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# "Pipeline Right-of-Way Encroachment in Arepo, Nigeria" Urban Data Analysis Critique

## *Introduction*

Nigeria is the largest crude oil producer in Africa and the eleventh largest globally. Crude oil is its government's biggest source of revenue; it accounts for about 75% of the government's revenue. Nigeria is divided into thirty-six states with six geopolitical regions i.e., north-west, north-east, north-central, south-east, south-south and south-west. The six geopolitical regions are carved out of states with similar ethnic groups and political history. Nigeria currently has four major oil refineries: one in the north-west zone in Kaduna state, one in Warri in Delta State in the south-south zone, and the one in Port Harcourt in Rivers State consists of two plants, which is also in the south-south zone. Refined crude oil products from the major refineries are typically transported to various pump stations and depots by rail, road, coastal waterway, and pipeline systems. However, In Nigeria, the road and pipeline systems are dominant due to the limited rail network and lack of inland waterways. A pipeline right-of-way (PROW) is a strip of land over, under, and around crude oil pipelines where some of the property owner's legal rights have been granted to a pipeline operator. Usually, a PROW is established about fifteen meters from each side of a pipeline. Seismic disturbances caused by legitimate civil engineering works in the area or by farming activity can compromise pipeline operation. Nigeria has a total pipeline grid of just above five thousand kilometers, which consists of multiproduct and crude oil pipelines. These pipelines form a network that interconnects the petroleum storage depots across the country and the four major refineries and connects the offshore terminals. This system of oil pipelines transports crude oil to the refineries. The multiproduct pipelines are used to transport products from the refineries and import-receiving jetties to the petroleum storage depots. Petrol tanker and pipeline explosions are frequent in Nigeria where, despite the country's multibillion-dollar oil and gas industry, most people live in poverty. Fires and explosions often occur as people try to siphon fuel from pipelines and as a result of accidents involving fuel tankers on poorly maintained roads and from exposed pipeline. The aim of the paper is to assess the effect of community encroachment on PROW and its socioeconomic implications on Arepo, Ogun State, which is in the south-west zone, using remote sensing and geographic information system (GIS) techniques. Existing pipeline infrastructure in the area were examined, the extent of encroachment on PROW were identified using the ArcGIS computer software buffer tools, and the security implication due to this encroachment were assessed.

*Methods*

Ogun state has twenty local government areas. Arepo, the study area, is in the Obafemi Owode local government area. Figure 1 shows where in Nigeria, Ogun state is located, and it also shows its other states. Figure 2 shows the twenty local government areas in Ogun state. Figure 3 shows the satellite image of Arepo in the Obafemi Owode local government area. Figure 4 shows the buffer distances from the PROW i.e., the vulnerable and the non-vulnerable areas. All figures were obtained from the paper. “The vulnerability levels indicate the impact of incidents of pipeline explosion that could occur from incessant oil bunkering, sabotage, or domestic fire accidents. This could further result in causalities and property loss due to the impact of the pipeline incident.” In figure 4, the study area was divided into four zones using buffers of fifteen, thirty, sixty and ninety meters respectively. The total number of encroaching buildings and the estimated total number of persons affected in the study area were determined by the buffering operation. Questionnaires were sent out to the residents of Arepo and data from figure 4 were used in order to compile Table 1 to 6 shown below. Table 1 shows the sampling used in Arepo. Structured questionnaires were administered to household heads in the community (i.e., the 60% of building shown in Table 1). A sixty percent sample was purposively taken due to homogeneity characterizing the study area.

*Discussion*

Table 2 shows the relationship between respondents' length of stay in the study area and the distance of their respective buildings to the pipeline. Those nearest the pipeline have the least tenure of residence, showing that people prefer to live farther from the pipeline. Residents are unwilling to build too close to the pipeline, probably due to well understood impacts on building and human health. It would be better to visualize this data using a line or bar graph instead of a table in order to better see the relationship between length of stay in the study area and the distance of the respective buildings to the pipeline. Table 3 shows reasons residents moved to the community. Most people moved to the area to engage in retail trading, and the rest moved to the community for employment purposes by other organizations. It would be better to visualize this data using a bar chart also. Table 4 shows the response of the community to cases of oil spills. Whenever there was an oil spill, some residents saw it as an avenue to vandalize the pipeline to gain from black-market sales. It would be easier to see the relationship between the response of the respondent and the distance of respondent's residence from pipeline if the data was presented using a graph, which also applies for Table 5 and 6. Table 5 shows the suggested safety measure on the PROW versus the distance to pipeline, and Table 6 shows the dominant building uses along the PROW. Residential buildings are most dominant in the community.

From the study, it was calculated that in zone A (i.e., where buffer distance = 15m), the total number of encroached buildings on the PROW is 26 and the estimated total number of persons within this zone is 728. How exactly the total number of persons within the zone was calculated was not explained, and the estimate used for the number of persons in a household was not stated, so one cannot tell how close the calculation would come to the real value. People living in zone A are very highly vulnerable to the pipeline explosion incidents in the community. How often a pipeline explosion incident occurs and the casualties and injuries that stem from it were not stated in the paper. Such information would be useful to create incident maps. At zone B (i.e., where buffer = 30m), 78 buildings with an estimated population of 2184 persons fall within. The buildings and persons in this zone are considered to be under high vulnerability in the incidence of a pipeline explosion. Buildings that fall within this zone are depicted with the color blue as shown also in Figure 4. Zone A is depicted with red. Also, at Zones C (i.e., where buffer = 60 m) and D (i.e., where buffer = 90m), the total number of buildings is 89 and 147, with an estimated population of 2492 persons and 4116 persons, respectively. The buildings in these zones are under medium and low vulnerability levels. These vulnerability levels are depicted by turquoise blue and green colors, respectively; buildings with no vulnerability are shown in yellow-peach. It is difficult to see the 30m and 90m buffer lines in figure 4 because their colors look similar. The vulnerability levels indicate the impact of a potential pipeline explosion, which could occur from human activities like continual oil bunkering or sabotage as well as domestic fire accidents. The implication of these findings for planning is that buildings that fall in zones A and B should be marked for contravening town planning regulations and consequent removal or demolition.

*Conclusion*

Overall, the study is not informative and is quite futile. The main thing it showed was the demographics of the people living in Arepo community, and the distance of their residence to the pipeline. The analysis did not full answer the effect of community encroachment on PROW and its socioeconomic implications on Arepo. It did not answer nor show how living in a PROW affects one's social and economic life, the dangers of living in a PROW e.g., number of oil spill incidents on a yearly or monthly basis, number of casualties and illness reported as a result of the oil spills, the quality of life of people living in a PROW compared to people not living in a PROW, the environmental cost to PROW homeowners, etc. The study and paper only stated the obvious, which is that people living in a PROW are the most vulnerable to any pipeline explosion incidents. Therefore, the results of this analysis cannot be used to affect any policy or decision making. There are already laws that prohibit people from building to close to a pipeline. For example, the American Petroleum Institute recommends setbacks of 50 feet (approximately 15.24 meters) from petroleum and hazardous liquids lines for new homes, businesses, and places of public assembly.

Figures and Tables

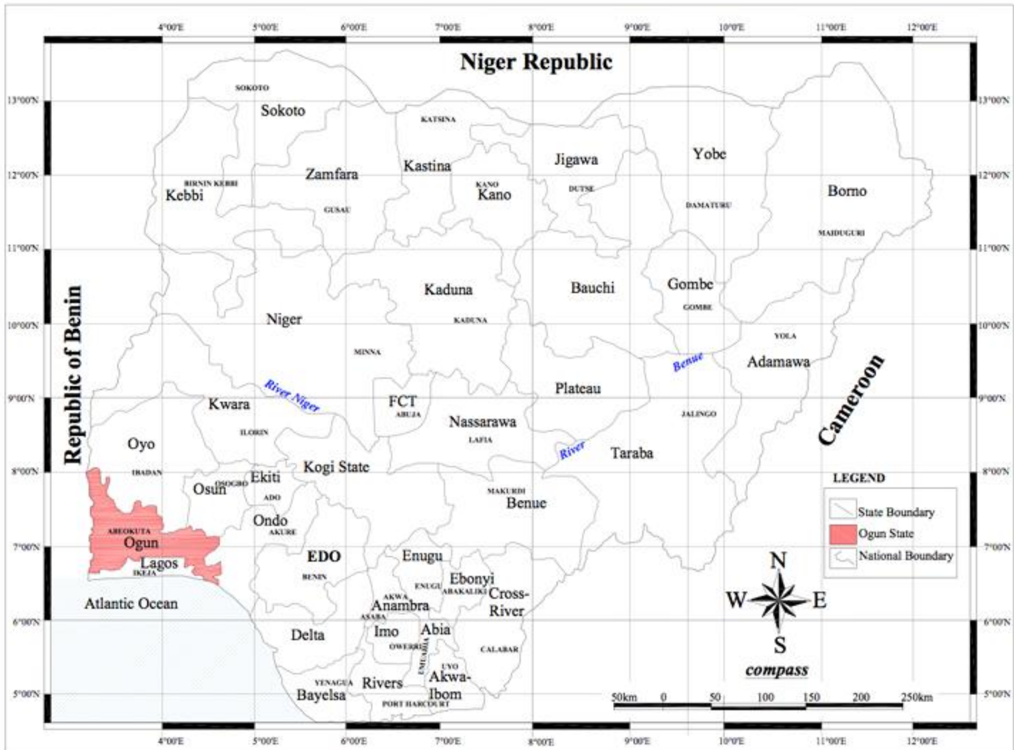


**Figure 1:** Map of Nigeria showing the study area in its national setting
Source: Survey Department, Ministry of Works, 2016

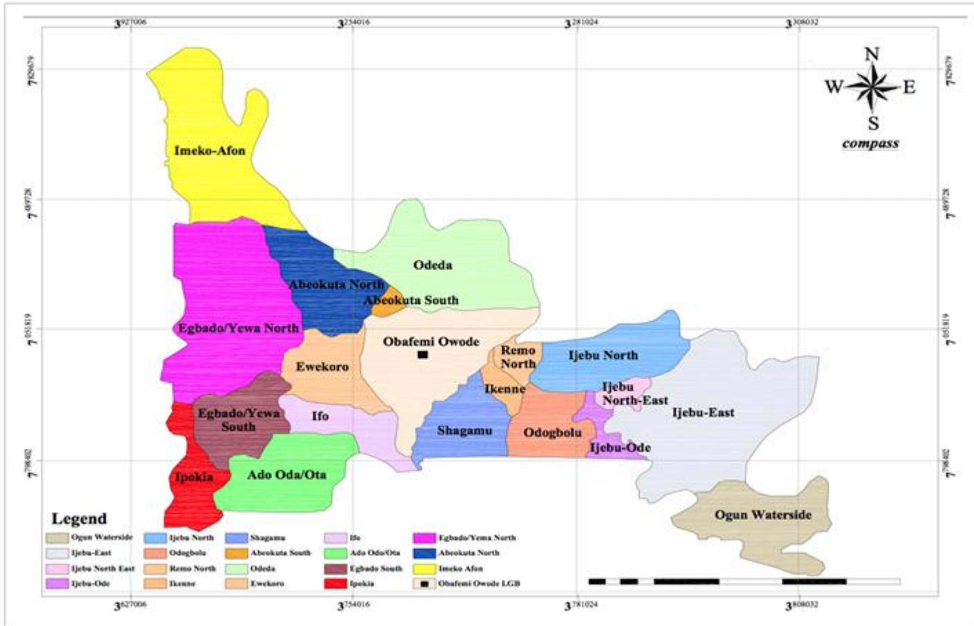


**Figure 2:** Map of Ogun State showing the study area in its regional setting
Source: Survey Department, Ministry of Works, 2016

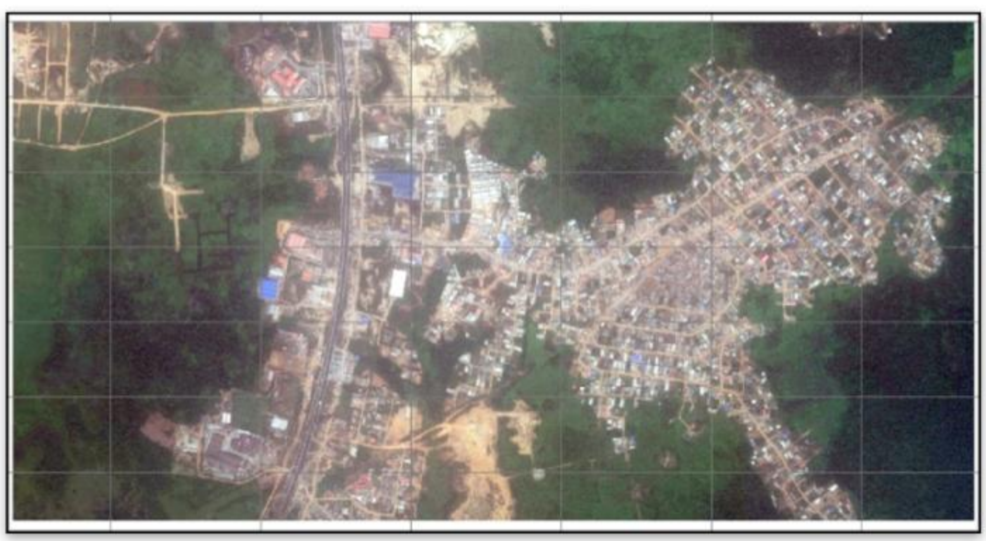

**Figure 3:** Google Earth imagery of the study area
Source: Google Earth, 2016

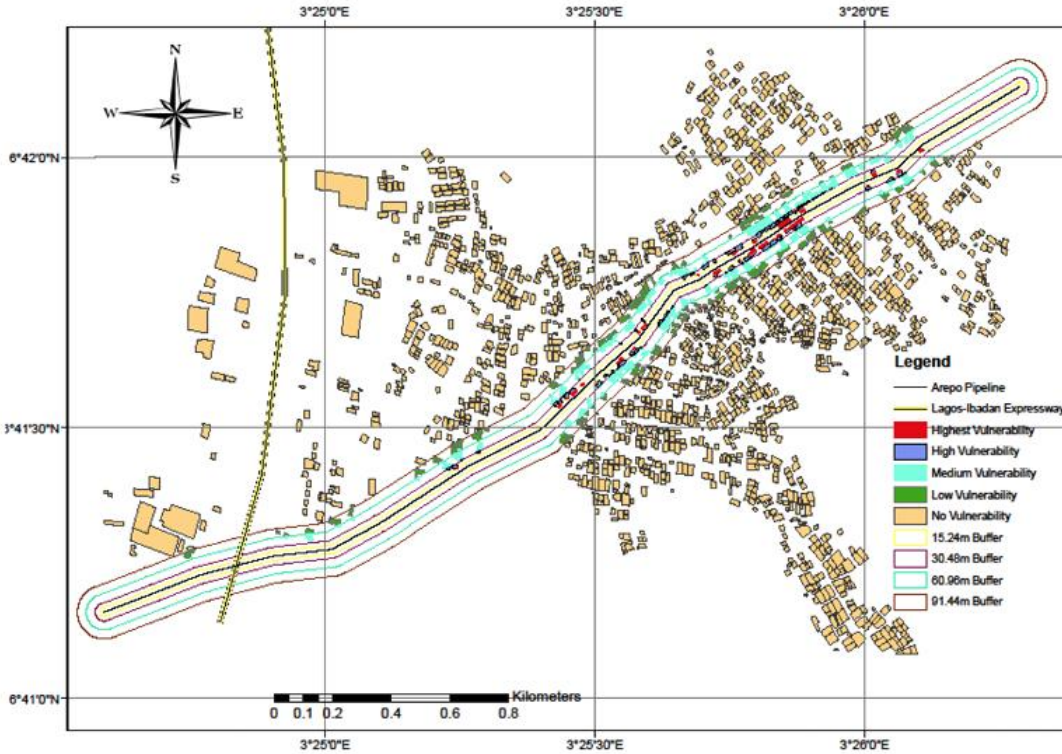


**Figure 4:** Vulnerability zones/buffer along the PROW in Arepo, Nigeria
Source: Authors' fieldwork, 2016

**Table 1:** Sampling in the Arepo community (the study area)

| Buffer distance from Pipeline | Zone | Total no. of buildings | 60% of buildings |
|---|---|---|---|
| 15m | A | 26 | 16 |
| 30m | B | 78 | 47 |
| 60m | C | 89 | 53 |
| 90m | D | 147 | 88 |
| **Total** | | **340** | **204** |

Source: Authors' fieldwork, 2016

**Table 2:** Length of stay of respondents vs. distance to pipeline

| Length of stay | Distance of Respondent's Residence from | | | | Total Freq | Total % |
|---|---|---|---|---|---|---|
| | < 15 m | 15 -29 m | 30-59 m | 60 – 90 m | | |
| below 5yrs | 33 | 16 | 0 | 0 | 49 | 24.5 |
| 5-10yrs | 0 | 15 | 14 | 11 | 40 | 20.0 |
| 11-15yrs | 27 | 16 | 0 | 0 | 43 | 21.5 |
| above 15yrs | 0 | 33 | 21 | 14 | 68 | 34.0 |
| **Total** | **60** | **80** | **35** | **25** | **200** | **100.0** |

Source: Authors' fieldwork, 2016

**Table 3:** Attraction factor to community vs. distance to pipeline

| Attraction Factor | Distance of Respondent's Residence from Pipeline | | | | Total Freq | Total % |
|---|---|---|---|---|---|---|
| | < 15 m | 15 -29 m | 30-59 m | 60 – 90 m | | |
| Lumbering | 0 | 0 | 0 | 0 | 0 | 0 |
| Trading | 43 | 46 | 14 | 11 | 114 | 57 |
| Employment | 17 | 34 | 21 | 14 | 86 | 43 |
| Grand Total | 60 | 80 | 35 | 25 | 200 | 100 |
| **Total** | **60** | **80** | **35** | **25** | **200** | **100.0** |

Source: Authors' fieldwork, 2016

**Table 4:** Community response to oil spillage vs. distance to pipeline

| Response | Distance of Respondent's Residence from Pipeline | | | | Total Freq | Total % |
|---|---|---|---|---|---|---|
| | < 15 m | 15 -29 m | 30-59 m | 60 – 90 m | | |
| Report to security agency | 20 | 17 | 4 | 3 | 44 | 22.0 |
| Evacuate from area of spill | 22 | 18 | 7 | 4 | 51 | 25.5 |
| Vandalize the pipeline | 42 | 21 | 19 | 7 | 89 | 44.5 |
| Do nothing | 10 | 6 | 0 | 0 | 16 | 8.0 |
| **Grand Total** | **94** | **62** | **30** | **14** | **200** | **100.0** |

Source: Authors' fieldwork, 2016

**Table 5:** Suggested safety measure on the PROW vs. distance to pipeline

| Recommended Measure | Distance of Respondent's Residence from Pipeline | | | | Total Freq | Total % |
|---|---|---|---|---|---|---|
| | < 15 m | 15-29m | 30-59 m | 60- 90 m | | |
| Erection of "No Trespass" signs | 10 | 20 | 30 | 30 | 90 | 45.0 |
| Aerial surveillance | 2 | 0 | 0 | 0 | 02 | 1.0 |
| Security patrol along pipeline right-of-way | 10 | 12 | 9 | 7 | 38 | 19 |
| Enforcement of Town Planning Regulations | 20 | 8 | 0 | 0 | 0 | 14 |
| All of the above | 10 | 10 | 10 | 12 | 12 | 21 |
| **Total** | **60** | **80** | **35** | **35** | **24** | **100** |

Source: Authors' fieldwork, 2016

**Table 6:** Dominant building uses along the PROW vs. distance to pipeline

| Dominant Building Use | Distance of Respondent's Residence from Pipeline | | | | Total Freq | Total % |
|---|---|---|---|---|---|---|
| | < 15 m | 15-29m | 30-59 m | 60- 90 m | | |
| Commercial | 0 | 33 | 11 | 0 | 44 | 22.0 |
| Residential | 53 | 39 | 24 | 25 | 141 | 70.5 |
| Industrial | 3 | 5 | 0 | 0 | 8 | 4.0 |
| Mixed | 4 | 3 | 0 | 0 | 7 | 3.5 |
| Total | 60 | 80 | 35 | 25 | 200 | 100.0 |
| **Total** | **60** | **80** | **35** | **35** | **24** | **100** |

Source: Authors' fieldwork, 2016

# Works Cited

Oyinloye, Michael Ajide, et al. "Pipeline Right-of-Way Encroachment in Arepo, Nigeria." *Journal of Transport and Land Use*, vol. 10, no. 1, Journal of Transport and Land Use, 2017, pp. 715–24, http://www.jstor.org/stable/26211752.