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Full Length Research Paper

A Survey of Residential and Mini-industrial Wiring Systems in Nigeria: A Case Study of Bayelsa State, Southern Nigeria

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Abstract: Electrical fire in Nigeria towns and villages has assumed an alarming state, due to circuit overloading, wrong connections, and substandard materials. This study investigated the compliance of residential and commercial wiring systems in Bayelsa state, Nigeria, if they are in compliance with international approved standards. Primary and secondary data were used to achieve the aim of this study. Well-tailored questionnaires were administered to electricians working within the state, to ascertain the level of their works (electrical wiring) to Nigeria Industrial standard. Results obtained from the questionnaire feedback revealed that most of the electrical wiring within the state falls below national and international standards. Analyzing the results, 70% of the electricians carrying out electrical wiring within the state, had no formal education neither they are registered with any professional body. In addition, the study revealed that integrity checks are not done on 90% of electrical installations within the state, to determine their compliance with approved Nigeria or international standards. It was also seen in the results that about 60% of the electrical wiring in the state are been done with substandard materials, due to the high cost of the standard materials. As revealed by the results, 65.45% of the respondents did not take into account the electrical load of the buildings, due to the lack of detailed wiring plans of the buildings. It was seen that only 86.36% of the respondents endeavor appropriate connections during electrical wiring; while 13. 64% of the respondent did a "rough-and-ready" electrical wiring. Results obtained from this study will be helpful in appraising the state of residential and commercial buildings' electrical wiring, to prevent frequent electrical fires outbreak.

Keywords: Bayelsa State, electrical wiring, electrical fire, electrical load, integrity checks

INTRODUCTION

Electricity is one of the major prime movers of economic growth and development of a nation. Hence, with our reliance on electricity, there are potential electrical safety hazards if appreciate precautions are not taken (Platinum Electricians, 2020). Power installations and operations are capital intensive projects, and determine the workability of all industries that are powered by electrical current (Ogbuefi *et al.*, 2020). Electrical wiring is one of the major parts of building construction. Electrical wiring is the connection (linking) of electrical accessories such as: sockets, lamp holder, distribution boards, fuses or cut-outs, ceiling rose, etc. with electrical wire or cable of the

appropriate rating. According to Electrical Engineering Portal (EEP), wires used in electrical wiring are normally coded with colour codes for easy identification. In electrical wiring, current entered a circuit through the hot (live) wire (usually red colour) and returned along neutral wire (usually black or light gray colour). An electrical circuit is a continuous loop, which carries electricity from the mains (e.g. distribution line), throughout the house, then returns it back to the mains. Switches and other electrical appliances are usually connected to a single electrical circuit (EEP, 2020). Electrical wiring are done by trained professionals, but in some countries like Nigeria, due to lack of skill workforce, people with informal education, commonly called “engineers” within the locality, are mainly employed to carry out the electrical wiring of buildings. The utilization of substandard electrical materials or wrong connection of the circuit is very dangerous, as it can lead to electrical fires or breakdown of the system.

Electrical fires are fires comprising the potential energization of electrical appliances and accessories. Electrical fires are mainly caused by either over-loading of the circuit or short-circuiting the system (Fair, 2014). Safely of human lives and materials in residential, administrative or commercial buildings is of high priority to every country. Electrical fire has become a serious threat to the life and materials in residential and commercial buildings (Madueme, 1997). Electrical fires are dangerous to combat, since water is a good conductor of electricity. Cases of firefighters experiencing electrical shocks during electrical fires fighting have been reported across the country. This has led to the death of some firefighter (Jeffcase, 2010).Recently; electrical fire outbreak has become rampant in Bayelsa state. In September 2020, it took immediate intervention of the Bayelsa state fire service, to prevent an electrical fire which started from an automobile workshop, from spreading to neighbouring buildings (PM news, 2020). During January 2018, scores of people were rendered homeless in Bayelsa state capital (Yenagoa), after an inferno caused by electrical fire razed down tens of residential buildings. Furthermore, another inferno suspected to be caused by electrical fire razed a popular market (Swali) in Yenagoa, Bayelsa state capital.

Although several researchers (Babrauskas, 2003; Ahmed, 2014; Adekunle *et al.,* 2016) had worked on the causes and remedy of electrical fires, there is no literature on the state of residential and mini-industrial wiring systems in Bayelsa state, Nigeria. Hence, this study was carried out to appraise the state of residential and commercial buildings in Bayelsa state. The objective of this study is to ascertain the compliances of the electricians to the to Nigeria Industrial standard (NIS), during the course electrical wiring of residential and commercial buildings in Bayelsa state. The results will be helpful to the government in educating both the electricians and their clients, on the need of using standard materials and methods in electrical wiring, in order to prevent electrical fire and other electrical disasters.

MATERIALS AND METHODS

Study area

Bayelsa state is located within the crude oil rich Niger Delta region of Nigeria (Figure 1), and was created from parts of Rivers and Delta states 1996. Bayelsa state has geographical location falls within Lat. 04º15' N, 05º23' S and long 05º22' W and 06º45' E (Nigeriagalleria, 2020). According to the Nigeria Investment Promotion Commission (NIPC), Bayelsa state has a total land mass of about 9,059 Km^2, and population of about 1.7 million people. The natural vegetation of the state is mainly mangrove and tropical rain forest. It is having common boundary with Rivers state in the Western region, Delta state in the Northwestern region, and Gulf of Guinea in the southern region (NIPC, 2020). The state experiences two major seasons, the rainy season that occurred between March and October, and the dry season that occurred between October and March. The rains come with heavy downpour during the rainy season. Due to its oil rich nature, man oil exploring companies are operating within the state. Apart from the oil mining business; agribusiness, small scale manufacturing companies and education tourism are thriving well in the state.

Data collection and analysis

Primary and secondary data were collected, for the purpose of this study. The primary data was collected through Well-structured questionnaires, administered to the electricians working within the state; while the secondary data were collected from existing literature. The questionnaires were administered between January and February 2020. Out of 120 questionnaires distributed, 110 questionnaires were retrieved. The obtained data were subjected to descriptive statistical analysis such as mean, pie chart and table. The answers provided by the respondents were then analyzed according to the objectives of this study.

RESULTS AND DISCUSSION

The answers provided by the respondents were analyzed and discussed below:

Qualification of Respondents

The results from the questionnaires presented in (Figure 2) revealed that only 30% of the respondents that carried out electrical wiring in Bayelsa state received formal education and registered with professional bodies.

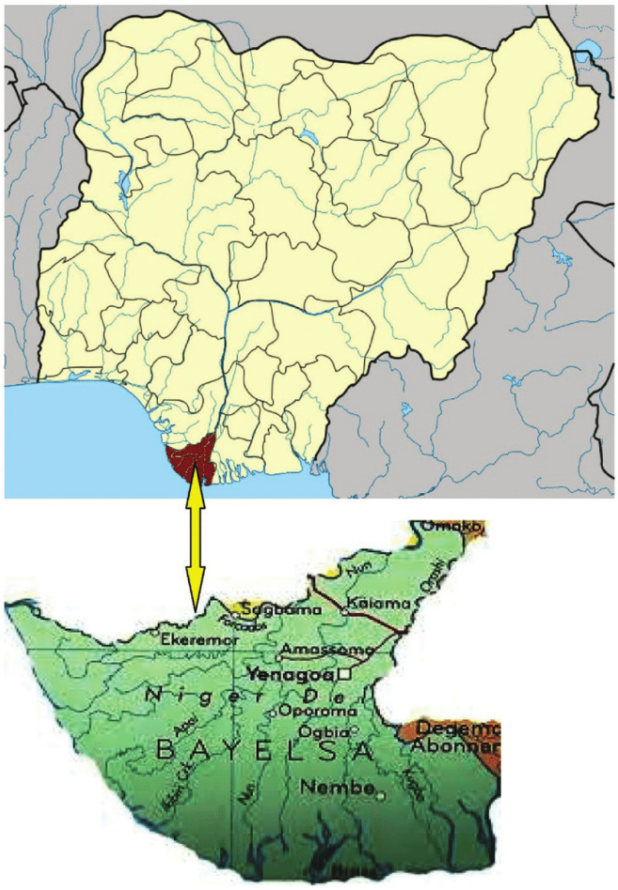

Figure 1: Bayelsa state map. Source: Alade et al. (2018).

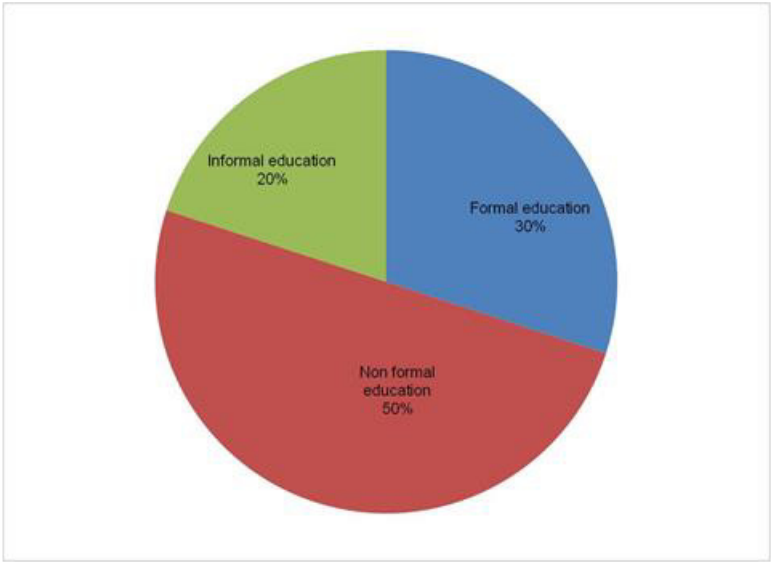

Figure 2: Qualification of the respondents.

The questionnaires feedback, as presented in (Figure 2) indicated that 50% of the respondents received non-formal education, and they are not registered with professional bodies. The feedback further revealed that,

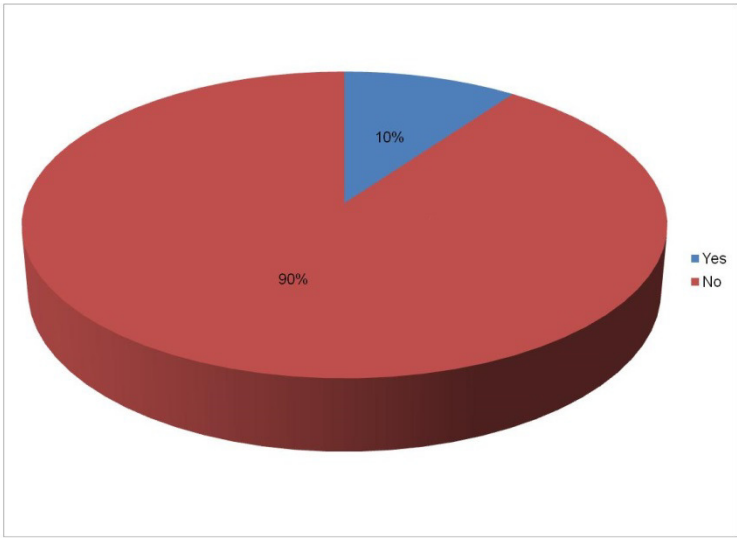

Figure 3: Integrity checks on electrical installation.

20% of the people that carried out electrical wiring in Bayelsa state did not received formal or non-formal education. They carried out the electrical wiring job through experience or trial or error method. Although they get the job done at times, in some cases, they messed up the job. People that received either the non-formal and informal education are considered as quacks, in engineering. At times the quacks constitute nuisance in the power sector, because their connections can interfere with the distribution line; hence shutting down the transformer and causing power outage. According to the Licensed Electrical Contractors Association of Nigeria (LECAN), the actions of quack individuals in electrical installation contribute to the power crisis facing the power sector in Nigeria (Nigeria Engineers, 2020).These quacks did not follow any approved standard for electrical wiring and installation, during the course of their job. According to Arubayi (2017) wrong electrical accessories are mostly used by quacks, due to either lack of knowledge of the electrical load of the building or cutting corners to maximum profit. Most of the people are forced to employ the services of the quacks in the electrical wiring, because they considered the charges of the professionals to be too expensive.

Integrity checks of the electrical installations

From the questionnaires retrieved, it was observed 90% of the electricians did not carried out integrity checks on electrical installation (Figure 3), to determine their compliance to Nigeria standards, for electrical components and technology. The copper cables and wires used in the electrical wiring were subjected to NIS 430:2000 test on copper resistance. In addition, the technicians responded that no electrical test for cable cords and wires for voltages up to and Including 459/750, as recommended by NIS 356: 1997, were done on the cable cords and wires. Furthermore, flame retardant characteristics of electric cables test, recommended by NIS 170: 1983, are not performed on the cables the used for the electrical wiring. Lack of integrity checks can result to burning cables, which will lead to electrical fire if any inflammable material is nearby. These serious threats to the electrical safety of the building, as electrical fires can occur due to overloading, short-circuiting, or system failure.

Substandard materials

The study revealed that 60% of the electrical wiring are been done by using substandard materials, during the processing electrical wiring and installation (Figure 4). They attributed the problem to the inability and unwillingness of their clients, to buy the standard electrical accessories due their high cost; hence bargaining the safety of the occupants of the building. In Bayelsa state, a superior (standard) 15A electrical socket cost between 1,500 and 2,000 Nigeria naira (about 5 USD), while the substandard (inferior) ones cost between 400 and 600 Nigeria naira (about 1.2 USD). Therefore, most property developers prefer the cheaper ones to the superior ones. It had been ascertained that the utilization of the substandard or wrong cable size and other electrical accessories, in electrical wiring can cause electrical disaster. Researches had shown that substandard materials are one of the major cases of electrical fires. According to Madueme (1997), high cost of electrical accessories and equipment is forcing the

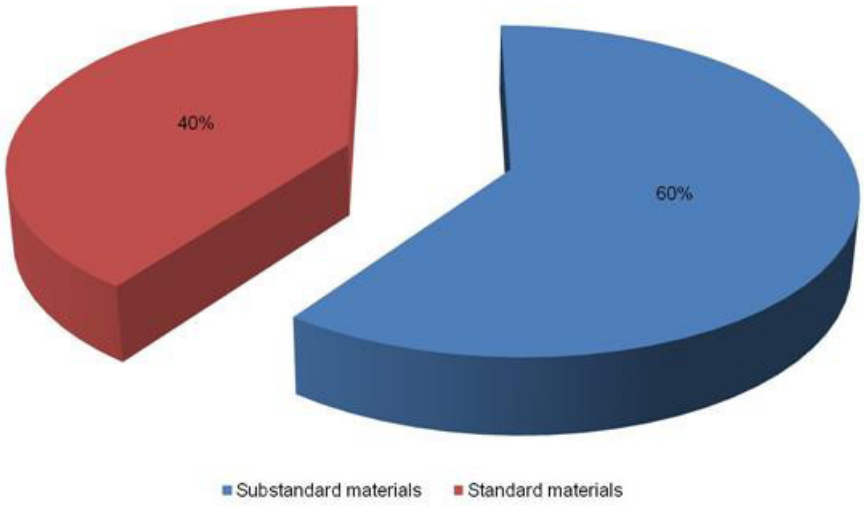

Figure 4: Materials used for electrical wiring in Bayelsa state.

people in the underdeveloped nations be choose sub-standard materials, that are less expensive during electrical installation, which will lead to fire out later. The utilization of sub-standard electrical materials in building wiring does not only endanger human lives, but is an economic sabotage. This is because it encourages frequent purchase of the same materials regularly (Madueme, 1997). Since most electrical wirings in local markets in Bayelsa state are done by non-professionals, using mostly substandard materials, which had led to rampant electrical fires within the state. Between January 2019 and October 2020, electrical fire had raze about ten major markets, automobile workshops and departmental stores in Bayelsa state, apart from the cases of residential buildings being burnt down by electrical fire.

Electrical load and collections

From the questionnaires retrieved, 65.45% of the respondents replied that they don't bother about the electrical load of the building, since there is no detailed electrical plan of the building (Table 1).While only 34.55% of the respondents take electrical load of the building into account, during the course of the electrical wiring. This portrayed that most of the residential and commercial buildings in Bayelsa state may be overloaded. Electrical overload is not only excessive electrical load, but it can occur during normal loading due to excessive supply voltage, caused by poor cables, floating neutrals or voltage surges (Babrauskas, 2009).

It was also observed from the questionnaires feedback that, a good number of the respondent did not take their connection method seriously. It is only 86.36% of the respondents endeavour appropriate connections during electrical wiring; while 13. 64% of the respondent did a "rough-and-ready" electrical wiring. This is dangerous as it can lead to electrical breakdown. For instance, ceiling rose are only used in circuits with voltage less than 250 volts, as higher voltage might increase the chances of electrical fire or power surges. Poor connection is another vital cause of electrical fires. If connection is badly made, it will fail with time, and this failure can lead to ignition, depending on the nature the neigbouring environment. A glowing connection is an extreme case of an overheating connection and the temperature of a glowing connection can exceed 1200ºC (Babrauskas, 2003).Amateurs doing electrical wiring are a notorious cause of poor connections; hence, professionals are preferred to carry out electrical wiring of buildings (Platinum Electricians, 2020).

Installation of safety devices

It was observed from the answers provided by the respondents that, only 71% of them installed appropriate safety devices in the buildings, during electrical wiring (Figure 5). The rest 39% of the respondents technically ignore installing safety devices in the building, during the course of the electrical wiring. They attributed the problem to the unwillingness of their clients, to provide money to buy the appropriate earthling materials, circuit breakers and fuses, mostly when wiring stores and mini-apartments. This has become a menace mostly in the rural areas of the state. The non-installation of the recommended cut-out fuse by some technicians in those houses, posed serious threat to both the electrical appliances and during electrical fire. A fuse cut-out helps to protect the equipment inside the house from current surges and overloads. A short-circuit or overload will cause the fuse to melt; hence, disconnecting the house from the distribution line. Earthing (grounding) of very

Table 1: Appropriate electrical load and connections during electrical wiring

Parameter	Number of respondents		Percentage	
	Yes	No	Yes	No
Electrical load	72	38	65.45	34.55
Appropriate connections	95	15	86.36	13. 64

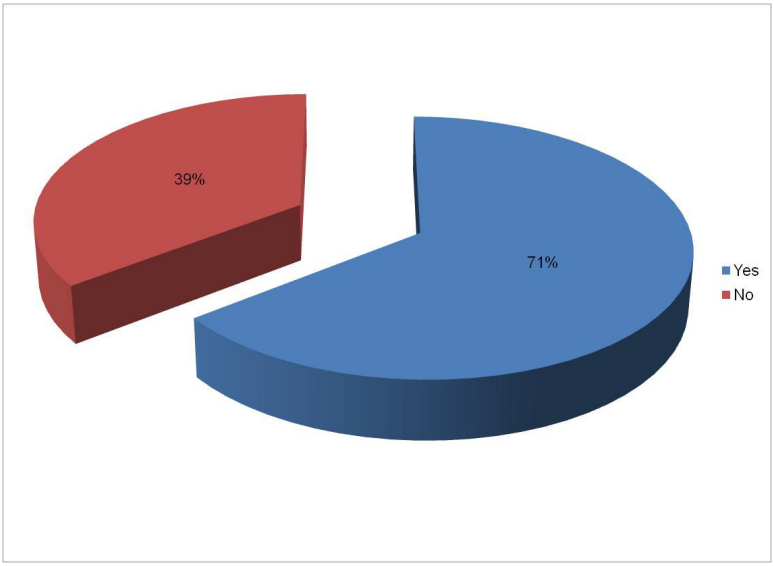

Figure 5: Installation of application safety devices in electrical wiring.

essential in electrical installations as it increased the life span of the equipment, as well as human beings operating them. Earthling helps to protect human life from the danger of electrical shock or death by blowing a fuse. This provide an alternative path for the fault current to flow, so that it will not endanger the life of the human being (Obeta and Nnadi, 2013; Adesina and Akinbulire, 2018). According to Adekunle *et al*. (2016), it is essential to shut off the electric line, to reduce the electrical rife to normal fire, before the engaging the fire with firefighting materials such as water or other conductive materials, to minimize electrocution. Results obtained from this study will be useful to the government in the electricians, on the need of using standard materials and methods in electrical wiring, in order to prevent electrical fire and other electrical disasters.

Conclusion

This present study was carried out on the assessment of the wiring systems in Bayelsa state of Nigeria. 120 well-structured questionnaires were distributed to electricians in the state, out of which, 110 were retrieved due to close monitoring. The answers provided by the respondents showed that most of them do not adhere to Nigeria Industrial standards. It was revealed in the study that there is shortage of skill workforce in the state. Only 30% of the respondents had formal education and are registered with professional bodies, while 70% of the respondents did not received formal education, and did not registered with any professional body. It was observed that most (60%) of the electrical materials used in electrical wiring in the state are substandard; hence put the users and the equipment at electrical risk. Furthermore, the results showed that good number (86.36%) of the respondents endeavour appropriate connections during electrical wiring, to prevent electrical fire or power surges. In terms of electrical safety devices, the answers provided by the respondents revealed that only 71% of them installed appropriate safety devices in the buildings during electrical wiring. While the rest 29% ignore most of the safety devices due to the non-co-operation of their clients; hence, leaving the users at the mercy of electrical fire and electrocution. These results of the study will be helpful to the state government and relevant agencies, to closely monitor electrical wiring in the state, to eliminate quacks and enhance professionalism. Also the government should set up a body to conduct thorough integrity tests of all the existing residential and commercial electrical wiring structures in the state, to ensure that they are grounded and met NIS

recommendations. This will help to improve electrical safety and minimize electrical fires.

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