data at the Nabire and Paniai Meteorological Stations. The data is displayed in graphical form, and the correlation is calculated to be analyzed descriptively. The results of the study show that there is a strong correlation between population growth and an increase in average and minimum average temperatures. While the average maximum temperature has a weak relationship to population growth.

## ABSTRAK

Pembangunan daerah merupakan program prioritas pemerintah Republik Indonesia. Wilayah yang mendapat pembangunan signifikan adalah Provinsi Papua. Bentuk pembangunan di Provinsi Papua adalah pemekaran daerah otonom baru (DOB). Pembentukan daerah otonom baru mendorong pembangunan di daerah pemekaran, khususnya di perkotaan. Kota yang semakin berkembang dapat memicu arus urbanisasi sehingga jumlah penduduk semakin meningkat. Pertambahan jumlah penduduk mempengaruhi parameter iklim khususnya suhu udara. Suhu diperkirakan akan meningkat akibat bertambahnya jumlah penduduk perkotaan dan ketidakseimbangan energi yang masuk dan keluar bumi. Penelitian ini bertujuan untuk mengetahui pengaruh jumlah penduduk terhadap variasi suhu di Kabupaten Nabire dan Paniai. Data yang digunakan adalah data suhu rata-rata, minimum, dan maksimum tahunan di Stasiun Meteorologi Nabire dan Paniai. Data ditampilkan dalam bentuk grafik, dan korelasinya dihitung untuk dianalisis secara deskriptif. Hasil penelitian menunjukkan adanya korelasi yang kuat antara pertumbuhan penduduk dengan peningkatan suhu rata-rata dan minimum rata-rata. Sedangkan rata-rata suhu maksimum mempunyai hubungan yang lemah terhadap pertumbuhan penduduk.

**Keywords:** *climate, resident, temperature, population growth, variation*

## INTRODUCTION

The Government of the Republic of Indonesia has authorized the formation of new autonomous regions in Papua, namely Central Papua, South Papua, and Highlands Papua (Setkab, 2022). The establishment of a new autonomous region encourages infrastructure development, especially in urban areas. City development can trigger urbanization, which is seen as a determining factor for a city to develop both physically and socially (Harahap, 2013). Urbanization causes an increase in the number of residents in urban areas. Population has a dominant impact on climate (Rai et al., 2019).

One of the climate parameters affected by population growth is surface air temperature. The temperature is predicted to increase in the future (IPCC, 2013). An

increase in surface temperature is an indicator of global warming as a result of an imbalance of incoming and outgoing energy in the Earth's atmosphere (Puspitasari & Surendra, 2016). An increase in population results in a diversity of activities among city dwellers, which directly or indirectly affect parameters of the local climate, especially temperature (Mas'at, 2008). The THI (thermal comfort index) states that the closer to the city center, the greater the percentage of discomfort (Wati & Fatkhuroyan, 2017).

Research related to variations in surface temperature has been carried out in various regions. Annual temporal variations show that there is an increase in temperature over a 30-year period in Java by 0.11–1.24°C (Prasetyo et al., 2021). The significant development of the DKI Jakarta area has caused surface air temperatures to increase by 0.17°C from the annual average in the last 28

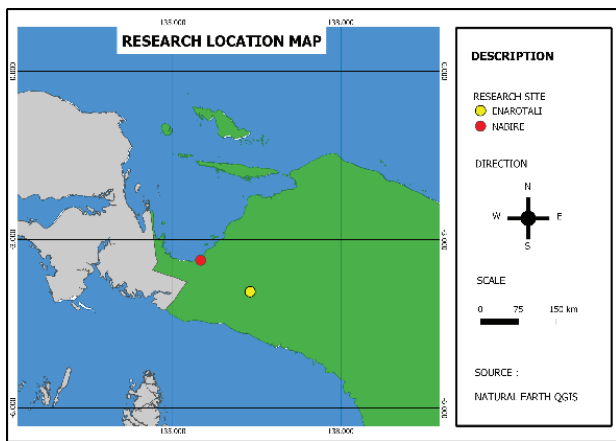
years, with urban areas experiencing a greater increase at 0.8°C (Mas'at, 2009). The increase in the number of motorized vehicles in the DKI Jakarta megacity is rapidly increasing the humidex heat index (Wati & Nasution, 2018).

Research that has been conducted in various regions has shown similar results: an increase in surface temperature every year. Therefore, it is necessary to conduct research on the effects of variations in surface temperature on rapid development in Central Papua. The purpose of this study was to determine the relationship between temperature and population growth in Central Papua so that the results of the research can be taken into consideration in the development of a new autonomous region in Central Papua.

**METHODS**

**Research Location**

The districts of Nabire and Paniai are the site of the research (Figure 1). Paniai Regency is situated in the Weyland Mountains, whilst Nabire Regency is situated at Cendrawasih Bay. Nabire district is expected to represent urban and lowland temperature variations, while Paniai district represents rural and highland temperature variations.



**Figure1.** Map of research location in Enarotali and Nabire Meteorological Stations, Papua.

**Data Analysis**

The data used are temperature data from observations at the Nabire and Enarotali Paniai Meteorological Stations, as well as population data from the Nabire and Paniai Central Statistics Agency from 2007 to 2021. The temperature data used is average, maximum, and minimum air temperatures.

Temperature and population data are displayed in graphical form and the correlation is calculated (Table 1). The formula for calculating the correlation is as follows:

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{n\sum x^2 - (\sum x)^2} \sqrt{n\sum y^2 - (\sum y)^2}}$$

Where:

$r$  = correlation coefficient  $x$  and  $y$

$x$  = average temperature

$y$  = number of population

**Table 1.** Correlation coefficient description (Sugiyono, 2012)

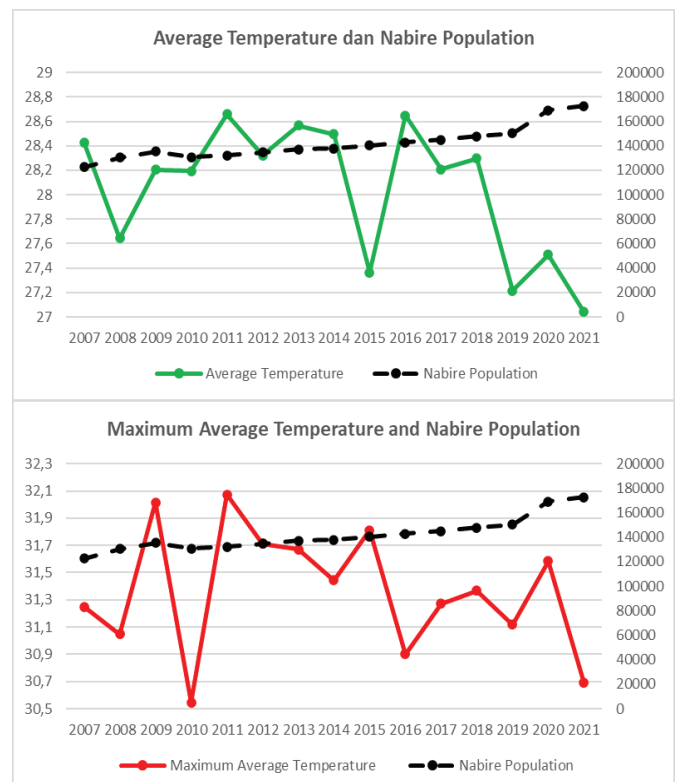
R value (correlation)	Remarks
0.00 - 0.199	Very Weak
0.20 - 0.399	Weak
0.40 - 0.599	Medium
0.60 - 0.799	Strong
0.80 - 1.000	Very Strong

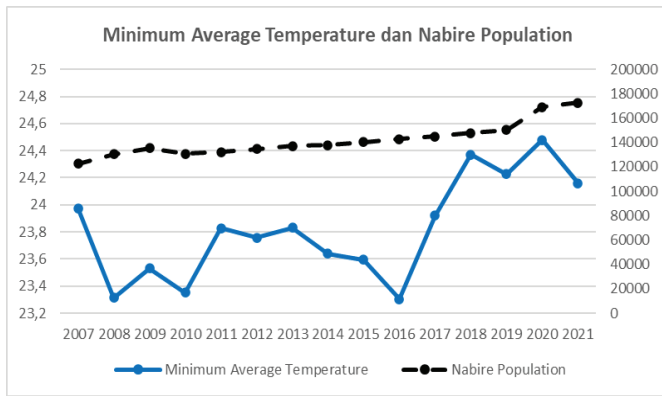
**RESULTS AND DISCUSSION**

**Air Temperature Variation in Relation to Nabire Regency Residents' Numbers**

Graphs and coefficients of correlation different findings are revealed by the temperature in Nabire Regency (Table 2). In contrast to the average lowest temperature, which tends to rise, the average maximum temperature and average temperature vary from year to year (Figure 2).

As illustrated in Figure 2, the correlation between temperature and population density in Nabire Regency ranges from inversely to directly proportional. Population increase and average temperature have a reasonably strong inverse relationship ( $r = -0.63$ ). Population growth and maximum temperature have a





**Figure 2.** Graph of the relationship between average temperature, maximum temperature, minimum temperature, and population in Nabire Regency.

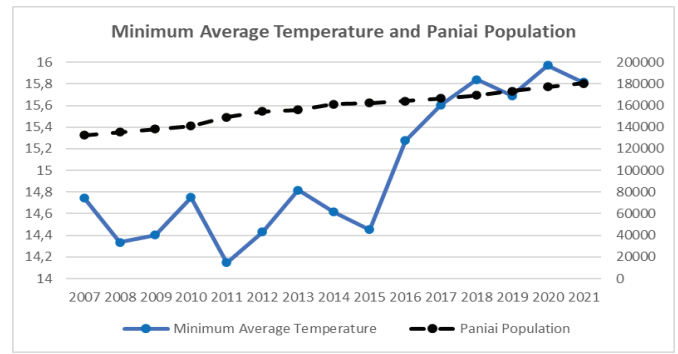
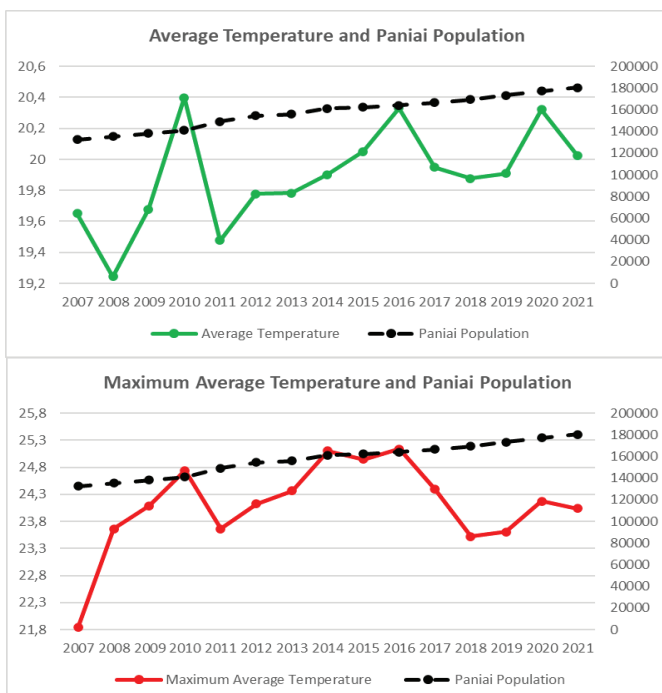
weak inverse relationship (correlation value = -0.21). The lowest air temperature illustrates a straight proportional relationship. There is a strong direct association between population increase and the minimum temperature, as indicated by the correlation value of 0.64 (Table 3).

**Table 2.** Correlation coefficient of average, maximum, and minimum temperature to the number of residents in Nabire Regency.

Corellation Coeficient	
Average temperature	0.53
Average maximum temperature	0.35
Average minimum temperature	0.79

**Variation in Air Temperature According to Paniai Regency Residents' Numbers**

Correlation coefficients and graphs Similar findings are shown by the Paniai district's air temperature. Annual trends indicate that minimum, maximum, and



**Figure 3.** Graph of the relationship between average temperature, maximum temperature, minimum temperature, and population in Paniai Regency.

average temperatures tend to rise (Figure 3).

Based on Figure 3, there is a clear correlation between Paniai's population increase and air temperature. The average temperature has a relatively significant correlation (0.53) with itself, and it is directly proportional. With a correlation coefficient of 0.35, the average maximum temperature and population increase have a weak direct link. With a correlation coefficient of 0.79, the minimum average temperature and population increase have a significant direct proportionate relationship.

**Table 3.** Correlation coefficient of average, maximum, and minimum temperature to the number of residents Paniai Regency.

Corellation Coeficient	
Average temperature	-0,63
Average maximum temperature	-0,21
Average minimum temperature	0,64

**CONCLUSION**

Based on visual analysis and the correlation coefficient between population and air temperature, the following conclusion may be drawn:

In Paniai Regency, population growth is directly proportionate to rising average air temperature and has a high correlation with it; in Nabire Regency, the correlation is inverse but still reasonably strong. In the regencies of Paniai and Nabire, population growth and average maximum temperature have a poor association. In Paniai and Nabire Regencies, population growth is directly correlated with the average minimum temperature.

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