Atmospheric Fallout at Nakoyakpala in NZererkore, Republic of Guinea

Abstract

This study is a contribution to the study of air pollution at Nakoyakpala neighborhood, Urban Commune of Nzerekore, Republic of Guinea. Its main objective is to analyze atmospheric fallout at Nakoyakpala neighborhood. To do this, four (04) atmospheric fallout measuring sites were identified in this neighborhood: S1 (Nakoyakpala Market Roundabout); S2 (Crossroads bordering the Mohomou, Gbangana and Nakoyakpala neighborhood very close to the welding workshop); S3 (Empty space facing the Parc des Princes nightclub) and S4 (University of NZerekore Courtyard). Atmospheric fallouts were measured over a 13-hour period for a 12-day period (from May 5 to May 16, 2025) at our various stations. The dust amount was 0.1350 g at S1, 0.1111 g at S2, 0.0961 g at S3 and 0.0451 g at S4, respectively. Thus, the total quantity of dust per hour in the Nakoyakpala neighborhood across the different sampling stations is 27.72 $mg.m^{-2}.h^{-1}$. It was also determined by day; it is 665.28 $mg.m^{-2}.day^{-1}$ over an area of 237 ha. This study on atmospheric fallout is the first in Guinea. It will allow environmental authorities to know with more precision the atmospheric fallout in Republic of Guinea.

Keywords: Air pollution; Atmospheric fallout; Dust quantity ; Nakoyakpala.

1. INTRODUCTION

Air pollution due to high concentrations of small particles is a severe issue in West Africa (**Kounouhewa et al., 2020**). However, dust fallout can have diverse impacts ranging from major health problems to environmental concerns in West Africa (**Mweendi et al., 2023**). According to **Canha et al., (2021)**, **Durant et al., (2009) and Kgabi et al., (2012),** the substances present in the air include but not limited to particulate matter (i.e., dust, liquid droplets, and smoke), gaseous pollutants (i.e., nitrogen oxides, volatile organic compounds, oxone, ammonia, and carbon monoxide), heavy metals and culturable bacteria which all lead to the depreciation of the air quality, and they are an indication of the air quality state with respect to a particular site. Also, urban dust samples are normally associated with more negative health impacts than those collected from rural areas, and this is attributed to the high rate of development and massive traffic. In DACCIWA project (Dynamics-Aerosol-Chemistry-Cloud-Interactions In West Africa), **Djossou et al., (2018)** published the policy relevant findings of this action and clearly claimed the need for long-term and reliable measurements of meteorological data and particulate matter concentrations in South West Africa. The policy relevant findings of the DACCIWA project, an international research action funded by the European Union 7th Framework Programme, were published in 2018 (**Evans et al., 2018**). Particulate matter also represents suspended dust that is settleable or can be deposited at a particular site in the atmosphere and referred to then as dust fallout (**Dudu et al., 2018 ; Liebenberg-Enslin et al., 2017 ; Pope and Dockery 2006**). However, the components and quantities of atmospheric dusts fallout have been reported to be the pollution indicator of large urban areas (**Pervez et al., 2009**).

Dust storms are common phenomena in many parts of the world, especially in arid and semi-arid region (**Al-Awadhi et al., 2014**). Dust can be a nuisance as it can settle on tree leaves, open surfaces such as roads and streets, on roof tops of buildings, and even inside buildings (**Mweendi et al., 2023**), also, dust fallout or dust in general is constantly emitted into the ambient air from a variety of activities and sources that can be natural or anthropogenic. Such anthropogenic activities lead to the accumulation of trace elements on buildings, plants, in air, soil, water, and on road dust (**Mugudamani et al., 2022**). Road dust refers to the re-suspended particulate matter found on roads, mostly in troughs. According to **Sampson (2017)**, the road dust sometimes comprises of soil and sand particles that are assorted with litter, and rubble that becomes airborne due to traffic movements. Moreover, the multiplicity and complexity of sources of atmospheric dusts in urban regions (e.g. industrial complexes composed of a variety of industrial processes, automobiles, construction activities etc.) has put forward the need of source apportionment of these sources indicating their contribution to specific environmental receptor (**Pervez et al., 2009**). Dust storms are common phenomena in many parts of the world, especially in arid and semi-arid region. Today, atmospheric fallout is considered a major problem affecting both developed and developing countries (**Guerin et al., 2003**). Its negative impacts are felt directly or indirectly by different countries. According to **WHO, 2019**, 99% of the world's population lived in places where air quality thresholds were not met, and 4.2 million premature deaths were caused by ambient air pollution mainly due to exposure to fine particulate matter (PM2.5). In France, for example, nearly 40,000 deaths are attributed to population exposure to PM2.5 each year, resulting in an average loss of 8 months of life expectancy and accounting for 7% of total annual mortality due to PM2.5 exposure, particularly among people aged 30 and over (**Medina et al 2021**). According to the Global Burden of Disease (GBD) study estimates, around 4.2 million total deaths were directly attributable to particulate matter smaller than 2.5 μm (PM2.5) ambient air pollution in 2015 (**Cohen et al., 2017 and Fofana et al., 2025**).

In Guinea, the problem of air quality is a crucial issue that deserves everyone's attention. Agricultural practices, road traffic, and the various fires that have struck the country represent a real problem contributing to the release of enormous quantities of fine particles (PM2.5) into the atmosphere. Air pollution is causing increasing damage to the environment, affecting all prefectures in the country. Rainfall is a factor influencing the transport of particles to the ground. Depending on its frequency and intensity, it contributes to varying degrees to limiting dust dispersion. The lack of rain, on the other hand, encourages the resuspension of dust in the air by wind or passing vehicles. Therefore, dust levels are higher during dry periods than during humid periods. The capital of Guinea's Forest Region (NZerekore) is no exception to this reality. During the dry season, the city remains shrouded in a cloud of dust from its roads. Given these issues, government intervention is crucial for improving air quality in all of the country's prefectures. In a context of urban densification, where pressures on the environment are increasing, this study fills a gap in local data on air quality in NZerekore.

However, most of the researchers did not address the dust fallout. Nevertheless, no research has been done on dust fallout at Nakoya Kpala in NZererkore. Therefore, the main objective of this study was to evaluate the dust fallout in Kakoya kpala. This study provides database that can be used to establish a baseline of dust fallout.

2. METHODOLOGY

Nakoyakpala is located to the west of the urban commune of NZerekore on the NZerekore-Yomou national road. It is limited to the east by the Gbanghana district, to the west by the village of Kéréma to the north by the Mohomou district and to the south by the Theyegno village. The prefecture of NZerekore (latitude between 7°32 and 8°22 North, longitude 9°04 West and 560 m altitude) is located in the south-east of Guinea. The climate type is Equatorial guinean with a rainy season extending from May to October and a dry season from November to April (**Kante et al., 2019 and Djossou et al., 2024**).

For this study, we chose representative measurement sites of atmospheric fallout in the Nakoyakpala neighborhood. These different pollution sites are: S1 (Nakoyakpala Market Roundabout); S2 (Crossroads bordering the Mohomou, Gbangana and Nakoyakpala neighborhood very close to the welding workshop); S3 (Empty space facing the Parc des Princes nightclub) and S4 (University of NZerekore Courtyard) (**See Fig. 1**). The table 1 presents the material used in this study. For the collection of dust samples, we have adopted the following approaches:

- Preparation of the devices: In accordance with the accredited method (NF X 43-014), Owen dust gauges consist of a funnel and a bottle, allowing for the quantification of dust fallout. The contents of the buckets are exposed to the ambient air and contain black plastic to limit the proliferation of algae and micro-organisms, then covered with a mesh to prevent coarse materials from entering. The entire system is inserted into a tripod that serves as a support. The collection height is 3 m from the ground. The devices we used consisted of iron tripods, 18.5 cm diameter buckets, and wire mesh.
- Distilled water sampling: We then sampled distilled water for sterilizing the equipment and for collection.

- Installation of the devices: All buckets were thoroughly washed with distilled water before being displayed to remove all traces of dust.
- Device Removal: The activity took place between May 5 and May 16, 2025, a period of 12 days. We removed all the buckets on the same day to minimize exposure variations. The storage period between sampling and analysis must not exceed 60 days (according to the standard).
- Analysis: After collection, the various samples were sent to the analytical chemistry laboratory of the NZerekore University for analysis and interpretation, taking into account the study objectives.

To determine the amount of dust in the study area across the different sampling stations, we used the following formulas:

$$QPS = \frac{\mathbf{Vf \times Mp}}{\mathbf{Vp}}$$

Where, Vp: Volume collected after exposure ; Mp: Quantity of dust obtained in Vp ; Vf: Final volume obtained after exposure.

3. RESULTS AND DISCUSSION

For this study, we established a permanent network for monitoring dry atmospheric fallout, consisting of 4 measurement points. To determine the amount of substance, we collected and analyzed 500 ml of each sample for quantification. The results from the different analyses are presented in **Table 2**. The amount of dust obtained in the 500 mL was determined for each station. Atmospheric fallouts were measured over a 13-hour period for a 12-day period (from May 5 to May 16, 2025) at our various stations. Thus, we determined the total amount of dust over an area of 237 ha. **Figure 2** shows the total amount of dust measured at the four stations. It was 0.1350 g at S1, 0.1111 g at S2, 0.0961 g at S3 and 0.0451 g at S4, respectively. The total amount of dust measured ranges from 0.1350 g to 0.0451 g in our study area. As a note, the amount of dust on station S1 is higher than those of the other stations and the lowest amount of dust is measured on station S4. We also calculated the average amount of dust in our study area; this allowed us to determine the total amount of dust in that area. This average quantity was 0.0968g. Thus, the total quantity of dust per hour in the Nakoyakpala neighborhood across the different sampling stations is 27.72 $mg.m^{-2}.h^{-1}$. It was also determined by day; it is 665.28 $mg.m^{-2}.day^{-1}$ over an area of 237 ha.

The indicative dust levels according to AIR Languedoc-Roussillon were of different levels: low dust levels (less than 150 mg/m^2/day); medium dust levels (between 150 and 250 mg/m^2/day) and high dust levels (more than 250 mg/m^2/day). For this study, we found 665.28 mg/m^2/day. This value is greater than 250 mg/m^2/day, which allows us to say that the dust level is high in our study area. However, we can say with certainty that our study area is facing heavy dust accumulation linked to atmospheric fallout. According to **Al-Barakah et al., (2014)**, a wide variety of pollutants and/or microbial diversity has been associated with dust and/or dust fallout particles. The dust fallout contains heavy metals occurring in varying concentrations and the status of pollution of the dust fallout varies from low to severe concerning the inconsistent of these heavy metal indices that are the contamination factor, pollution load index and the enrichment factor (**Mweendi et al., 2023**).

4. CONCLUSION

This study allowed us to highlight the atmospheric fallout in the Nakoyakpala neighborhood, urban commune of NZerekore over a period of 13 hours over a period of 12 days. Thus, the total amount of dust measured in the neighborhood was 665.28 $mg.m^{-2}.day^{-1}$. This study could thus provide the first element of expertise for urban and environmental policies in Guinea. This work will enable them to set up a continuous watering system during the dry season and then implement an air quality monitoring system.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies suchas Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Liste of Tables

Table1: List of materials used

Materials	**Use**
Bucket with a volume of 5 liters	To collect the fallout
Tripods	To support the buckets
Distilled water	For sterilizing equipment and retaining dust in buckets
Cans	For the collection of distilled water
Black plastic	To protect buckets from solar radiation
Fences	To prevent coarse matter from entering the buckets
Magnetic Stirrer Hotplate	To shake the sample
Balance analytique	Analytical balance
Test tube and beaker	To measure the quantity of water
Funnel and filter paper	For filtration
Oven	For drying

Table 2 : Amount of dust for each station

	S1	**S2**	**S3**	**S4**
Vp (ml)	500	500	500	500
Vf (ml)	1550	1654	896	1780
Mp (g)	0,135	0,1111	0,0961	0,0451
QTP (g)	0,4185	0,3675	0,1722	0,1605

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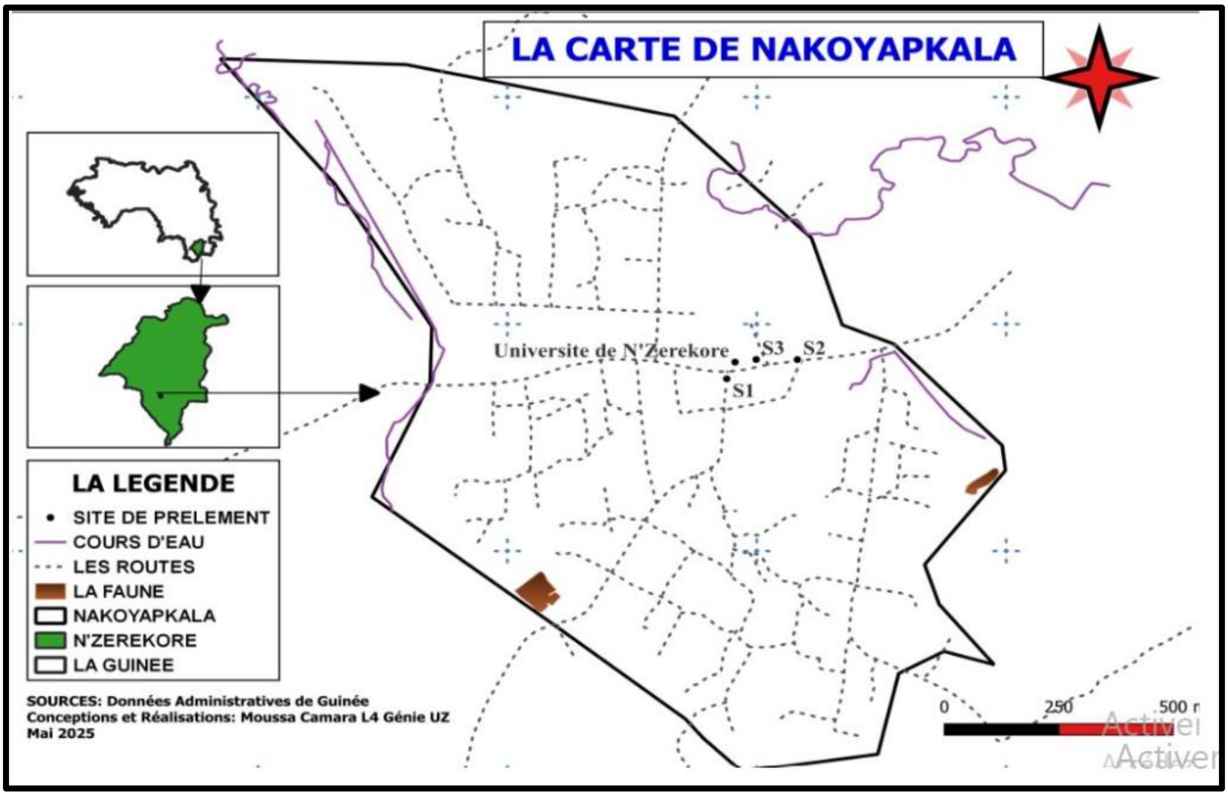

Figure 1 : Location of the stations

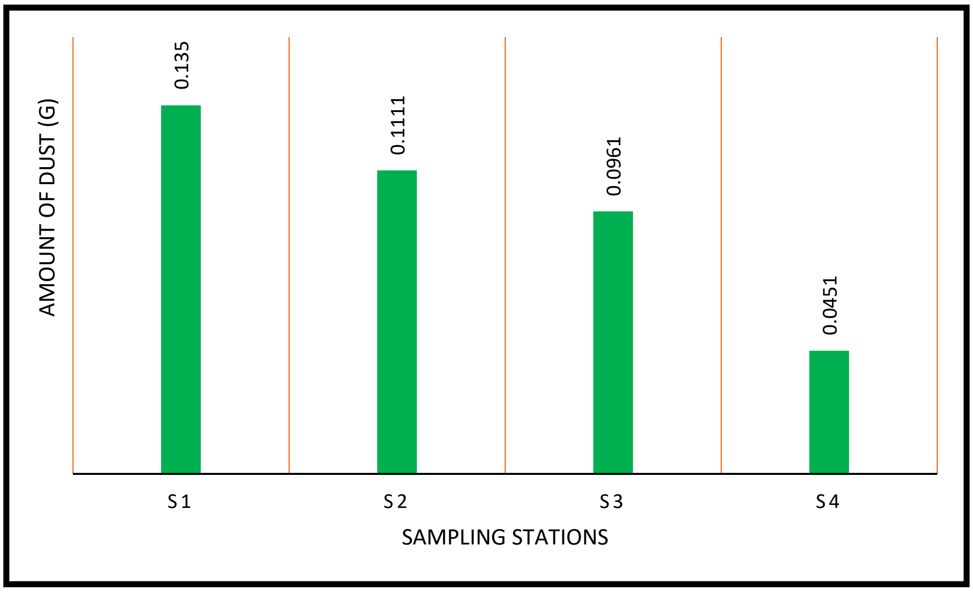

Figure 2: Total amount of dust measured at the four stations