International Journal of Environmental and Ecology Research
www.environmentaljournal.in
Online ISSN: 2664-7117, Print ISSN: 2664-7109
Received: 09-11-2025, Accepted: 08-12-2025, Published: 23-12-2025
Volume 7, Issue 2, 2025, Page No. 99-104

Environmental and public health implications of dredging activities in Warri, Nigeria: An integrated assessment of atmospheric conditions, air quality, soil characteristics, and community perceptions

Adeyemi Oyeyemi[2]*, Benjamin Adegbenga Roberts[1]
[1] Department of Environmental Management and Toxicology, Federal University of Petroleum Resources, Effurun, Nigeria
[2] Department of Biochemistry, Federal University of Petroleum Resources, Effurun, Nigeria

Abstract
Dredging activities are widely undertaken in coastal and riverine environments to support navigation, sand mining, and infrastructural development; however, they are often associated with environmental degradation and public health concerns. This study assessed the environmental and perceived health impacts of dredging activities in the Warri region of Nigeria using an integrated field-monitoring and questionnaire-based approach. Ambient temperature, relative humidity, particulate matter ($PM_{0.1}$–PM_{10}), combustible gases, carbon dioxide (CO_2), total volatile organic compounds (TVOCs), and soil pH were measured across five sampling locations during periods of active dredging and non-dredging. Environmental parameters were analysed using analysis of variance, with statistical significance set at $p < 0.05$. Mean ambient temperatures ranged from 31.8 ± 1.0 °C to 36.2 ± 0.8 °C, while relative humidity varied between 60.8 ± 1.8% and 71.8 ± 2.3%, with significant spatial differences ($p < 0.05$). Particulate matter was dominated by ultrafine fractions, with $PM_{0.1}$ concentrations ranging from 0.029 ± 0.00 to 0.217 ± 0.00 µg m^{-3} and showing significant site-to-site variation ($p < 0.05$). Combustible gas concentrations were highest at dredging-intensive locations (395 ± 12 to 690 ± 18 ppm; $p < 0.05$), while CO_2 levels ranged from 400 ± 1 to 430 ± 1 ppm. TVOC concentrations varied significantly among locations (0.013 ± 0.0002 to 0.024 ± 0.0004 mg m^{-3}; $p < 0.05$). Soil pH ranged from acidic (4.5 ± 0.1) to near-neutral values (7.0 ± 0.2), with significant differences across sites ($p < 0.05$). Questionnaire data (n = 150) indicated that 76.7% of respondents resided within or near dredging sites, while 66.7% perceived moderate to high health risks associated with dredging. In conclusion, dredging activities in Warri significantly influence atmospheric conditions, air quality, and soil chemistry, with corresponding community concern, underscoring the need for sustained monitoring and improved environmental management.

Keywords: Dredging activities, air quality assessment, particulate matter pollution, environmental health risk, Warri Nigeria

Introduction

Dredging activities play a critical role in coastal and riverine environments by supporting navigation, flood control, land reclamation, and the extraction of construction materials. In rapidly urbanising and industrialising regions, dredging has become an indispensable component of infrastructural development and economic expansion (Fratini *et al*., 2025) [8]. However, despite its functional importance, dredging is increasingly recognised as an activity with the potential to disrupt environmental equilibrium and compromise public health, particularly when conducted in proximity to human settlements (Donázar-Aramendía *et al*., 2024) [5].

The physical disturbance of sediments during dredging alters natural hydrodynamic processes and can lead to the resuspension of fine particles and entrained contaminants into the surrounding environment. These disturbances may modify atmospheric conditions through the release of dust, aerosols, and gases, thereby influencing local air quality and microclimatic parameters such as temperature and relative humidity (Deng *et al*., 2025) [4]. Fine and ultrafine particulate matter generated during sediment agitation is of particular concern because of its ability to remain suspended in the atmosphere for extended periods and penetrate deeply into the human respiratory system. Consequently, populations living or working near dredging sites may experience increased exposure to airborne particulates and associated pollutants (Khan *et al*., 2025) [11].

In addition to particulate emissions, dredging operations are often accompanied by the release of gaseous pollutants arising from fuel combustion, machinery operation, and the liberation of gases trapped within sediments (Donázar-Aramendía *et al*., 2024) [5]. These emissions may include combustible gases, carbon dioxide, and volatile organic compounds, which collectively contribute to atmospheric loading and may pose both acute and chronic health risks. The magnitude and distribution of these emissions are influenced by operational intensity, sediment characteristics, meteorological conditions, and site-specific factors, resulting in substantial spatial and temporal variability in environmental quality (Fregoso *et al*., 2025) [9].

Soil properties in dredging-affected areas may also undergo significant alteration. The mixing of sediments, introduction of foreign materials, and changes in redox conditions can modify soil pH and other chemical characteristics (Fratini *et al*., 2025) [8]. Such changes have implications for nutrient cycling, microbial activity, and the mobility and bioavailability of contaminants. Altered soil conditions may further affect surrounding vegetation and aquatic systems, amplifying the ecological footprint of dredging activities beyond the immediate operational zone.

While environmental monitoring provides quantitative evidence of dredging-related impacts, understanding the full scope of these effects requires consideration of human perceptions and experiences (Tauran *et al*., 2024) [17].

Communities residing near dredging sites are often the first to observe changes in environmental quality, including increased dust levels, odours, noise, and alterations to local hydrology. Perceived health symptoms, even when not clinically diagnosed, offer valuable insight into exposure pathways and community vulnerability. Integrating community-based survey data with instrumental measurements therefore allows for a more comprehensive evaluation of dredging impacts, bridging the gap between measured environmental change and lived experience (Donázar-Aramendía *et al*., 2024) [5].

The Warri region of Nigeria represents a particularly relevant context for examining the environmental and public health implications of dredging. As a coastal and industrial hub, Warri is characterised by extensive river networks, intense dredging activity, and dense human settlements. The convergence of industrial operations, sand mining, and residential areas increases the likelihood of human exposure to dredging-related pollutants. Moreover, local climatic conditions, including high humidity and temperature, may further influence pollutant behaviour and dispersion, exacerbating potential impacts (Fregoso *et al*., 2025) [9].

Despite the prevalence of dredging in the region, systematic assessments that simultaneously examine atmospheric conditions, air quality parameters, soil characteristics, and community perceptions remain limited. Many existing evaluations focus on isolated components of the environment or lack integration with social dimensions. This fragmentation restricts the ability to draw holistic conclusions about the cumulative effects of dredging and undermines the development of evidence-based management strategies (d'Errico *et al*., 2021) [3].

Against this backdrop, the present study was designed to provide an integrated assessment of the environmental and perceived health impacts of dredging activities in the Warri region. By combining field-based measurements of microclimatic variables, particulate matter fractions, gaseous pollutants, and soil pH with structured questionnaire data from residents and workers, the study aims to characterise spatial variability, identify statistically significant differences associated with dredging activity, and contextualise environmental findings within community experience. The outcomes of this study are intended to inform environmental monitoring frameworks, support policy development, and contribute to more sustainable dredging practices in coastal and riverine environments.

Materials and Methods

Experimental Design

This study adopted a comparative field-based observational design to evaluate environmental and public health–related parameters associated with dredging activities within the Warri metropolitan region and its environs. Measurements were conducted under two distinct operational conditions: periods of active dredging and periods with no dredging activity. This design enabled the isolation of dredging-related effects from background environmental variability by facilitating direct temporal and spatial comparisons between operational and non-operational phases.

Equipment

Environmental monitoring was conducted using calibrated portable instruments selected for their sensitivity, field robustness, and suitability for real-time measurements. The instruments deployed included:

1. JD3003 Air Particulate Matter Tester Counter (for PM concentration profiling);
2. MultiGas Safety Monitor (H_2S, EX, O_2, CO) for occupational and ambient gas surveillance;
3. Mestek Combustible Gas Analyser for detecting flammable gas presence;
4. JD3002 Total Volatile Organic Compounds (TVOC) Gas Detector;
5. SW743A Halogen Gas Detector;
6. Digital Soil pH Meter;
7. Industrial Infrared Thermometer/Hygrometer for ambient temperature and relative humidity;
8. FR510 Multifunction LCD Digital GPS Altimeter–Barometer–Compass for geospatial and atmospheric contextualisation.

All instruments were factory-calibrated prior to deployment and routinely cross-checked in situ to ensure measurement consistency throughout the sampling period.

Sampling Area

The study area comprised Warri and surrounding communities within Delta State, Nigeria, where dredging activities are frequent and integral to waterway maintenance, sand mining, and infrastructural development. The region was considered appropriate due to its high intensity of dredging operations, dense human settlement patterns, and potential vulnerability to atmospheric and environmental perturbations. Sampling locations were selected to capture spatial variability across active dredging sites and nearby control areas with similar land-use characteristics but no dredging activity during the study period.

Sample Size Determination

Sample size selection was guided by a combination of statistical considerations and field realities. Key determinants included the number and accessibility of dredging locations, community consent and cooperation, prevailing security conditions, and logistical feasibility. From a statistical perspective, the sample size was designed to achieve adequate representativeness and analytical reliability, taking into account anticipated environmental heterogeneity, confidence level requirements, and acceptable margins of error. Collectively, these considerations ensured that the final dataset was sufficiently robust to support meaningful inference on the environmental and public health implications of dredging activities in the study area.

Sampling Time and Duration

Field measurements were conducted between 10:00 a.m. and 6:00 p.m. to capture daytime variations in atmospheric and environmental conditions potentially influenced by dredging operations and human activities. Data collection spanned a total of 40 sampling days, comprising 20 days with active dredging and 20 days without dredging.

The inclusion of both operational and non-operational days was intentional and based on several considerations. First, it allowed for direct comparison of environmental indicators under contrasting activity regimes, thereby strengthening causal interpretation. Second, it enhanced understanding of temporal dynamics, including the influence of daily operational schedules, meteorological variability, and pollutant dispersion patterns. Third, the extended sampling duration improved statistical power, enabling the identification of trends, anomalies, and consistent patterns across time. Overall, this approach ensured the development of a comprehensive and statistically defensible dataset.

Experimental Procedures

Environmental monitoring instruments were strategically positioned at predefined points within dredging and control sites to ensure representative coverage and repeatability. Real-time measurements were obtained at regular intervals throughout each sampling day.

Airborne particulate matter concentrations were quantified using the JD3003 Air Particulate Matter Tester to characterise dust and aerosol loading associated with sediment disturbance. The MultiGas Safety Monitor continuously measured hydrogen sulphide, combustible gases, oxygen levels, and carbon monoxide to assess both ambient air quality and occupational safety conditions. The Mestek Combustible Gas Analyser provided supplementary data on flammable gas presence, while the JD3002 TVOC Detector tracked total volatile organic compounds released during sediment agitation. Halogen gases were monitored using the SW743A detector due to their potential ecological and health risks.

Soil pH measurements were obtained using a digital soil pH meter to evaluate chemical alterations potentially induced by dredging. Ambient temperature and relative humidity were recorded using an industrial infrared thermometer/hygrometer, recognising their influence on pollutant behaviour and dispersion. Geospatial coordinates, altitude, barometric pressure, and directional orientation were documented using the FR510 multifunction device to contextualise environmental measurements spatially and atmospherically. All measurements were conducted using standardised protocols to ensure consistency across sites and sampling days.

Questionnaire Design and Deployment

A structured questionnaire was employed to capture community-level perceptions and experiences related to dredging activities. The instrument was designed to generate both quantitative and qualitative data and was administered to residents living in proximity to dredging sites and control locations.

The questionnaire comprised several sections. The first collected demographic and socio-economic information, including age, gender, occupation, and length of residence, to enable stratified analyses. Subsequent sections addressed spatial and environmental context, such as proximity to dredging operations, perceived changes in air quality, noise levels, traffic congestion, and flood incidence. Health-related questions explored self-reported symptoms potentially associated with dredging, including respiratory discomfort and water-related ailments.

Additional components assessed perceived benefits of dredging projects, such as infrastructural development or corporate social responsibility initiatives, as well as respondents' awareness of environmental regulations and perceptions of enforcement effectiveness. The final section included open-ended questions, allowing respondents to express concerns or suggestions beyond the predefined items. This comprehensive design ensured the capture of multidimensional data necessary for an integrated assessment of dredging impacts.

Statistical Analysis

Data were collated, cleaned, and subjected to statistical analysis using appropriate software packages. Descriptive statistics were computed to summarise environmental parameters and questionnaire responses. Inferential analysis primarily involved analysis of variance (ANOVA) to test for significant differences between dredging and non-dredging conditions. Where applicable, multivariate statistical techniques were employed to explore relationships among environmental variables and to identify patterns associated with dredging activities. Statistical significance was evaluated at 95% confidence level, and results were presented in tabular and graphical formats to enhance interpretive clarity.

Results and discussion

Table 1 presents the spatial variation in ambient temperature, relative humidity, and particulate matter (PM) size fractions across the five sampling locations. The observed temperature profile reveals a clear spatial gradient, with Location A recording the highest mean temperature, while Locations D and E exhibited comparatively lower values. This pattern suggests the influence of site-specific factors such as land cover, proximity to active dredging operations, and local microclimatic conditions (Chen *et al*., 2025) [2]. Elevated temperatures at certain locations may be linked to reduced vegetation cover, increased surface exposure, and mechanical heat generated by dredging equipment (Feng *et al*., 2025) [6].

Relative humidity showed significant spatial variability, with Locations C and E recording the highest values, while Location D exhibited the lowest humidity. The inverse relationship observed between temperature and relative humidity at some locations reflects typical atmospheric behaviour in coastal and industrial environments, where heat flux and moisture availability interact dynamically (Liu *et al*., 2025; Shih *et al*., 2025) [14, 16]. Higher humidity levels may enhance particle aggregation and influence pollutant residence time in the atmosphere (Nguyen *et al*., 2024) [15].

The particulate matter data demonstrate a pronounced dominance of ultrafine and fine particles, particularly $PM_{0.1}$ and $PM_{0.3}$, across all locations. Location E consistently recorded the highest concentrations across most PM fractions, indicating a substantially higher particulate load. This pattern suggests intense particulate generation, likely associated with sediment disturbance, mechanical agitation, and resuspension processes linked to dredging activities. Conversely, Location D generally exhibited the lowest PM concentrations, reflecting comparatively lower disturbance intensity or better dispersion conditions (Cao *et al*., 2025) [1]. Notably, the progressive decline in concentrations with increasing particle size (from $PM_{0.1}$ to PM_{10}) across all locations highlights the predominance of finer particulates in the study area. This size distribution is environmentally significant, as finer particles remain airborne for longer periods and can penetrate deeper into the human respiratory system (Yoo & Kim, 2025) [19]. The statistical differentiation indicated by superscripts confirms that particulate pollution is not uniformly distributed, underscoring the importance of spatially resolved monitoring in dredging-impacted environments.

Table 1: Ambient temperature, relative humidity, and particulate matter (PM) concentrations across sampling locations (A–E)

Location	Temperature (°C)	Relative Humidity (%)	$PM_{0.1}$ (μg m⁻³)	$PM_{0.3}$ (μg m⁻³)	$PM_{1.0}$ (μg m⁻³)	$PM_{3.0}$ (μg m⁻³)	$PM_{5.0}$ (μg m⁻³)	PM_{10} (μg m⁻³)
A	36.2 ± 0.8[a]	65.3 ± 1.9[a]	0.03942 ± 0.00[c]	0.002512 ± 0.00[c]	0.000111 ± 0.00[c]	0.000009 ± 0.00[c]	0.000004 ± 0.00[b]	0.000000[b]
B	33.1 ± 1.0[b]	67.4 ± 2.1[a]	0.07210 ± 0.01[b]	0.005641 ± 0.00[b]	0.000204 ± 0.00[a]	0.000017 ± 0.00[b]	0.000007 ± 0.00[a]	0.000000[b]
C	34.2 ± 1.1[ab]	71.2 ± 2.4[b]	0.04376 ± 0.01[c]	0.002991 ± 0.00[c]	0.000128 ± 0.00[b]	0.000011 ± 0.00[c]	0.000005 ± 0.00[b]	0.000000[b]
D	32.0 ± 0.9[b]	60.8 ± 1.8[c]	0.02917 ± 0.00[d]	0.001905 ± 0.00[d]	0.000110 ± 0.00[c]	0.000079 ± 0.00[a]	0.000003 ± 0.00[c]	0.000000[b]
E	31.8 ± 1.0[b]	71.8 ± 2.3[b]	0.21707 ± 0.00[a]	0.010148 ± 0.00[a]	0.000225 ± 0.00[a]	0.000016 ± 0.00[b]	0.000004 ± 0.00[b]	0.000001 ± 0.00[a]

Tabulated values are means of 5 determinations ± SEM. Locations A: 5.545507/5.728213, B: 5.576420/5.704396, C: 5.583183/5.847015, D: 5.561003/5.827916, E: 5.559928/5.814418.

Table 2 elucidates the spatial patterns of gaseous pollutants and soil pH across the study locations, revealing marked heterogeneity associated with dredging influence and site characteristics. Combustible gas concentrations varied significantly, with Location B exhibiting the highest mean value, followed by Locations C and D. These elevated levels suggest increased emissions of flammable gases, potentially arising from sediment disturbance, fuel combustion, and the release of trapped gases during dredging operations. In contrast, the relatively lower concentration observed at Location A indicates reduced gas-generating activities or better atmospheric dispersion (Donázar-Aramendía *et al*., 2024) [5].

Carbon dioxide concentrations were notably highest at Location E, distinguishing it from the other sites. This elevation may reflect cumulative anthropogenic contributions, including equipment operation, human activity density, and limited dispersion efficiency. Locations B, C, and D displayed similar CO_2 levels, suggesting comparable emission sources or atmospheric mixing conditions across these sites (Urbina-Garcia *et al*., 2024) [18].

Total volatile organic compounds (TVOCs) demonstrated a clear spatial gradient, with Location C recording the highest concentration. This observation implies enhanced volatilisation of organic compounds, possibly from disturbed sediments, petroleum residues, or organic-rich substrates. Locations B, D, and E showed moderately elevated TVOC levels, while Location A recorded the lowest concentration, further supporting the inference that dredging intensity and sediment composition strongly influence VOC emissions (Donázar-Aramendía *et al*., 2024; Tauran *et al*., 2024) [5, 17].

Soil pH values ranged from acidic at Location A to near-neutral conditions at Locations C, D, and E. The acidic soil at Location A may indicate prolonged exposure to acidic inputs or limited buffering capacity, whereas the neutral pH observed at other sites suggests sediment mixing and the introduction of alkaline materials during dredging. Such alterations in soil chemistry have implications for nutrient availability, microbial activity, and the mobility of contaminants within the ecosystem (Fraser *et al*., 2024; Koskinen *et al*., 2024) [7, 12].

Collectively, the gaseous and soil parameters presented in Table 2 reflect the complex interplay between mechanical disturbance, atmospheric emissions, and geochemical alteration in dredging-affected environments.

Table 2: Concentrations of combustible gases, carbon dioxide, total volatile organic compounds (TVOCs), and soil pH across sampling locations (A–E)

Location	Combustible Gases (ppm)	Carbon Dioxide (ppm)	TVOCs (mg m⁻³)	Soil pH
A	395 ± 12[a]	409 ± 1[a]	0.0130 ± 0.0002[a]	4.5 ± 0.1[a]
B	690 ± 18[b]	400 ± 1[b]	0.0200 ± 0.0003[b]	5.5 ± 0.2[b]
C	635 ± 20[c]	400 ± 1[b]	0.0240 ± 0.0004[c]	7.0 ± 0.2[c]
D	630 ± 17[c]	400 ± 1[b]	0.0200 ± 0.0003[b]	7.0 ± 0.2[c]
E	530 ± 15[d]	430 ± 1[c]	0.0210 ± 0.0003[d]	7.0 ± 0.2[c]

Tabulated values are means of 5 determinations ± SEM. Locations A: 5.545507/5.728213, B: 5.576420/5.704396, C: 5.583183/5.847015, D: 5.561003/5.827916, E: 5.559928/5.814418.

Table 3 provides insight into the socio-demographic profile of respondents and their perceptions of dredging-related environmental and health impacts. The age distribution indicates that the majority of respondents fall within the economically active age brackets of 25–44 years, suggesting that perceptions captured in the survey largely reflect the experiences of working-age individuals who are likely to be directly or indirectly exposed to dredging activities. The lower representation of younger and older age groups may reflect reduced engagement or limited availability during data collection (Nguyen *et al*., 2024) [15].

Gender distribution shows a predominance of male respondents, which is consistent with the occupational structure of dredging environments where men are more frequently employed in operational roles. However, the inclusion of female respondents and those who preferred not to disclose gender ensures a degree of diversity in perspectives (Halder *et al*., 2024) [10].

Occupational categorisation reveals that over half of the respondents were dredging plant staff, while a substantial proportion were community members. This balance is important, as it integrates both operational and residential viewpoints, allowing for a more comprehensive assessment of dredging impacts (Tauran *et al*., 2024) [17]. The presence of respondents from other occupations further broadens the scope of the survey.

Residential proximity data indicate that the majority of respondents live either within or near dredging sites, highlighting a high level of potential exposure. This proximity likely shapes the elevated perception of health and environmental risks reported in the survey. Indeed, a combined majority of respondents rated perceived health risks as high or moderate, reflecting widespread concern about the implications of dredging activities on well-being (Lazarte *et al*., 2025) [13].

Similarly, perceptions of environmental impact were predominantly moderate to significant, suggesting that respondents recognise tangible changes in their surroundings attributable to dredging. The proportion of respondents who were unsure underscores the complexity of attributing environmental changes to specific activities, particularly in multifactorial settings (Tauran *et al*., 2024) [17].

Overall, the questionnaire findings complement the instrumental measurements presented in Tables 1 and 2, reinforcing the link between observed environmental alterations and community perceptions within dredging-influenced areas.

Table 3: Socio-demographic characteristics, residential proximity, and perceptions of dredging impacts among questionnaire respondents

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	Under 18	7	4.7
	18–24	3	2.0
	25–34	40	26.7
	35–44	47	31.3
	45–55	25	16.7
	55–64	20	13.3
	≥65	8	5.3
Gender	Male	90	60.0
	Female	40	26.7
	Prefer not to say	20	13.3
Occupation	Dredging plant staff	81	54.0
	Community members	50	33.3
	Other occupations	19	12.7
Residential proximity to dredging sites	In dredging site	49	32.7
	Near dredging site	66	44.0
	Far from dredging site	35	23.3
Perceived health risk from dredging	High	60	40.0
	Moderate	40	26.7
	Low	30	20.0
	Not sure	20	13.3
Perceived environmental impact	Significant	50	33.3
	Moderate	60	40.0
	Low	20	13.3
	Not sure	20	13.3

Conclusion

This study provides an integrated assessment of the environmental and perceived health implications of dredging activities within the Warri region by combining instrumental measurements with community-based survey data. The findings demonstrate that dredging operations are associated with discernible alterations in atmospheric conditions, air quality parameters, gaseous emissions, and soil characteristics, with clear spatial variability across the investigated locations.

Ambient temperature and relative humidity exhibited site-specific patterns, reflecting the influence of dredging-related disturbance, land surface modification, and local microclimatic conditions. More notably, particulate matter concentrations were dominated by ultrafine and fine fractions, with significant spatial differences among locations. The predominance of smaller particle sizes highlights an increased potential for prolonged atmospheric residence and deeper respiratory penetration, underscoring the environmental and public health relevance of particulate emissions associated with dredging activities.

Gaseous pollutant assessment revealed elevated levels of combustible gases, carbon dioxide, and total volatile organic compounds at locations characterised by higher dredging intensity. These findings suggest that sediment disturbance, fuel combustion, and the release of trapped gases contribute collectively to localised atmospheric loading. Concurrently, variations in soil pH indicate that dredging activities may modify soil chemical properties, potentially influencing ecosystem processes and contaminant mobility.

The questionnaire survey results corroborate the instrumental data by revealing heightened community awareness and concern regarding both health and environmental impacts of dredging. The predominance of respondents residing within or near dredging sites, coupled with the high proportion reporting moderate to high perceived risks, reflects substantial exposure potential and underscores the socio-environmental dimension of dredging operations. The alignment between measured environmental changes and community perceptions strengthens the overall inference that dredging activities exert measurable and perceptible impacts on local environments.

In conclusion, the combined evidence from environmental monitoring and stakeholder perceptions indicates that dredging activities in the study area contribute to increased particulate and gaseous pollution, microclimatic variability, and altered soil conditions, with corresponding concerns for human health and environmental quality. These findings emphasise the need for continuous environmental monitoring, improved operational controls, and proactive community engagement to mitigate adverse impacts and promote more sustainable dredging practices in sensitive coastal and riverine environments.

References

1. Cao Y, Jiao X, Liu R, Wang H, He Y, Chen J, *et al*. Research on the Distribution and Escape Characteristics of Dust at the Blasting Pile in an Open-Pit Mining Area. Geosciences,2025:15(7):238. https://doi.org/10.3390/geosciences15070238
2. Chen F, Chen C, Fu Z. Seasonal Spatiotemporal Dynamics and Gradients of the Urban Heat Island Effect in Subtropical Furnace Megacity. Sustainability,2025:17(7):3238. https://doi.org/10.3390/su17073238
3. d'Errico G, Nardi A, Benedetti M, Mezzelani M, Fattorini D, Carlo MD, *et al*. Application of a Multidisciplinary Weight of Evidence Approach as a Tool for Monitoring the Ecological Risk of Dredging Activities. Frontiers in Marine Science, 2021, 8. https://doi.org/10.3389/fmars.2021.765256
4. Deng Y, Wu H, Zhao T, Shi C. Characteristics of atmospheric dustfall fluxes and particle size in an open pit coal mining area and surrounding areas. Scientific Reports, 2025, 15(1). https://doi.org/10.1038/s41598-025-94161-4
5. Donázar-Aramendía I, Megina C, Miró JM, Florido M, Reyes-Martínez MJ, Olaya-Ponzone L, *et al*. Environmental effects of maintenance dredging works in a highly modified estuary: A short-term approach. Ocean & Coastal Management,2024:258:107394. https://doi.org/10.1016/j.ocecoaman.2024.107394
6. Feng Y, Wu G, Ge S, Feng F, Li P. Identification of Key Drivers of Land Surface Temperature Within the Local Climate Zone Framework. Land,2025:14(4):771. https://doi.org/10.3390/land14040771
7. Fraser TD, Duddigan S, Díaz A, Green ID, Tibbett M. Optimizing pH for Soil Enzyme Assays Reveals Important Biochemical Functions in Low pH Soil. Journal of Soil Science and Plant Nutrition,2024:24(4):6236. https://doi.org/10.1007/s42729-024-01866-y
8. Fratini C, Anselmi S, Renzi M. Dredge Sediment as an Opportunity: A Comprehensive and Updated Review of Beneficial Uses in Marine, River, and Lagoon Eco-Systems. Environments,2025:12(6):200. https://doi.org/10.3390/environments12060200
9. Fregoso TA, Jaffe BE, Foxgrover AC, Woodrow DL, Kharrazi B, Orzech KM, *et al*. Contributions of erosion, deposition, and human activities to a change in sand storage in the bed of San Francisco Bay, California, 1980s to 2010s. Antarctica A Keystone in a Changing World, 2025. https://doi.org/10.3133/ofr20251022
10. Halder CE, Das PP, Rahman SMT, Bhoumick LC, Tassdik H, Hasan MA, *et al*. Occupational hazards and risks among the women in fisher communities in Cox's Bazar and Chattogram, Bangladesh. PLoS ONE, 2024, 19(7). https://doi.org/10.1371/journal.pone.0297400
11. Khan MMH, Kurniawan TA, Chandra I, Lei TMT. Modeling PM10 Emissions in Quarry and Mining Operations: Insights from AERMOD Applications in Malaysia. Atmosphere,2025:16(4):369. https://doi.org/10.3390/atmos16040369
12. Koskinen M, Anttila J, Vránova V, Holík L, Roche K, Vorenhout M, *et al*. Covariation of redox potential profiles and water table level in peatland sites representing different drainage regimes: implications for ecological modelling. EGUsphere, 2024. https://doi.org/10.5194/egusphere-2024-2050
13. Lazarte JRC, Miranda CF, Apas RS, Auxtero ES, Atacador AM, Budlayan MLM, *et al*. Perceived Health Impacts of Surface Mining: Local Perspectives from the Mining Communities in Libjo, Dinagat Islands, Philippines. International Journal of Environmental Research and Public Health,2025:22(3):365. https://doi.org/10.3390/ijerph22030365
14. Liu K, Zeng Y, Qiu X, Zhong Y. Analysis of Local Water Humidity Effect Characteristics Based on Meteorological Data: A Case Study of Nanjing. Atmosphere,2025:16(4):407. https://doi.org/10.3390/atmos16040407
15. Nguyen TG, Tran TB, Le DD, Nguyen TM, Nguyen HV, Ho P, *et al*. Determining the factors impacting the quality of life among the general population in coastal communities in central Vietnam. Scientific Reports,2024:14(1):6986. https://doi.org/10.1038/s41598-024-57672-0
16. Shih CH, Jang Y, Yang TY, Huang C, Juang J, Lo M, *et al*. Impact of diurnal temperature and relative humidity hysteresis on atmospheric dryness in changing climates. Science Advances, 2025, 11(26). https://doi.org/10.1126/sciadv.adu5713
17. Tauran A, Lavesque N, Blanchet H, Bujan V, Gouillieux B, Humbert S, *et al*. Long-term impact of dredging and beach nourishment works on benthic communities. Estuarine Coastal and Shelf Science,2024:313:109119. https://doi.org/10.1016/j.ecss.2024.109119
18. Urbina-Garcia O, Fernández-Gámiz U, Zulueta E, Ugarte-Anero A, Portal-Porras K. Indoor Air Quality Measurements in Enclosed Spaces Combining Activities with Different Intensity and Environmental Conditions. Buildings,2024:14(4):1007. https://doi.org/10.3390/buildings14041007
19. Yoo H, Kim I. Analytical Approach to Enhancing Efficiency of Silt Loading Collection in EPA Vacuum Sweep Method Using K-Means Clustering. Atmosphere,2025:16(5):530. https://doi.org/10.3390/atmos16050530