Comparing Air and Water Quality with Average Income in Los Angeles County

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Abstract

This study aims to examine the relationship between air and water quality in various cities across Los Angeles County and their corresponding average income levels, focusing on identifying potential disparities in access to clean air and water among lower-income communities. It is hypothesized that areas with lower income levels experience limited access to clean air and water resources. Data were collected from public sources including the California Office of Environmental Health Hazards Assessment and the 2022 census. Air and water quality data were ranked on a scale of 1 to 3, with 1 representing the lowest and 3 the highest quality. The data were then analyzed using ArcGIS software. The collected data were visualized through five figures: (1) Air and water quality population percentage by ranking, (2) Air quality represented in PM2.5 levels, (3) Drinking water quality ranked on a scale of 1 to 3, (4) Drinking water quality in relation to distance from the LA river, and (5) Median income per city. A negative correlation was observed between air quality and median income levels, indicating poorer air quality in lower-income areas. However, no significant correlation was found between water quality and median income.The study highlights the adverse impact of poor air quality on low-income communities and underscores the importance of addressing this issue as a public health concern.

The objective of the research project is to compare air and water quality in various cities throughout Los Angeles County with the average income to identify if there is a disparity amongst communities of lower income and their access to clean air and water. I hypothesize that areas of low income lack access to clean air and water. I collected my data from public resources such as the California Office of Environmental Health Hazards Assessment and the 2022 census. The data for air and water quality was then ranked from a numerical scale of 1-3, 1 being the lowest ranking and 3 being the highest or best ranking. My data was then put into ArcGIS and displayed into 5 figures: Air and water quality population percentage by ranking, air quality represented in PM2.5, drinking water quality ranked 1-3, Drinking water quality and distance from LA river, and median income per city. In conclusion, I found that there is a negative correlation between air quality and median income but there is no correlation between water quality and median income. The poor air quality has a negative effect on these low income communities and therefore should be a public health concern.

Background

As a result of climate change, there has been an increase in wildfires in California (Ebi et al. 2021). The increase in CO2 emissions over the past 100 years have resulted in more extraneous weather events every year (Ebi et al. 2021). California's climate has always had a wildfire season but in more recent years, wildfire season has become much longer and more intense (Dennison et al. 2014). Wildfires are exacerbated by the dry climate of California which, in recent years, has been escalated. Heat waves are one of the main factors that lead to wildfires and in addition to increasing the amount of wildfires per wildfire season, heat waves can exacerbate the amount of pollutants in the ozone layer which have negative effects on air quality (Ebi et al. 2021). The increase in wildfires puts many Californians at risk and results in air

quality that has a negative effect on their health. The increase in extreme weather events, specifically wildfires, is projected to continue (Ebi et al. 2021) and focusing on how to protect and prevent certain communities from being destroyed is part of the reality of living through climate change. The Environmental Protection Agency (EPA) is currently working towards researching the health impacts that wildfires have on the population. Some of the research the EPA is conducting includes a mobile phone app called “Smoke Sense”. This app allows users to make observations about the air quality outside and look at a map that shows the air quality in the area. In addition, the app provides information about how citizens can protect themselves from poor air quality. Users earn badges based on how much they explore the app which incentivises users to use the app. Smoke sense is a great option for individuals who would like to learn more about the air quality in their area and how to stay safe especially during wildfire season when smoke is rampant in their area.

In addition to the risk of wildfires and their contribution to air pollution, CO2 emissions produced by refineries, factories, and even cars impact low income communities all over California. Major cities like San Francisco and Los Angeles are heavily segregated by social class and areas like Oakland in San Francisco are being bombarded with pollution. Oakland has freeways, trains, and other transportation routes surrounding neighborhoods which affects the air quality in the area. NBC news interviewed a woman living in Oakland where the “Interstate 880 and the train station are both visible through the office window” (Purtell, 2020).

The California Air Resources Board (CARB) has made an attempt to combat the issue of air pollution by implementing a plan with the input of residents in neighborhoods most heavily affected by air pollution. Some of these areas include: Oakland, Stockton, Fresno, Boyle Heights, Carson, and El Centro (Larios, 2022). The areas were chosen all around California and were

nominated by both community members and air districts. CARB staff began their decision making process based on technical assessments and once those were completed the public was allowed to comment and help make the final decisions on what areas to add to the Community Air Protection Program. It is important that citizens have a say in the matter of which communities are selected to be a part of the Community Air Protection Program because these citizens are the ones directly affected by air pollution. By increasing the amount of communities protected by this program, those communities most affected by air pollution will get the attention and support they deserve.

Los Angeles county has some of the worst rated air quality (Briscoe, 2023) this terrible air quality has direct effects on the health of children with about 200,000 children in southern california having asthma (Briscoe, 2023). Air pollution targets future generations because it has the greatest negative effects on pregnant women and children (EPA, ND). The air quality in Los Angeles comes as a result of the car culture that is prominent in the area. Most people choose to drive their car rather than take public transport which results in air pollution concentrated in areas near freeways. The California Air resources board is attempting to mitigate air pollution in Los Angeles with the Advanged Clean Fleet Proposal which would require freight trucks, delivery vehicles, school buses, and garbage trucks to emit zero emissions (Clegern, 2023). This mandate is one of the first in the world to prohibit the sale of combustion trucks (Clegern, 2023). This is a huge step for reducing GreenHouse Gas (GHG) emissions and improving air quality. Trucks contribute to 25% of the GHG emissions and 35 % of the nitrous oxide emissions in California (Clegern, 2023).

In addition to air quality issues the water quality in low income communities also has a negative effect on resident's health. Fixing improper infrastructure that contaminates and does

not properly process water is expensive. Some solutions could add up to $30-$160 million per year (Hanak and Chappele, 2015). The funds for water pollution control are allocated to specific areas that need it (Hanak and Chappele, 2015). With the increase in storms as a result of climate change, the standard water treatment process struggles to handle the runoff from water pollution from the storms. Nitrate is a compound that commonly contaminates drinking water which tends to plague communities in agricultural regions (Schaider et al, 2019). Research like Schaider et al. have studied the connection between issues of water quality amongst communities and the correlation with wealth or lack thereof. In Los Angeles specifically, the water is sourced from external sources in addition to aqueducts connected to the Los Angeles River (Schnalzar, 2021). In this study the Los Angeles River will also be taken into account when observing drinking water quality in the county.

The main goal of this project is to directly compare air and water quality to median income. The scope of this project is Los Angeles county and the boundaries of the districts are individual cities within Los Angeles county. By comparing the air quality in each city compared with each district's income ranked I have been able to see if those who live in low income areas have worse air quality than those who live in higher income neighborhoods. This comparison will give the reader a better understanding of the environmental justice issues that the people of Los Angeles county endure.

Study Area and Data

Los Angeles county is the area of study which has the largest county population in the country (Ray, 2022). The county of Los Angeles has a population of 10 million and is made up of 272 neighborhoods. Los Angeles makes up 27% of California's population, which shows how integral this single county is to California as a whole. City boundaries are identified and the

median income per city was collected by the US Census Bureau. Average income is based on the 2022 census.

Air quality was calculated in PM2.5 and collected from the California Office of Environmental Health Hazards Assessment (Zeise et al., 2021). PM2.5 and PM10 are commonly used to measure air quality, PM2.5 includes smaller air particles than PM10, the 2.5 and the 10 representing micrometers (Larios, 2022). Due to the fact PM2.5 involves smaller particles, they are more likely to reach the deeper parts of the lung or in some cases the bloodstream (Larios, 2022). The concentration of particulate matter in PM2.5 and PM10 depends on the location, time of year, and weather conditions (Zeise et al., 2021). In this study I focus on PM2.5 due to the fact wildfire smoke produces pollution that is almost entirely in the PM2.5 range. Wildfires are a huge concern for citizens and contribute greatly to pollution in Los Angeles County (Zeise et al., 2021). Using spatial analysis, drinking water quality, air quality, and median are displayed on separate maps. OEHHA has calculated what areas contain unsafe drinking water using California's health standards (Zeise et al., 2021) some common contaminants include arsenic (from naturally occurring rocks found near water sources) and nitrate (from fertilizer). The Los Angeles river is also displayed spatially in the map representing water quality in order to properly represent water quality in Los Angeles county. Using these spatial comparisons allows for a visual representation of the possible environmental justice inequalities that occur in Los Angeles county.

Methodology

The data collected for this study came from various government sources such as OEHHA and Los Angeles County Enterprise GIS. In order to analyze water and air quality, PM2.5 was calculated and sourced from various CARB air monitoring networks (Zeise et al., 2021) and

water quality was calculated based on the average concentrations of various water contaminants (Zeise et al., 2021). The air monitoring networks, overseen by CARB, collect data on various common air pollutants (Zeise et al., 2021). The data collected from these networks were put into a database managed by CARB. Drinking water quality was measured based on the amount of contaminants in the water using the drinking water index provided by OEHHA. Water was checked in various locations along the water distribution system (Zeise et al., 2021).

The median income and Area Median Income (AMI) for each city was gathered via US Census and from the Los Angeles County Enterprise GIS. Air quality was calculated using PM2.5 which measures fine pollution particles. If PM2.5 is too high that means residents are breathing in too many harmful air particles. PM10 is also commonly used to measure air quality pollutants but is not focused on in this study due to the fact that PM2.5 measures smaller air particles than PM10 so they are more likely to enter deeper parts of the human lung (Larios, 2022). High fine particle matter in the air has been linked to heart and lung disease (Zeise et al., 2021).

The amount of fine particulate matter in the air of various places around Los Angeles County was calculated in PM2.5 and then ranked on a numerical scale from 1 to 3. 1 being ranked the lowest and 3 being the highest. Water quality data was calculated using a water boundary tool that helped map the state water system service in Los Angeles county. Once the system was laid out, the ground water quality was calculated based on these boundaries. And again the water quality was initially in numerical values and then ranked on a scale from 1-3 in order to visually display what areas have better water quality than others. 1 being the worst water quality and 3 being the best. Median Income was not given numerical rankings and instead kept its raw numbers. Because the audience is more familiar with income amounts, rather than PM2.5

the raw data can be displayed instead of a number ranking. The income amounts per city were broken down into 5 groups, the first being an average income between $0 and $52,438 and the greatest group ranging from $164,220 to $250,00. The main focus being median income rather than AMI in order for the audience to be able to interpret the wide variety of income for themselves. Median income, PM2.5 and drinking water quality were each given separate layers on the figure which allows for each layer to be compared and analyzed on their own.

Results and Findings

The distribution of income across cities in Los Angeles County varies greatly on location desirability, because Los Angeles is located along the Southern California coast and has a large metropolitan area, there is a higher demand for living in these specific areas. The majority of the coastal cities have high average incomes that range from $113,089 to $250,001 which are the two highest categories in this study; there are a few exceptions to this in El Segundo, San Pedro, and Long Beach. There is also a higher concentration of greater incomes more inland in West Los Angeles in cities such as Bel Air, Brentwood, and the Pacific Palisades. In contrast there is a concentration of low median incomes in central Los Angeles county ranging from Downtown Los Angeles and Koreatown to more southern areas such as Compton.

The distribution of water quality is heavily influenced by distance to the coast. Most coastal areas have a 1 in water quality. The more inland areas such as Burbank (North-Central) and West Covina (East) have water quality rankings of 3. There is no correlation between income and water quality. However, there is a correlation between drinking water quality and distance from the Los Angeles River. Areas closer to the Los Angeles River have a higher water quality ranking than those further from the river. This in part is due to the fact that the Los Angeles River is near many aqueducts that supply water to residents (Schnalzar, 2021). 53.45% of Los

Angeles county residents have access to drinking water that is in the 3 ranking. 27.17% of residents drink water that has a ranking of 2 while 19.38% of residents drink water that is ranked at 1 (Table 1). More than half of Los Angeles residents have clean drinking water while more than a quarter are left with moderate drinking water and almost one fifth are left with contaminated drinking water.

When observing air quality, there were multiple areas that had significantly higher PM2.5 rates than other areas. When observing Figure 1 there are three apparent locations with greater amounts of particulate matter. These areas can be found in the Claremont and Pomona Area (East), Downtown Los Angeles (Central), and Los Angeles (North-West) which are shown in dark blue (Figure 1). When comparing air quality to median income, the maps have similar patterns. There is a higher concentration of PM2.5 in areas with a lower median income (Figure 1 & Figure 4). 6.44% of residents have an air quality ranking of 3 (Table 1). While 55.23% of residents have an air quality ranking of 2 and 38.33% have an air quality ranking of 1 (Table 1). The percentage of Los Angeles county residents that have very clean air is low while more than half have moderately clean air and more than one third are left with unhealthy air. When comparing each figure there is a correlation between air quality and income and water quality and the location of the Los Angeles River.

Conclusion

The air quality in Los Angeles county is an example of environmental inequality that occurs based on social class. Those who come from low income areas are disadvantaged and more susceptible to long term health risks as a result of higher PM2.5 rates. While there is a correlation between lower air quality and lower median income there is no correlation between water quality and median household income. In order to combat the negative effects of air

pollution in low income areas regulations improving air pollution need to be put into place. Individuals can reduce their contribution to pollution through using more sustainable transportation methods such as public transit or biking. Although individuals contribute to pollution, factories and businesses have a much greater impact on air pollution. In Los Angeles County, the pollution that these organizations produce are regulated by the South Coast Air Quality Management District (SCAQMD) (“Pollution from Industries”). In order to reduce the air pollution in these concentrated areas, the air pollution standards need to be regulated and enforced more rigorously. Areas of low income should be given more priority in order to protect the public health of these communities. Breathable air is a human right that everyone, no matter what their income is, should have access to.

Tables and Figures

	Air Quality Population Percent (%)	Water Quality Population Percent (%)
Rank 3 (Best)	6.44	53.45
Rank 2	55.23	27.17
Rank 1 (Worst)	38.33	19.38

Table 1 Air and water quality population percentage by ranking

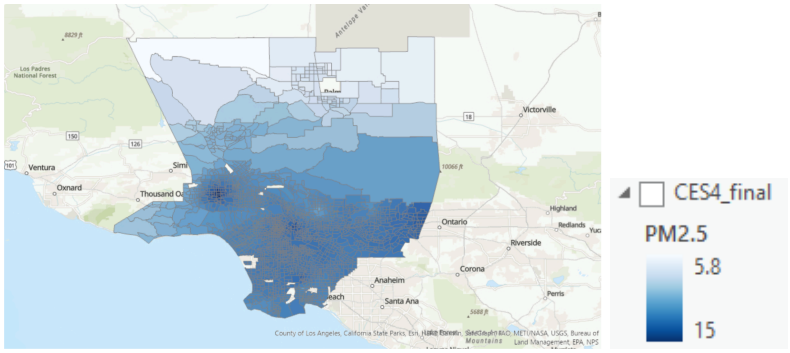

Figure 1 Air quality represented in PM2.5

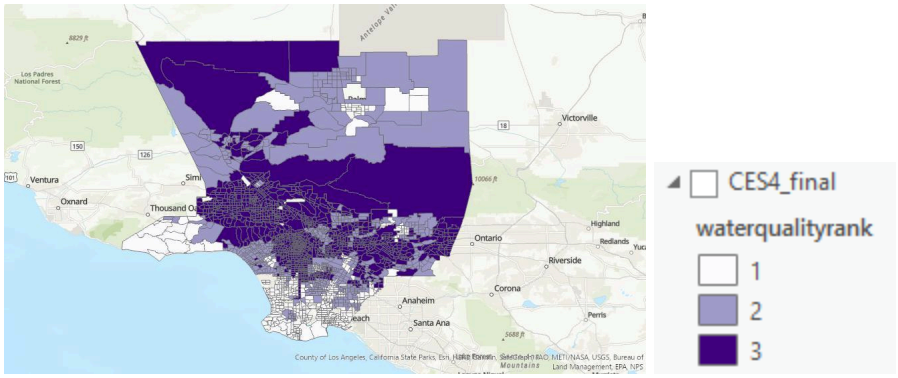

Figure 2 Drinking Water quality ranked from a scale of 1-3

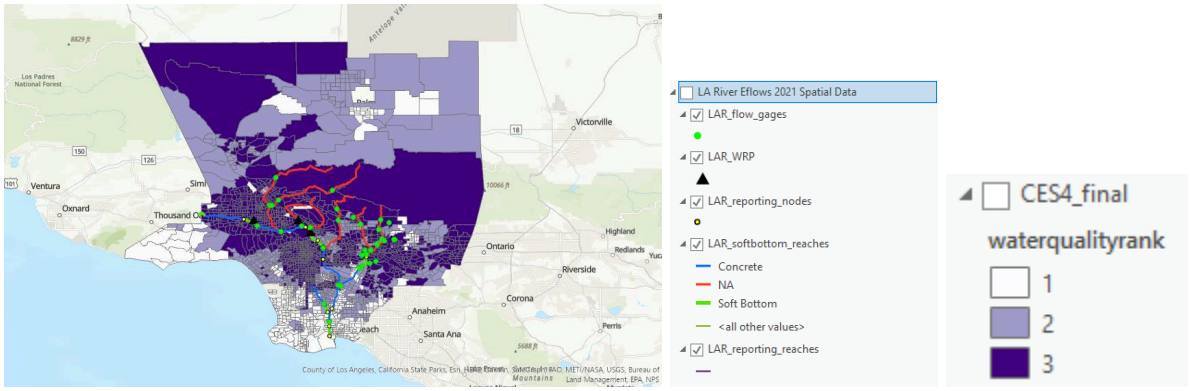

Figure 3 Drink water quality ranked 1-3 and Los Angeles River

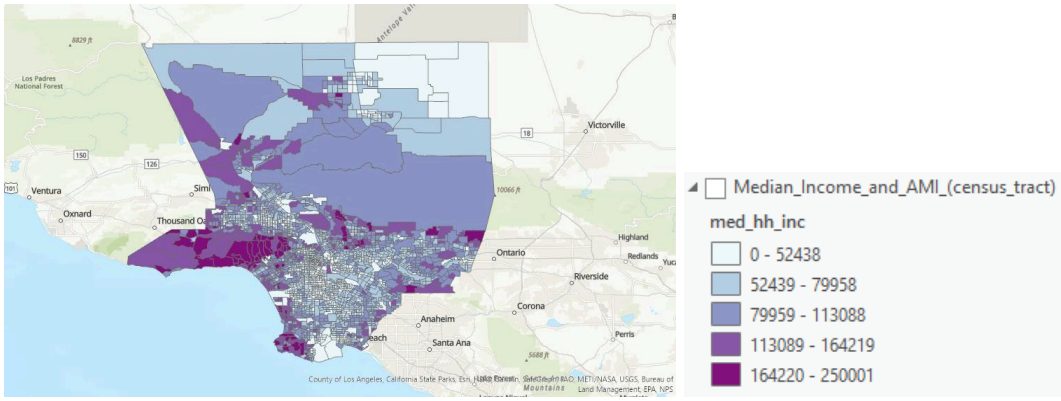

Figure 4 Median income per city split into 5 categories

References

U.S. Environmental Protection Agency. (n.d.). Smoke Sense Study: A Citizen Science Project Using a Mobile App. Retrieved from https://www.epa.gov/air-research/smoke-sense-study-citizen-science-project-using-mobile-app

California State Water Resources Control Board. (n.d.). Databases. Retrieved from https://www.waterboards.ca.gov/losangeles/resources/databases/index.html

IQAir. (n.d.). Los Angeles, California Air Quality Index (AQI) and Air Pollution Information. Retrieved from https://www.iqair.com/us/usa/california/los-angeles

Los Angeles Almanac. (n.d.). Los Angeles County Employment by Industry. Retrieved from https://www.laalmanac.com/employment/em12c.php

Los Angeles Times. (n.d.). Median Household Income for Los Angeles County Neighborhoods. Retrieved from https://maps.latimes.com/neighborhoods/income/median/neighborhood/list/

U.S. Environmental Protection Agency. (n.d.). EPA Research on Environmental Justice and Air Pollution. Retrieved from https://www.epa.gov/ej-research/epa-research-environmental-justice-and-air-pollution

California Air Resources Board. (n.d.). CARB Expands the Number of California Disadvantaged Communities in Statewide Community Air Protection Program. Retrieved from https://ww2.arb.ca.gov/news/carb-expands-number-california-disadvantaged-communities-statewide-community-air-protection

Public Policy Institute of California. (2021). California's Water Quality Challenges. Retrieved from https://www.ppic.org/publication/californias-water-quality-challenges/

NBC News. (2020, February 28). Low-income California Communities Enact Plan to Fight Disproportionate Air Pollution. Retrieved from https://www.nbcnews.com/news/us-news/low-income-california-communities-enact-plan-fight-disproportionate-air-pollution-n1172421

Margolis, H. G., Silva, R. A., Zhang, Y., Kwon, H., & Houston, D. Q. (2021). Application of a Machine Learning Method to Estimate Ozone and Fine Particulate Matter Concentrations in Southern California. International Journal of Environmental Research and Public Health, 18(2), 619. https://doi.org/10.3390/ijerph18020619

Previdi, M., & Polvani, L. M. (2015). Climate system response to stratospheric ozone depletion and its interaction with greenhouse warming. Geophysical Research Letters, 42(4), 1082-1089. https://doi.org/10.1002/2014GL059576

Research Division. (n.d.). *California Air Resources Board*. Inhalable Particulate Matter and Health (PM2.5 and PM10) | California Air Resources Board. https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health#:~:text=on%20particle%20size.-,PM2.,tissue%20damage%2C%20and%20lung%20inflammation

County of los angeles enterprise GIS. County Of Los Angeles Enterprise GIS. (2023, February 15). https://egis-lacounty.hub.arcgis.com/

Zeise, L., & Blumenfeld, J. (n.d.). *CalEnviroScreen4.0*. Oehha.ca.gov. https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40

Olyazadeh, R. (2023, October). *(PDF) geostatistic analysis, predicting the values of ozone ...* Reasearch Gate. https://www.researchgate.net/publication/303018745_Geostatistic_Analysis_Predicting_the_values_of_ozone_concentration_in_the_state_of_California

Air Quality Forecast. 4C Air. (2021, May 26). https://4cair.com/air-quality-forecast/

Ray, J. (2022, May 13). *L.A. County has more people than 40 states, but its political power doesn't reflect that*. Los Angeles Times. https://www.latimes.com/california/newsletter/2022-05-12/los-angeles-county-has-a-higher-population-than-40-states-essential-california

Schnalzer, R. (2021, September 27). *Ever wonder where your drinking water comes from? A reader asked and we answer*. Los Angeles Times. https://www.latimes.com/business/story/2021-09-27/la-drinking-water-sources

Los Angeles County Department of Public Health. (n.d.). *Pollution from industries and other businesses in Los Angeles County*. Pollution from Businesses | Los Angeles County Department of Public Health - Environmental Health. http://publichealth.lacounty.gov/EH/safety/pollution-industries-other-businesses.htm#airpollution

About Los Angeles County . COUNTY OF LOS ANGELES. (n.d.). https://lacounty.gov/government/about-la-county/about/#:~:text=It%20is%20one%20of%20the,27%20percent%20of%20California's%20population.