



E-ISSN: 0331-8516

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Received: 29 October 2024

Accepted: 11 November 2024

Published: 19 November 2024

Citation

Nwanjiobi, E.C., Woke, G.N., Hart, A.I. (2024). Environmental Baseline Assessment of Kaduna-Kano Proposed Site for Mando-Rimin Zakara 330kv Double Circuit Quad Conductor Project. *Eco-health and Sustainability*, 1(1), 75-80.
<https://doi.org/10.70726/ehs.2024.117580>

Environmental Baseline Assessment of Kaduna-Kano Proposed Site for Mando-Rimin Zakara 330kv Double Circuit Quad Conductor Project

Abstract

In Nigeria, commercial power is made available via the national grid, interconnecting numerous generating stations to the loads. The study was undertaken during the Fieldwork based on a review of available secondary information and primary data collected in the local communities. Primary data for this analysis was qualitative and quantitative and derived from key informant interviews, village-level surveys and focus group discussions. This study aimed to identify potential and significant adverse environmental baseline assessment of the Kaduna-Kano proposed site for the Mando-Rimin Zakara 330KV Double Circuit quad conductors project and suggest means of mitigating them to acceptable levels and enhancement measures for the beneficial impacts. Also, parameters such as BOD, DO, and Turbidity were considered part of surface water sites while water surface Microbial species were also considered, such as *Escherichia* species, *Giardia Lamblia* and *Vibrio* were found. The results show that the physical, chemical and biological characteristics and meteorological, climatic and hydrological characteristics were generally consistent with previous studies within the environment with few exceptions. An Environmental Social Management Plan (ESMP) has been developed to satisfy the long-term objectives of managing and monitoring the environmental and social impacts of the Project. The beneficial potentials of the project outweigh the conceivable adverse effects; nevertheless, mitigation measures were developed for the adverse impacts based on the best available practices.

Keywords : Environmental Impact Assessment, Environmental Social Management Plan, Sustainability, Kaduna-Kano, Electricity

Introduction

According to Ogbuefi and Madueme (2015), the Transmission Company of Nigeria (TCN), wholly owned by the Government, is in charge of the responsibility of receiving bulk electricity generated by the various power generation stations to the load control centres across the country and outside the country, ensuring efficient and cost-effective transmission, system operation, and improved service delivery. Substations are designed to accomplish the following functions. However, not all substations have all these functions: Change voltage from one level to another, regulate the voltage to compensate for system voltage changes, switch transmission and distribution circuits into and out of the grid system, measure electric power qualities flowing in the circuits, connect communication signals to the circuits, eliminate lightning and other electrical surges from the system, connect electric generation plants to the system, make interconnections between the electric systems of more than one utility, change alternating current to direct current or direct current

to alternate current, and control reactive kilovolt-amperes supplied to and the flow of reactive kilovolt-amperes in the circuits.

A study done by Tourab and Babouri (2015) found that the development and expansion of power systems worldwide increase the level of electromagnetic fields and the bio-organism and human body's exposure to electromagnetic radiation. Dib and Mordjaoui (2014) found the human body as a living antenna that can absorb and re-emit power energy in the environment. The physical interaction of time-varying electric and magnetic fields (ELF, EMFs) with the human body results in induced electric fields and circulating electric currents associated with endogenous ones, leading to changes in the functions of cells and tissues and subtle changes in hormone levels. According to Korpinen et al. (2011), exposure to ELFs during work tasks in high-voltage substations showed that the exposure limits reviewed and published by the International Commission on non-ionizing radiations exceeded in specific work tasks from service platforms.

The dispersion of pollutants is determined by many parameters, most notably atmospheric stability and wind (Kelishadi and Poursafa, 2010). According to Rajper et al. (2018), atmospheric SO₂, CO, NO₂ and particulate matter (PM) are the primary contributors to air pollution. The presence of these pollutants at levels beyond permissible limits causes serious health issues, such as breathing problems, allergies, cancers, cardiovascular and respiratory diseases, and even mortality (Wang et al., 2017). According to Wieser et al. (2021), air pollutants occur not only in the transport, industry, or coal combustion sectors but also in the construction sector. Pollutants have different sources of origin within the construction sector or the built environment. Outdoor sources include construction activities, which can lead to dust production, the use of construction machinery at sites, the production of building materials, or pollutant emergence at other different life cycle stages of buildings, such as the end-of-life stage.

Garcia-Aleega et al. (2017) found bioaerosols, or the biological particles of aerosols, to be predominantly formed by microbial origin. Bio-aerosols are ubiquitous in the environment and are easily dispersed in the air due to their small particle size (<2.5 µm). Given the potential high concentration of bioaerosols from urban, agricultural and industrial emissions (such as composting and other bio-waste processing facilities), its impact on local air quality is a growing public health concern. It is well known that bioaerosols in the air can induce respiratory diseases and infections, including tuberculosis and asthma. The study aimed to evaluate the envisaged socio-environmental Implications of the Mando (Kaduna) Rimi – Zakara (Kano) 330v DC Quad Conductors Project. The specific objectives are to (i) identify the environmental and social impact status of the project and (ii) examine the cost-effective mitigation measures during mobilization construction, commissioning and operation.

Materials and Method

Study Area

The project area cuts across two states (Kano and Kaduna) and nine LGAs. (Six are in Kano State Ungogo, Tofa, Rimi Gado, Kiru, Kobo, and Rogo, and three are in Kaduna Zaria, Kudan, and Igabi). The Transmission Line Right of Way (ROW) to be acquired for the project is approximately 205108 km long and 50 x 1m wide, thereby giving a total area of about 10,250,000 m² (1025 ha) while 5,490,000 m². The line is anticipated to link the existing Mando substation in Kaduna state with the Rimi-Zakara substation in Kano state.

The study focused on the identification of stakeholders and their impact on the community in terms of their infrastructures and also on their educational learning system, the institutional analysis and the system for monitoring and evaluation, among others. This led to adopting a study strategy that involved the following activities:

- i Conducting literature searches and reviews
- ii Conducting field visits to the study area.
- iii Determining target population and sample size for participatory rural appraisal and interviews;
- iv Conducting consultations and socio-economic surveys (Focus Group Discussions [FGDs], General Group Discussion [GGD], and In-Depth Interviews [IDI] with various stakeholder groups and interviews with key informants in the community
- v Conduct interviews with key stakeholders involved with the project
- vi Direct observations;
- vii Collating and analysing data obtained from all the sources and coming up with the findings and results.

Primary data collected for this analysis are both qualitative and quantitative and derived from key informant interviews, village-level surveys and focus group discussions. Various samples were collected and analyzed in the field.

Various samples were collected and analyzed in the field. The prevailing microclimatic conditions (temperature, rainfall, humidity, wind velocity and prevailing direction and atmospheric pressure) operating in the study area were measured on the field. Measurement was carried out with the aid of Aeroqual Aerocet 531. This equipment was calibrated and held at arm's length towards the direction of the prevailing wind for 2 minutes. The value of the climatic elements was read off-screen, and data was documented. The sampling locations for noise and air quality were the same for air quality.

Sources of Data

The summary of baseline conditions is based on data collected from the field and reviewed literature. The data acquired will be used in further environmental management decisions and future monitoring of any

changes in the environmental and social components. A combination of data from existing literature and field sampling was used to inform the preparation of the baseline chapters for various environmental and social components. Field studies and data collection were covered to characterize the baseline conditions of the proposed project environment.

- i Climate and meteorology
- ii Air quality and noise levels
- iii Geology/hydrogeology
- iv Surface and groundwater
- v Soil
- vi Sediment
- vii Vegetation & fauna wildlife
- viii Hydrobiology, fisheries and
- ix Socio-economics/health, demography and community characteristics

The acquisition of data basically involved field data gathering, measurements, and the collection of representative samples to establish the environmental conditions of the study area. This exercise involved a multi-disciplinary approach and was executed within a quality, health, safety and environmental (QHSE) management system approach. This approach ensured that the required data and samples were collected according to agreed requirements (scientific and regulatory) using the best available equipment, materials and personnel. A one-season field data-gathering exercise was performed to characterise the ecology and meteorology of the study area and determine seasonal variations of specific environmentally related parameters.

Elements of this approach include:

- i review existing reports that contain environmental information on the study area;
- ii designing and development of field sampling strategies to meet work scope and regulatory requirements;
- iii pre-mobilization activities (sampling equipment/materials calibrations/checks, review of work plan and schedule with team, and job hazard analysis);
- iv Mobilization to the field; fieldwork implementation - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures; and
- v Demobilization from the field; transfer of sample custody to the laboratory for analyses.) protocols were undertaken during samples collecting, handling and analysis to guarantee the integrity of the data and analytical results.

Materials consulted included approved reports on previous environmental surveys, publications, textbooks, articles, maps, etc., on the area and similar environments.

Results and Discussion

Social and Environmental Impact of the Project

Potential environmental and social impacts (including health and safety issues) associated with the proposed Project were assessed using a modified Leopold Interaction Matrix. Impact significance was also determined. In determining the significance of impacts, the factors considered included: magnitude of impacts (which is a function of the combination of the following impact characteristics: extent, duration, scale and frequency); value/sensitivity/fragility and importance of relevant environmental and social receptors; legal/regulatory requirements; and public perceptions (based on stakeholders' consultation). The identified potential adverse impacts are;

Impacts on Ambient Noise Level: The project area is noise-degraded. Noise levels were above the recommended threshold limit for specific receptors, which include residential, schools and mosques. The project shall add to the baseline noise level. During the operation phase, maintenance activities conducted near towers, substations, transmission lines, or ROW could increase noise levels that may disturb the neighbouring communities. The noise produced by transmission lines can be experienced as a buzz or a crackle, and noise created by substations comes mainly from power transformers. Generally, noise produced by substations is higher than that produced by transmission lines.

The audible noise emitted from high-voltage lines is caused by the discharge of energy that occurs when the electrical field strength on the conductor surface is greater than the 'breakdown strength' (the field intensity necessary to start a flow of electric current) of the air surrounding the conductor. This discharge is also responsible for radio noise, a visible glow of light near the conductor, an energy loss known as corona loss, and other phenomena associated with high-voltage lines.

The degree or intensity of the corona discharge and the resulting audible noise are affected by the transmission voltage and weather conditions such as humidity, air density, wind, rain, drizzle and harmattan. Water increases the conductivity of the air and so increases the intensity of the discharge. Also, irregularities on the conductor surface, such as nicks or sharp points and airborne contaminants, can increase the corona activity. The higher the voltages at which transmission lines operate, the higher the noise problem. Also, noise may be especially noticeable during nighttime when ambient noise levels are lower.

Impacts on Air Quality: About 30.8 tons of vegetal biomass shall be cleared along the right of way, and access roads will be upgraded and constructed. This shall contribute to global warming as the sink for carbon sequestration will be lost. During transport and clearing activities, the operation of the vehicles and machines will also result in the emission of greenhouse

gases such as methane and CO. Vehicles transporting men and materials will generate PM, SO₂, CO, NO_x, and CO₂ emissions. This activity is expected to add to baseline concentrations. It is noteworthy to mention that the quantity of emissions is dependent on the vehicle type, amount and conditions. Light-duty petrol vehicles without pollution control devices have the highest exhaust emissions during acceleration, followed by deceleration and idling cycles. Frequent cycle changes characteristic of congested urban traffic patterns thus tend to increase pollutant emissions. Hydrocarbon and CO emissions decrease at higher cruise speeds, while NO_x and CO₂ emissions increase. Emissions from diesel-fuelled vehicles include particulate matter, NO_x, SO₂, CO and hydrocarbons, most of which occur from the exhaust. Operating at higher air-fuel ratios (about 30:1 as opposed to the 15:1 characteristic of petrol-fuelled vehicles with electronic fuel injection engines), diesel-powered vehicles tend to have low HC and CO emissions despite having considerably higher particulate emissions. Particulates emitted from diesel vehicles consist of soot formed during combustion, heavy HC condensed or adsorbed on the soot and sulphates. In older diesel-fuelled vehicles, soot contributes to particulate emissions between 40% and 80%. The black smoke observed to emanate from poorly maintained diesel-fuelled vehicles is caused by oxygen deficiency during the fuel combustion or expansion phase. Particulate emissions from petrol-driven vehicles are usually negligible. When they do occur, such emissions will result from unburned lubricating oil, ash-forming fuel, and oil additives. Dust emission from land preparation and vehicle movements.

The dust emissions from the project's construction activities are due to land preparation and vehicular movements. Dust emissions have the potential to impact the close receptors due to the physical appearance, deposition on the roof of the residential areas and creating nuisance for the surrounding community. Material removal usually occurs with a bulldozer; cleared material is stored in piles for later use or during rehabilitation procedures. Fugitive dust is generated during material clearing, and wind-blown dust is generated from cleared land and exposed material stockpiles. Dust problems can also be generated while transporting the material, usually by truck, to the stockpiles. This dust can take the form of entrainment from the vehicle itself or due to dust blown from the back of the trucks during transportation. During the operation phase, maintenance activities conducted near pylons, substations, transmission lines or Right of way could increase noise levels, which may disturb neighbouring communities.

Propose A Cost-Effective Mitigation Measures

Mitigation Measures on Air Quality

- i Maintain and operate all vehicles and equipment engines in accordance with manufacturers' recommendations;

- ii. Regular cleaning of equipment, drains and roads within the project area to avoid excessive build-up of dirt;
- iii. Use covered trucks for the transportation of materials that release dust emissions and
- iv. Speed limits on-site of 25km/hr on unhardened roads and surfaces
- v. Provide and encourage the use of PPEs.
- vi. Limit vegetal clearing to RoW footprint

Mitigation Measures on Ambient Noise

Select 'low noise' equipment or methods of work, avoid dropping materials from height, where practicable, avoid metal-to-metal contact on equipment where possible, limit work activities to daytime only, ensure maintenance of vehicles and equipment and provide and encourage the use of PPEs such as ear muffs.

Future Environmental and Social Issues due to Development

- i *Community Agitation:* After the Right of Way acquisition by the proponent, there is a tendency for some people or individuals to be agitated over non-satisfactory engagement and compensations over land and other associated properties. This could lead to strife within communities or groups and stall the development. During labour recruitment and before complete construction activities, there is also potential for conflicts between neighbouring communities or individuals over employment quota systems, sub-contracting procedures or recruitment methodology. This will have a significant impact on the project construction phase.
- ii Increase in social vices Influx of workers into the project area also increases the risks of Sexually Transmitted Diseases (STDs) and could adversely impact the spread of HIV/AIDS. This impact, if left unmanaged, may result in long-term health issues, which may eventually lead to fatality. The impact arising from this is ranked as High.
- iii Emission of exhaust fumes, noxious gases, and increased ambient noise level; noise during the operation phase and maintenance activities conducted near pylons, substations, transmission lines, or ROW could lead to an increase in noise levels that may disturb neighbouring communities. The noise produced by transmission lines can be experienced as a buzz or a crackle, and noise created by substations comes mainly from power transformers. Generally, noise produced by substations is higher than that produced by transmission lines.

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near the conductor, an energy loss known as corona loss, and other phenomena associated with high-voltage lines. The degree or intensity of the corona discharge and the resulting audible noise are affected by the transmission voltage and weather conditions such as humidity, air density, wind, rain, drizzle and harmattan. Water increases the conductivity of the air and so increases the intensity of the discharge. Also, irregularities on the conductor surface, such as nicks or sharp points and airborne contaminants, can increase the corona activity. The higher the voltages at which transmission lines operate, the higher the noise problem. Also, noise may be especially noticeable during night time when ambient noise levels are lower. Consequently, these lines are designed, constructed, and maintained so that during dry conditions, they will operate below the corona-inception voltage, meaning that the line will generate a minimum of corona-related noise. Communities likely to be affected are mainly those where the line passes through residential areas such as Rigasa, Zakaria, Gwarzo, Kabo-Kayare, Kura-Markafi-Hunkuyi, Mando, Markafi-Gabuchi, and Turau-Gwarzo. Personnel and equipment shall be transported to the project location via hydrocarbon fuel vehicles. The combustion of these fuels shall produce noxious gases and fumes, such as carbon monoxide, oxides of sulphur, lead, etc., into the atmosphere. This impact was described as adverse, short-term, reversible, and medium.

- iv. Kidnapping of workers and visitors on site: The kidnapping of workers and visitors on site is among the significant security concerns in Nigeria now. During maintenance of towers and substation equipment, personnel and company contractors may be victims of kidnappers. Some of these attacks may result in the death of victims, which is harmful, direct, and irreversible.
- v. Loss of Vegetation of the Project Area: The vegetation shall be removed. Power line and substation construction will require vegetation clearing of a combined area of 14.15 km²(1,025 Ha TL and 390Ha for Substation)land for TL, substations and access roads. It is estimated that 30.8 tons of vegetal biomass shall be cleared to establish this project. Vegetation clearing during this phase shall impact the current biodiversity of the project area, including their habitats.

Conclusion

The identified adverse impacts of the proposed project include potential air and noise pollution; soil, sediment, groundwater and surface water contamination from accidental discharges of wastes; workplace accidents; traffic and community conflict; migratory and raptor avian species; and loss of IUCN plant species. Consequently, cost-effective mitigation/ amelioration measures have been designed to ensure that these impacts are prevented, reduced or controlled to as low as reasonably practicable to provide the conservation of biodiversity in the area and enhance continual

compliance with environmental standards and requirements in Nigeria. It is understood that the project will result in substantial social and economic benefits for Nigeria. The cost-effective mitigation measures developed would ensure the plans/ procedures for managing the significant impacts of the project are maintained throughout the project implementation. This work has documented the existing environment of the area, potential and associated impacts of the proposed project, proffered cost-effective mitigation/ ameliorative measures for impacts and enhancement measures for the beneficial impacts. Based on the outcome, the following recommendations were made;

- i Zero tolerance of illegal activities by Contractor personnel, including prostitution, illegal sale or purchase of alcohol, sale, purchase or consumption of drugs, illegal gambling or fighting;
- ii Policy and sanctions against drunkenness and alcohol and drug abuse during working time or at times that will affect the ability to work within accommodation camps or acquired from outside the camp while accommodated in the camp;
- iii Compliance with applicable health and safety requirements (including wearing prescribed personal protective equipment, preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment);
- iv All vehicles shall be kept in good working condition by periodic and regular maintenance.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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