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Effects of Meteorological Parameters on Air Quality Index (AQI) in the Vicinity of Plastic Recycling Industries in Kano Metropolis, Nigeria.

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Abstract

Meteorological conditions significantly affect ambient air quality in metropolitan settings. Sub-indices were calculated using the air quality mathematical approach developed by the United States Environmental Protection Agency (USEPA) to determine the AQI. The main objectives of this study were to evaluate the AQI status at an alternative plastic recycling facility and ascertain the relationship between the AQI and climatic parameters in Kano Metropolitan City, North Western Nigeria. According to the research findings, the AQI recorded the following in the afternoon: CO (0 to 15), NO_2 (0 to 2), $PM_{2.5}$ (80 to 200), and PM_{10} (23 to105). In the morning the CO (0-35), NO_2 (0-4), $PM_{2.5}$ (124-240), and PM_{10} (28-106) AQIs were observed. The AQI levels of concern classified the air quality as very poor for $PM_{2.5}$, moderate for PM_{10},moderate for carbon monoxide (CO), and safe for nitrogen dioxide (NO_2). The results of the study show a considerable strong negative association between humidity and AQI of $PM_{2.5}$ ($r=-0.64$, $p<0.05$) and between AQI of CO and PM_{10} ($r=-0.41$, $p<0.05$), as well as a weak positive correlation between temperature and AQI-PM_{10} ($r=0.477$, $p<0.05$).The study recommend strict and appropriate industrial emission management, industrial air pollution control, and efficient waste management of plastics, including steps to reduce the burning of plastic, in the study area to lower the risks associated with these pollutants.

Keywords: Ambient Air quality, plastic recycling industries, Kano metropolis, Low-income countries

INTRODUCTION

In the modern era, air pollution has grown to be a major global environmental concern due to expanding urbanization, industry, and development endeavors (Zhang *et al.,* 2016; Ghosh *et al.,* 2023). Poor air quality (PAQ) is a persistent global issue that harms both the environment and human health (Chukwu *et al.,* 2022a; World Health Organization, 2023; National Center for Atmospheric Research, 2023; Chukwu *et al.,* 2024b). An increasing amount of research suggests that lower-income and more marginalized populations bear a disproportionate share of the burden of air pollution (Bell *et al.,*2013; Jbaily*et al.,* 2022; Rentschler and Leonova, 2023). Air pollution, mostly from human activity, appears to be one of the leading causes of death in low- and middle-income nations (Lelieveld*et al.,* 2020; Rentschler and Leonova, 2023). Emerging nations, in contrast to developed nations, have seen a significant increase in industrialization and urbanization in recent times. This process is often unregulated and does not follow regulations regarding air quality. This has made the problem of air pollution worse

(Miller & Associates, 2012; Sarah & Associates, 2021). Unplanned and uncontrolled growth activity, excessive fossil fuel combustion, and a lack of appropriate national or international policy have all contributed to the decline in atmospheric quality; 90% of air pollution-related deaths occur in low- and middle-income countries (Gurjar *et al.,* 2016; Fuller *et al.,* 2022; Ghosh *et al.,* 2023).

More than 80% of urban residents are exposed to air pollution levels that are higher than WHO recommendations, and more than 98% of cities in low- and middle-income countries do not meet air quality regulations, according to Manju *et al.,*(2018) and Keyes *et al.*,(2019). Studies by Fuller *et al.,*(2022) and Ghosh *et al.,* (2023) estimate that air pollution kills 6.5 million people yearly in developing countries, a figure that is on the rise. Air pollution causes more than 6.5 million fatalities annually in developingnations, and this number is growing, according to Fuller *et al.,* (2022) and Ghosh *et al.,* (2023). Higher concentration levels of air pollution are caused by a number of factors, including laser regulations governing air quality, the prevalence of older, more polluting vehicles and machinery, fossil fuel subsidies, congested urban transportation systems, rapidly expanding industrial sectors, and slash-and-burn agricultural practices (McDuffie *et al.,* 2021; Rentschler and Leonova, 2023).

Meteorology is the study of the atmosphere and associated processes that affect how pollutants behave in the atmosphere (Vaishali *et al.,* 2023). Meteorological factors also affect fluctuations in pollution concentrations and levels at local, regional, and global scales (Shukla *et al.,* 2008; Cichowicz *et al.,* 2020; Rizos *et al.,* 2022; Zisopoulos*et al.,* 2023). Meteorological circumstances are significant in defining ambient air pollution because they have a direct and indirect impact on the emissions, transportation, generation, and deposition of air pollutants. The dispersion, transformation, and removal of particulate matter from the lower atmosphere are significantly influenced by meteorological parameters, both directly and indirectly, as multiple scientists have found (Singh *et al.,* 2021; Das *et al.,* 2021; Cheng *et al.,* 2007; Gorai *et al., (*2015), and Vaishali *et al.,* 23). Additionally, Zhang *et al.,* (2017) have shown how changes in air humidity affect particulatematter. More specifically, increased humidity variance significantly raises the $PM_{2.5}$concentration (Zisopoulos*et al.,* 2023). Numerous studies on the effects of climate variabilitiesand atmospheric pollution on humans have connected meteorological circumstances and features to air pollutants (Oji and Adamu, 2020). Few studies have explored the relationship between temperature, relative humidity, wind direction, wind speed, and air quality in urban Kano (Elminir, 2005; Oji and Adamu, 2020). The correlations between climaticconditions and air quality, particularly within the plastic recycling industry, have not yet been investigated in Kano City. This study seeks to fill this gap by assessing the impact of plastic recycling industries on ambient air quality in the metropolitan area of Kano, Nigeria.

MATERIALS AND METHODS

Study Area

Kano metropolis is located in the north western region of Nigeria, between latitudes 11° 55′ 0″ N and 12° 0′ N (Figure 1). The Kano metropolis is situated in the dry-sub-humid agroecological zone of Nigeria (Ojanuga, 2006; Karkarna and Matazu, 2021). The total area of metropolitan areas is about 499 km^2, and the urban area is about 137 km^2. The Kano metropolitan area is one of the fastest-growing cities in West Africa, both economically and demographically (Maigari, 2014; Karkarna and Matazu, 2022). In northern Nigeria, it is the most populated region (Barau *et al.,* 2015; Yunus, 2021; Matazu and Ali, 2023). The semi-arid climate of the Kano metropolitan region is characterisedby an average daily temperature of approximately 30°C (Liman *et al.,* 2014; Matazu and Ali, 2023). The Kano metropolitan region is one of the fastest growing in West Africa in terms of both population and economy(Barau *et al.,* 2015; Yunus, 2021; Matazu and Ali, 2023). The Kano metropolitan area has a semi-arid climate, with daily average temperatures of about 30°C. The lowest temperature (20°C) ever recorded occurred in December and February (Liman *et al.,* 2014; Yunus, 2021; Matazu and Ali, 2023). Seasonal rains and other fluctuations in the climate are common occurrences in Kano that have a major effect on the surrounding vegetation. The dry season and the wet, or rainy, season are the two main seasons. From May to the start of the dry season in September, there is a rainy season.

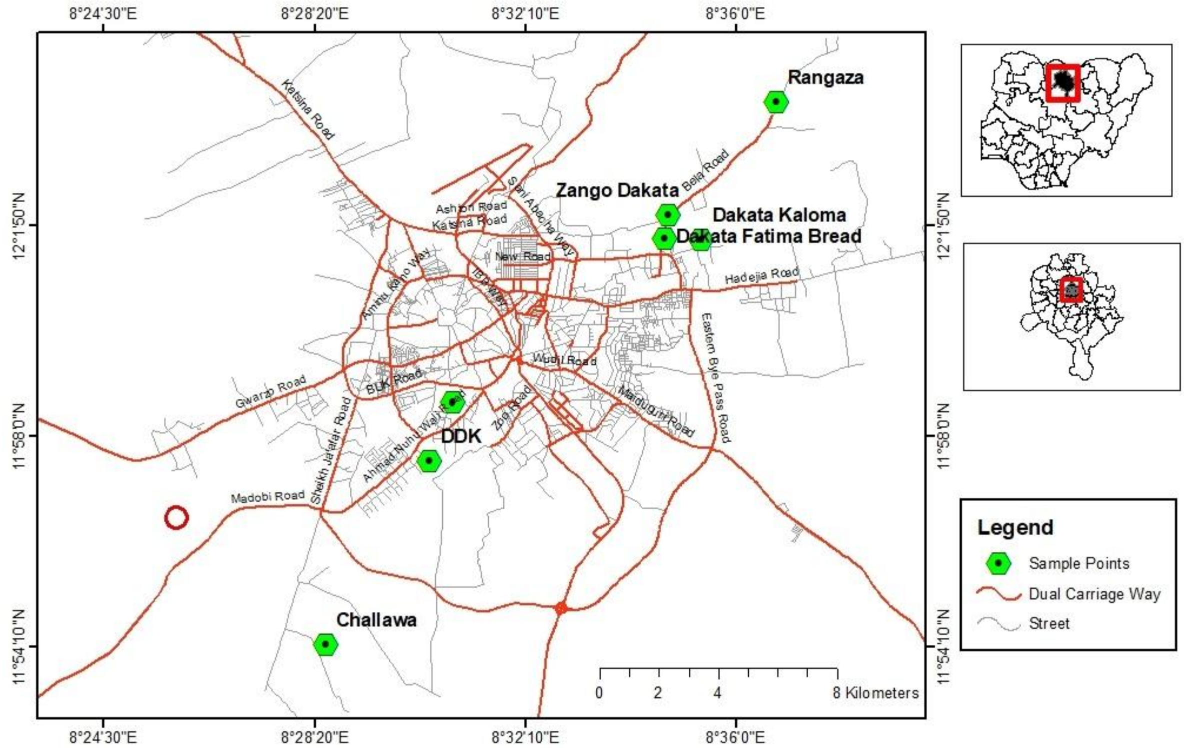

Figure 1: Map showing the sampling sites

Sampling Sites
Fieldwork was conducted at seven distinct plastic recycling facilities situated in the Kano metropolitan area, Nigeria,over 42 days, from December 25, 2022, to February 5, 2023. As seen in Figure 1 above, the industrial zonesthat were chosen were Challawa, DDK, Janbulo, Zango, Dakata A, Dakata B, and Rangaza. The locations of the recycling plants in the study area were selected by purposivesampling, which was employed to monitor the concentrations of air pollutants in different industrial sites.

Data Collection
In compliance with USEPA regulations, the concentrations of nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter (PM_{10}), and particulate matter ($PM_{2.5}$) were monitored both in the morning and afternoon period .The air measurements were taken during the dry season when the rain had minimal impact. These measurements were used to calculate the Air Quality Index (AQI). During a field study, numerous sampling stations close to the research region were monitored for air concentration at various separations from one another using portable active in situ samplers. The Q-TRAK 7575-X (TSI Inc., USA) was used to measure the temperature, relative humidity, and CO levels in the ambient air at one-minute intervals.

These instruments have been widely used to evaluate pollutant concentrations in many previous studies (Abhijith and Kumar, 2019; Rivas *et al.,* 2017; Sharma and Kumar, 2020). The PM_{10} and $PM_{2.5}$particulatematter concentrations were measured using the Life Basis portable meter.The nitrogen dioxide was measured with a hand-held meter, a ZDL-1400. Q-TRAK 7575-X instruments have been widely used to measure pollutant concentrations in several previous studies (Abhijith and Kumar, 2019; Rivas *et al.,* 2017; Sharma and Kumar, 2020).

Statistical Data Analysis
Descriptive statistics were first computed for meteorological and air pollution data. A significant association between the air quality index and meteorological data was found using a Pearson product-moment correlation approach.

Air Quality Index Assessment
The Air Quality Index reduces complicated information on the quality of the air caused by different contaminants to a single number (the index value), name, and color (Ghosh et al., 2023). The Air Quality Index for the area with recycling plants was calculated using the USEPA (2009) technique. For the calculation of AQI, the methodology of USEPA (2009) is followed (Equation (1));

$$\boldsymbol{AQI = (IH_1 + IL_0) / (BPH_1 + BPL_0) \times Cp + BPL_0\ ) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Eqn\ 1}$$

Where, Ii = AQI for the ith pollutant. BPHi = Breakpoint concentration greater or equal to the given concentration. BPLo = Breakpoint concentration smaller or equal to given concentration. IHi = AQI value corresponding to BPHi. ILo = AQI value corresponding to BPLo. Cp = Pollutant concentration.

RESULTS AND DISCUSSION
According to Table 1, the study area typically had carbon monoxide values of 0-1.4 $\mu g/m^3$ in the morning and 0-1.2 $\mu g/m^3$ in the afternoon. The average carbon monoxide content in the research area was the lowest, at less than the 4 $\mu g/m^3$ WHO permitted limit. This low CO level suggests that air pollution is acceptable, which could be connected to the slow-burning of fossil fuels in recycling power plants. The current study shows far lower CO levels than previously published information from several locations: According to Alfaki (2019), CO levels in Sudanese plastic industries ranged from 0.0 to 15.77 ppm; Maiwada *et al.,* (2020) recorded CO values in Zaria City, Nigeria, ranging from 3 to 15 ppm; and Zahra *et al.,* (2022), reported CO levels in Faisalabad City, ranging from 3.03 to 3.08 mg/m^3. Carbon monoxide is emitted in recycling power plants when fuels such as gas and oil do not burn completely. The blood's supply of oxygen is reduced when carbon monoxide is inhaled, leaving less oxygen for the heart, brain, and other vital organs.

As shown in Table 1, the average nitrogen dioxide (NO_2) content in the study region was found to be lower in the morning (ranging from 0 to 0.4 g/m^3) than in the afternoon (ranging from 0.1 to 0.7 g/m^3). The findings indicate that the highest recorded average NO_2 content (0.6 $\mu g/m^3$) is significantly lower than the WHO limit of 10 $\mu g/m^3$ established in 2021. The average annual nitrogen dioxide level of 63 $\mu g/m^3$ was discovered in Accra, Ghana by Wang *et al.,* (2022), which is significantly higher than our results. Similarly, research by Hasan *et al.,* (2018) in Bangladesh discovered that areas around garment manufacturing facilities had nitrogen dioxide levels between 2.03 to 90.95 $\mu g/m^3$. Moreover, Morabet *et al.,* (2021) noted that local traffic conditions in urban environments have a major impact on the concentration of NO_2.

Table 1 Mean Concentration of Air Pollutant Parameters in the Study Area

	MORNING				AFTERNOON			
INDUSTRIES	CO μg/m³	NO_2 μg/m³	$PM_{2.5}$ μg/m³	PM_{10} μg/m³	CO μg/m³	NO_2 μg/m³	$PM_{2.5}$ μg/m³	PM_{10} μg/m³
Challawa	0.0	0.0	8.2	9.0	0.0	0.0	8.0	7.0
DDK	0.1	0.0	12	7.0	1.2	0.1	4.0	14
Janbulo	1.4	0.1	6.2	5.3	0.7	0.2	10	10
Dakt A	0.6	0.0	9.4	7 .0	0.6	0.7	5.0	15
Dakt B	0.0	0.0	6.5	4.2	0.4	0.3	4.0	6.0
Rangaza	1.2	0.2	8.0	11.0	0.1	0.2	6.1	9.1
Zango	0.4	0.4	12.0	8.1	0.2	0.3	10	3.4
WHO (2021)	4.0	10	5.0	15.0	10	10	5.0	15

Sources: Fieldwork, 2023

Table 1 shows that the average $PM_{2.5}$ concentration ranged from 4 to 10 μg/m³ in the afternoon and peaked in the morning at 6.2to 12μg/m³. These values exceeded the World Health Organization (WHO) limit of 5 μg/m³ set in 2021. The present findings were somewhat higher than those of a study conducted in an industrial zone in South India by Peter *et al.,* in 2023, found maximum $PM_{2.5}$ levels of 73 μg/m³in 2018 and 55 μg/m³2020. Additionally, Mutahi *et al.,* (2021) reported an average $PM_{2.5}$ value of 166 μg/m³ in Beiwandani, Kenya, which was higher than the mean value found in the current study. Southern Land *et al.,* (2022) studied $PM_{2.5}$ trends over a 20-year period in more than 10,000 urban areas in a related study. They discovered that 86% of urban residents, or 2.5 billion people, were affected by $PM_{2.5}$ levels higher than the WHO's 2005 baseline of 10 μg/m³. Variations in particulate matter concentration signal changes in primary and secondary particle emissions and responses. Two examples of primary sources of PM that originate from both natural and human sources include burning fossil fuels in an industrial recycling setting and soil dust.

According to the results shown in Table 1, the mean concentrations for PM_{10} had the lowest values recorded in the morning (4.2–11μg/m³) while the highestlevels wereobtained in the afternoon (3.4-15 μg/m³). The results of Yusuf *et al.,* (2017), who investigated average PM_{10} concentrations ranging from 568,082 + 266,441 μg/m³ to 638,520 + 355,672 μ/m³ in the vicinity of the plastic waste disposal industry in Malaysia, differed from the current study. Similarly, Akinfolarin *et al.,* (2017) found that mean PM_{10} concentrations surrounding industrial sites fluctuated between 5.16.73 and 1139.63 μg/m³ during the dry season and between 11.45 and 78.78 μg/m³ during the wet season in Port Harcourt, Nigeria.

Air quality index (AQI) analysis

Figure 2 displays the CO AQI readings, which varied from 0 to 35. The results show that the CO AQI values at the recycling facilities at Janbulo (35) were higher, suggesting that the air quality was acceptable and might not have been hazardous to the health of the recycling workers. Asa Dam Industrial Area of Kwara State, located in North Central Nigeria, has a lower AQI score for CO (1), according to the Dada *et al.,* (2020) research. Their findings are not consistent with this study. Carbon monoxide is produced in recycling plants when fuels like gas and oil are not burned completely. The blood's supply of oxygen is reduced when carbon monoxide is inhaled, leaving less oxygen for the heart, brain, and other vital organs. High CO levels have the power to over-power humans in a matter of minutes, to the point of unconsciousness (Abulude *et al.,* 2021).

The nitrogen dioxide (NO_2) Air Quality Index (AQI) values, which range from 0 to 4, are displayed in Figure 3 for each recycling facility. This result indicates that the AQI-NO_2 at the plastic recycling companies in the study region is acceptable and poses no concern to the recycling workers. In a related study conducted in Morocco in 2021, Morabet *et al.,* showed that at peak hours, AQI-NO_2 readings varied from 0 to 50 (good) and 51 to 100 (unhealthy for sensitive persons). Previous research has shown that NO_2 and ozone mix to form NO_2, hence a rise in ozone levels is predicted to follow a decrease in NO_2 levels (Bechle *et al.,* 2013 and Abulude *et al.,* 2022).

The AQI-$PM_{2.5}$ values for these pollutants were found to fall between 124 and 240, indicating an extremely bad air quality index level of pollution, according to the results shown in Figure 4 below. Janbulo got the lowest rating (124) and the highest AQI readings (240) were found in the recycling industrial regions of DDK. The current findings are inconsistent to those of Akinfolorin *et al.,* (2017), who discovered that the Air Quality Index (AQI) for $PM_{2.5}$ at three emerging industrial locations in the South-South region of Nigeria ranged from "good" to moderate during the wet season. During the dry season, the AQI ratings for every site under investigation ranged from "very unhealthy" to "hazardous."

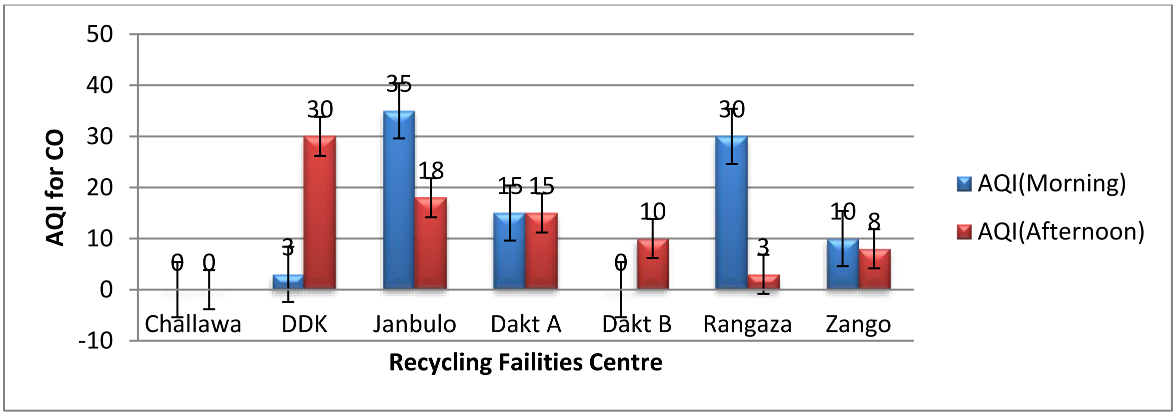

Fig 2: AQI for CO across sampling sites

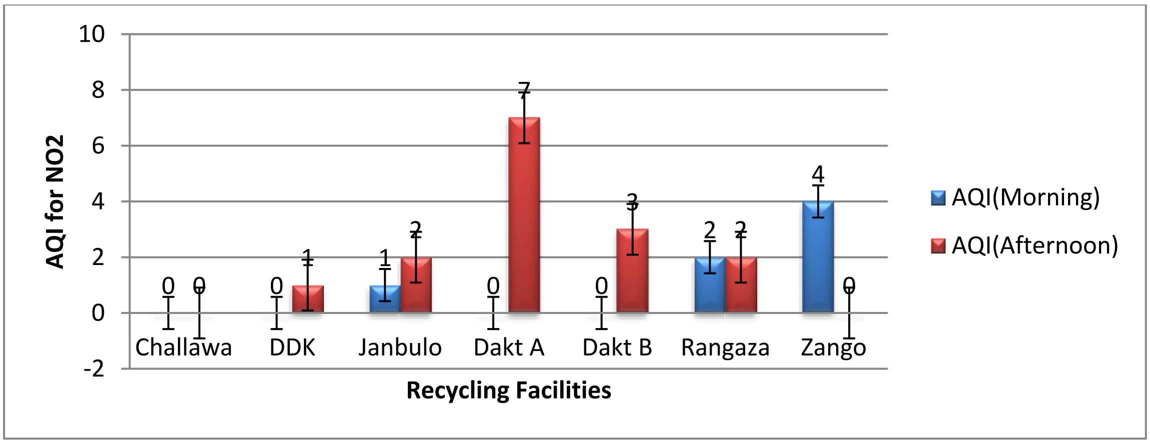

Fig 3: AQI for NO_2 across sampling sites

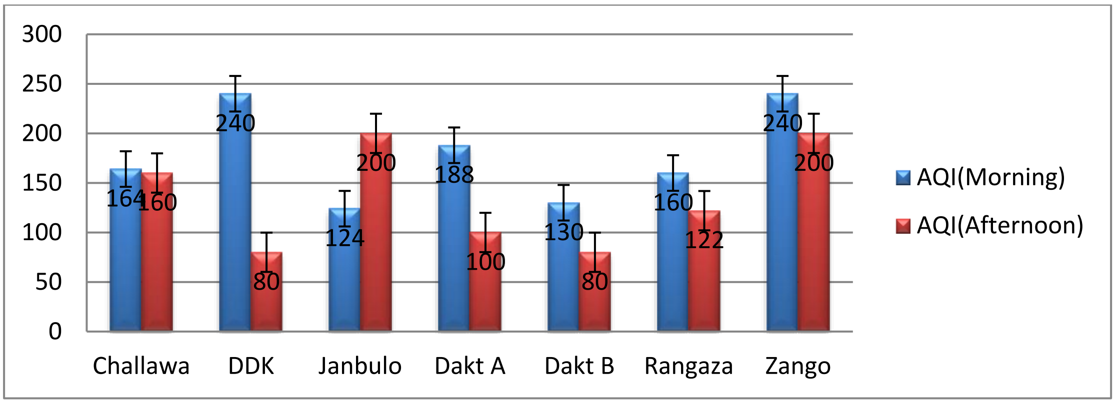

Fig 4: AQI for $PM_{2.5}$across plastic recycling facilities centre

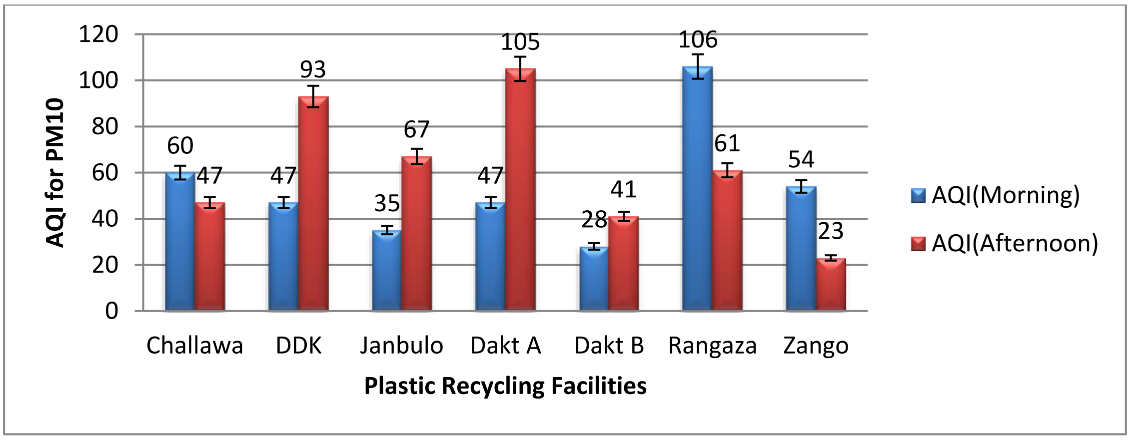

Fig 5: AQI for PM_{10} across plastic recycling facilities centre

Based on the data displayed in Figure 5, the AQI-PM_{10} values for these pollutants were reported to fall between 33 to 100, suggesting a moderate level of pollution. Zango (23) received the lowest AQI rating in the afternoon session, while Rangaza(106), Dakata A (105), and DDK (93) received the highest ratings. Our results contradict those of Abulude *et al.*, (2022), who reported significant differences in the AQI for PM_{10} among 253 urban and suburban communities in Nigeria, ranging from 3 to 143. The mechanical shredding, melting, and extrusion processes used in plastic recycling result in a significant amount of airborne particles being released by these industries. Long-term exposure to PM_{10} can cause respiratory problems, especially in vulnerable populations like children, the elderly, and people with underlying medical illnesses

Air Quality Index, Level of Concern and Description

The AQI range, morning and afternoon AQI levels for different contaminants and the associated degrees of health concern are shown in Table 2. The AQI is divided into many ranges, and the corresponding colors indicate the severity of pollution and its impacts on people's health. The CO AQI in the morning is between 0 and 35, falling into the "Good" range (0-50 AQI range). In the afternoon, the CO AQI drops even lower, to a range of 0–15, also considered to be in the “Good” range. When the air quality index for CO is at a "Good" level, it means that there is little to no risk of air pollution to human health. The morning AQI for PM_{10} is 28 to 106, falling into the "Unhealthy" (100–150 AQI range) category of air quality. Similarly, the afternoon AQI falls into the "Unhealthy" category, ranging from 23 to 105.

Based on the results presented in Table 2, the AQI obtained in the morning for $PM_{2.5}$ falls between 124 and 240, meaning that the air quality is classified as "Very Unhealthy" (AQI range: 250–350). The AQI remains in the "Very Unhealthy" range in the afternoon, but it drops somewhat to a range of 80 to 200. Particularly in places where plastic recycling businesses are present, these elevated $PM_{2.5}$ levels are cause for alarm.

Table 2:Air Quality Index, Level of Concern and Colour

Pollutant	AQI Range	AQI (Morning)	AQI (Afternoon)	Levels of Health Concern
CO	0-50	0-35	0-15	Good
PM_{10}	100-150	28-106	23-105	Unhealthy
$PM_{2.5}$	250-350	124-240	80-200	Very unhealthy
NO_2	0-50	0-4	0-2	Good

Source: Fieldwork, 2023

The NO_2 AQI remains low throughout the day, ranging from 0–4 in the morning to 0–2 in the afternoon, both of which fall within "Good" range (Table 2). Since the NO_2 level is still wellwithin the "Good" category, indicating that the air quality is adequate and poses little to no risk to health, there is very little risk associated with such low levels of NO_2. Therefore the selectedair quality parameters' AQI falls between "good" and "unhealthy".Previous research has shown that the majority of AQIs in South and North America, , are below 40, which contrastswiththe current findings. This finding may result from tight adherence to clean air regulations; indeveloped countries, it may result from the combination of the region's cold, wet climate and stringent clean air regulations (Abulude*et al.*, 2021).

The Correlation between Meteorological parameters and Air Quality

Pearson correlation coefficients were used to examine the relationship between the Air Quality Index (AQI) of several pollutants (CO, NO_2, PM_{10}, and $PM_{2.5}$) and meteorological variables (temperature and humidity). Table 3 shows that AQI-$PM_{2.5}$ and AQI-PM_{10} had a significant positive association ($r = 0.84^*$, $p<0.05$), AQI-PM_{10} and temperature had a mild positive correlation ($r = 0.477$, $p<0.05$), and AQI-NO_2 and CO had a positive correlation ($r = 0.610$, $p<0.05$). Furthermore, it was discovered that humidity and temperature had negative correlations. These findings demonstrate that the two groups of pollutants originate from different sources of pollution.

Table 3 correlation coefficients between meteorological parameters and Air quality index (AQI)

Variable	CO	NO_2	$PM_{2.5}$	PM_{10}	Temp	Humidity
CO	1					
NO_2	**0.52***	1				
$PM_{2.5}$	0.37	0.86	1			
PM_{10}	0.42*	**0.61***	**0.84***	1		
Temperature (^{0}C)	0.04	0.52	-0,23	0.44*,	1	
Humidity (mm)	-0.25	0.41*	-0.64*	0.91	-0.36*	1

* Correlation is significant at the 0.05 level (2-tailed).

The current results contradict several previous studies, such as those conducted by Biwas *et al.*, (2020) and Abdullah *et al.*, (2018), which demonstrated a positive correlation between temperature and PM_{10}, CO, and NO_2.Increased AQI is somewhat favorably connected with temperature and relative humidity, according tothe findings illustrated in thetable, which show the interaction between meteorological elements and the dynamics of air quality. The current study demonstrates the significance of meteorological factors in affecting the AQI, a gauge of air quality. The negative coefficients for precipitation, temperature, and relative humidity imply that better air quality is produced by pleasant weather. Previous research has shown that rising temperatures often cause particulate matter (PM) to decrease; however, in urban environments, this relationship may be impacted by a number of variables and processes (Yang *et al.*, 2017; Kirešová and Guzan, 2022; Logothetis *et al.*, 2023).

Influences of Meteorological Parameters on AQI

The average temperature and relative humidity for each of the seven plastic recycling facilities are shown in Figures 6 and 7. The findings show that the study area had a temperature profile with morning temperatures ranging from 25°C to 34°C and afternoon temperatures ranging from 24°C to 38°C (Figure6). Dakata B recorded the highest afternoon temperature, at 38°C. The greatest differences in temperature between morning and afternoon were found in Janbulo and Dakata B. This could be explained by the increased dilution and dispersion of pollutants at higher temperatures, as well as the potential increase in chemical reactions that lead to pollution degradation (Zhu *et al.*, 2021; Ghosh *et al.*, 2023). Figure 6 illustratesthat temperature data shows that most places have morning temperatures greater than afternoon ones, with Rangaza exhibiting the biggest shift (33°C to 22°C).

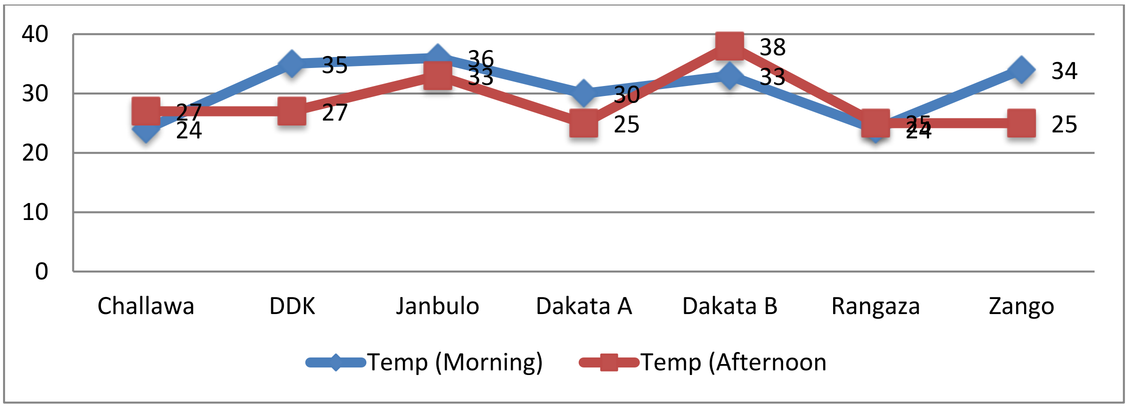

Fig. 6 Temp profile for the average morning and Afternoon period

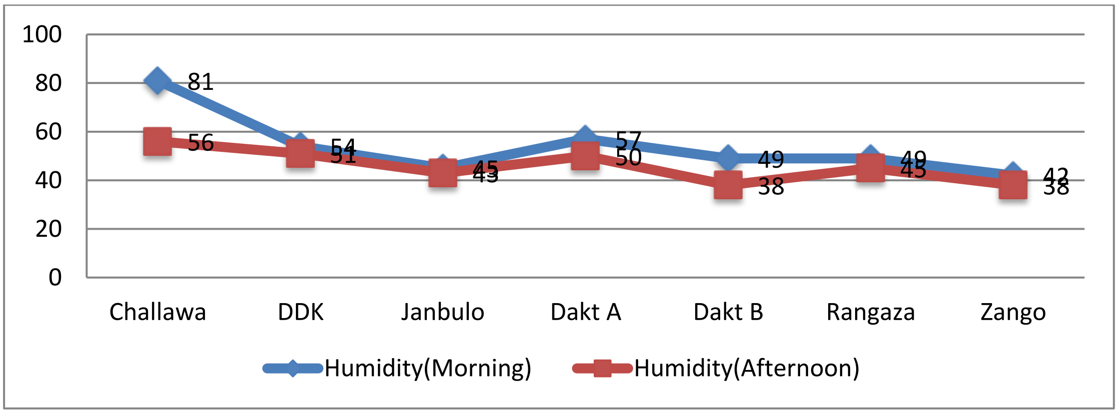

Fig. 7 Humidity for the average morning and Afternoon period

Figure 7 depicts a line graph comparing morning and afternoon humidity levels across seven locations: Challawa, DDK, Janbulo, Dakt A, Dakt B, Rangaza, and Zango. Challawa has the highest humidity levels in the morning (81%), and in the afternoon (56%), as seen in Figure 7. DDK and Janbulo recycling plants show similar trends, with morning humidity levels at 56% and 54%, respectively, and afternoon humidity at 45% and 45%. Zango has the lowest afternoon humidity at 38% and the lowest morning humidity at 48%. The findings of Oji and Adamu (2022), who found that variations in humidity had a substantial impact on the concentration of pollutants during both the rainy and dry seasons, are not supported by the present investigation.

CONCLUSIONS

This study assessed the relationship between the AirQualityIndex(AQI) and weather at seven distinct plastic recycling industrial sites within the city of Kano, in northwestern Nigeria. Based on the AQI calculated ateach plastic recycling business using the United States Environmental Protection Agency (USEPA) formula, the concentrations of air pollutants (NO_2, CO, $PM_{2.5}$, and PM_{10}) were tracked in this study. The association between the AQIof several pollutants (CO, NO_2, PM_{10}, and $PM_{2.5}$) and meteorological variables (temperature and humidity) was investigated using the Pearson correlation coefficients.TheAQI for the study area indicated that $PM_{2.5}$ levels were categorized as extremely poor, with values ranging from 80 to 240. While CO levels were relatively low, ranging from 0 to 35, PM_{10} levels were moderate, ranging from 23 to 106. The range of NO_2 values is 0 to 4, however, they stayed below allowable bounds. A weak positive correlation was found between AQI and NO_2 and between AQI and PM_{10} and NO_2. It was discovered that temperature had a strong negative relationship with AQI and PM_{10} and a significant positive correlation with $PM_{2.5}$.To reduce the hazards caused by these pollutants in the research area, the report suggests putting in place strict and efficient industrial emission controls, improved air pollution management, and better methods for managing plastic waste, including steps to reduce the burning of plastic.

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