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Analysis and Distribution of Pipeline Explosion Disaster in Nigeria (1998 - 2016)

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Abstract: Pipeline explosion has been a major disaster in Nigeria for the past three decades which has resulted in National social economic loss. This study examines the annual trend and variability accompanying this disaster; it also determines the spatial distribution of pipeline explosion for a period of two decades. Eighteen years data containing a number of cases and fatality of pipeline explosions were obtained from different reports and online news which was analyzed using spatio-temporal approach. Analysis was carried out using the number of cases and fatality data over a period of eighteen years. The result shows that the trend in the number of cases increased generally R^2=0.18 while the trend in the number of death decreased drastically. It was observed that the number of cases in the year 2016 was high compared to the number of death attributed to it. Also, it was noticed that pipeline explosions has only occurred in the Southern part of Nigeria in the past two decades although pipelines also run through the northern part of Nigeria. The study concluded that Southern states are vulnerable to the future disaster of pipeline explosion and more cases are likely to strike if proactive measures are not taken serious in the subsequent years.

Key words: *Pipeline explosions, Spatio temporal*

I. INTRODUCTION

Hosts of communities around the world today are being constantly exposed to different risk of natural and human induced disasters resulting to loss of life and properties worth trillions of dollars (UNISDR, 2013). One of such disaster currently affecting Nigeria is pipeline explosion.

History of oil exploration can be traced back to the year 1956 when oil was first discovered in Oloibiri oil field in Kugbo bay, Rivers state (Lawal, 2012). This has necessitated the use of pipelines as a means of transporting petroleum products from oil refineries and importing incoming resources to storage depots. According to pipelines and product marketing company (PPMC) Nigeria has over 5,001km of oil pipelines consisting of 4,315km of multiproduct pipelines and 666km of crude oil pipelines buried about 1 meter beneath the surface of along a 25 m wide Right of Way (ROW) specially acquired by the Government concerned (Lawal, 2012). There are 159 oil fields and 1481 wells in Nigeria where 78 out of the 159 oil fields are located in the Niger Delta region of the country (Department of Petroleum Resources, 1997). Extensive exploration and production of petroleum in Nigeria especially in the Niger Delta area has exposed the country to frequent threat of pollution, also the current activities of avengers and Vandals has further provoked this threat as oil thieves now rupture pipelines leaving thousands of barrels of crude oil to flow into the swamps and creeks which has led to severe environmental degradation, economic loss, soil, air and water pollution, health hazards, pipeline explosions etc. . However more factors which can lead to pipeline explosions can be attributed to when oil and gas companies fail to keep to laid down safety regulations or take alternative route in order to maximize profits, Negligence, carelessness, violations of safety regulations, and accidental pipeline strike (Klein, 2009). Additional factors were identified which includes ,Poor maintenance of pipes, poor pipeline network monitoring, Metal fatigue, Corrosion, Mechanical damages, Improperly repaired welds, Problematic products, Damage caused by chemicals, Violations of applicable codes, Inadequate safety practices,poor communication and transportation in the vulnerable communities. (Omodanisi et al, 2015).

Environmental issues continue to take over as more activities that trigger pipeline explosion arises on a daily basis. An example is the case of the most deadly pipeline explosion that occurred on October1998 at Jesse town in Delta state that killed about 1200 people leaving several people injured due to a ruptured pipeline that had resulted in bunkering and subsequently led to an explosion, the fire from this explosion burned for five days before a fire fighting company could quench it. Also in another case of explosion that happened on May 2008 in Ijegun, a suburb of Lagos, the explosion took place after a bulldozer struck an oil pipeline from which fuel started to spill out; moments later an explosion occurred which extended through neighboring communities, It reportedly extended through buildings with residents inside even Ijegun Primary School was also damaged with more than 15 homes and 20 vehicles burnt, 100 people were reportedly killed with others injured (Wikipedia, 2016). Subsequently, more explosions continued to occur due to Vandalism and Sabotage. It is now evident that the physical, and biochemical integrity of this planet is being compromised day-to-day by the destructive processes which are not only constant but increasing both in quantum and in rate. While some of the impacts might be gradual, other impacts may be instantaneous which includes Population displacement, loss of life**,** Economic Losses**,** Environmental pollution and ecosystem damage**,** Fear and Security threats, Environmental degradation and threatened habitat (Omodanisi, et al, 2015) also found out about one of the communities that had an incidence of pipeline explosion which is Ilado-odo in the suburb of Lagos that the biotic and abiotic components of the community were severely impaired, and effect may last for a long time if there is no post-disaster recovery programme.

These cases clearly show the dominance of both natural as well as man-made features have combined to make Nigeria one of the most environmentally stressed regions in the world with minimal mitigation/ recovery processes. The combined effects of these features have resulted in a noticeable and disturbing rate of degradation in the environment, posing different risk and

bringing emergencies and various exposure of risk to the populace.

The damage caused by this disaster (pipeline explosions) is mostly unquantifiable and varies with the geographic location, climate/weather and the degrees of vulnerability of the populace. This affects the mental, social, economic, and political state of affected area and people. Experiences have shown generally that disasters on several occasions completely disorganize the normal day to day life, where average needs and process like food shelter and health conditions are affected depending on the strength and severity of the disaster (Ovosi, 2015). Much work has been done on 'pipeline vandalism', its impact on the environment and the nation at large especially in the Niger Delta region where pipeline explosion was identified as one of the end result but not extensively examined and analyzed.

This paper discusses and analyzes the trend and fatalities of pipeline explosion for a period of two decades and also examines the spatial distribution of these occurrence over Nigeria, which could be useful for planning, mitigating against future occurrences and for proper decision making.

II. STUDY AREA

Nigeria is the most populous country in Africa; it is situated on the Gulf of Guinea in West Africa. It shares boundary with Benin, Niger, Cameroon, and Chad. Nigeria is found in the Tropics, where the climate is seasonally damp and very humid. It is affected by four climate types which are distinguishable from the southern part of Nigeria to the northern part of Nigeria through Nigeria's middle belt. Nigeria has six main Geopolitical zones namely: North Central also known as Middle Belt, North East, North West, South East, South South, South West, with land area of 910,771 sq. km and total area of 923,768 sq. km. Nigeria has an estimated population of 177,155,754 (growth rate: 2.47%); birth rate: 38.03/1000; infant mortality rate: 74.09/1000 and expectancy: 52.62 life (wikipedia.org, 2016).

In the Pipeline explosion case trend It was observed that the pipeline explosion cases were the highest in year 2000 and 2016 having 10 cases each followed by year 2004, 2006 and 2013 having four cases each then year 1999, followed by 1998, 2005, 2009, 2010, 2011, 2012 and 2014 having 2 cases each with year 2001, 2003, 2007, 2008 and 2015 having 1 case each in two decades. It is generally observed that the trend of pipeline explosion cases is high.

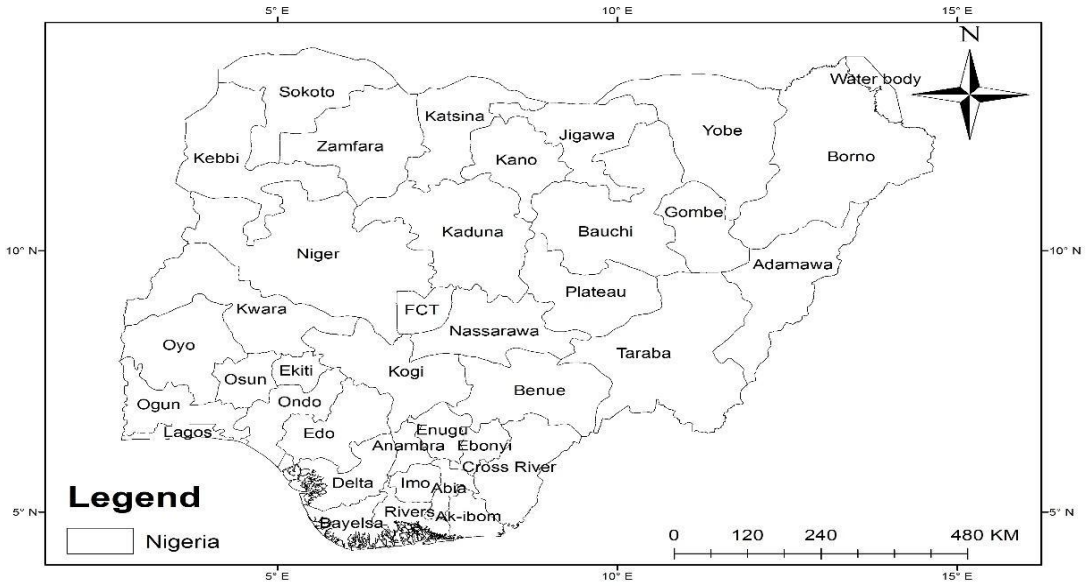


Figure 1: Study Area Map

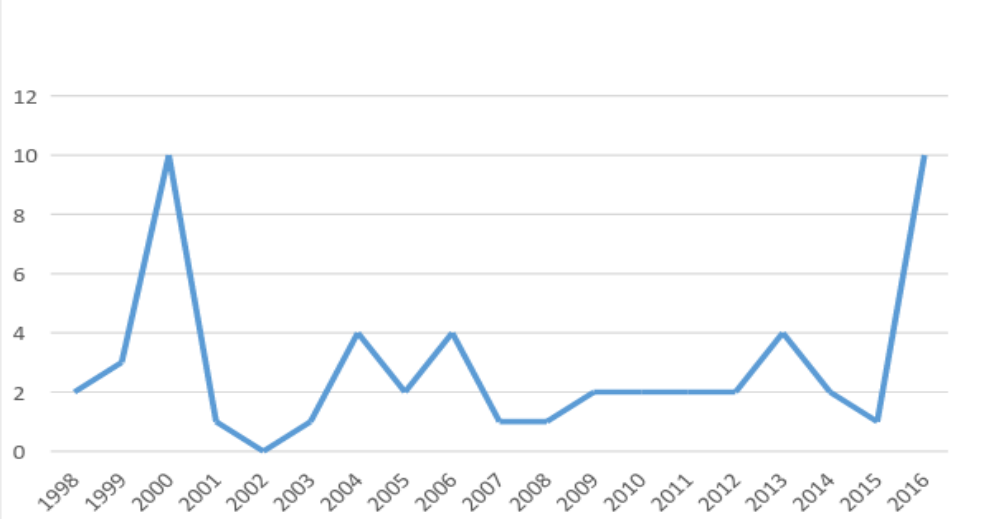


Figure 2: Trend of Pipeline explosions cases within the study area

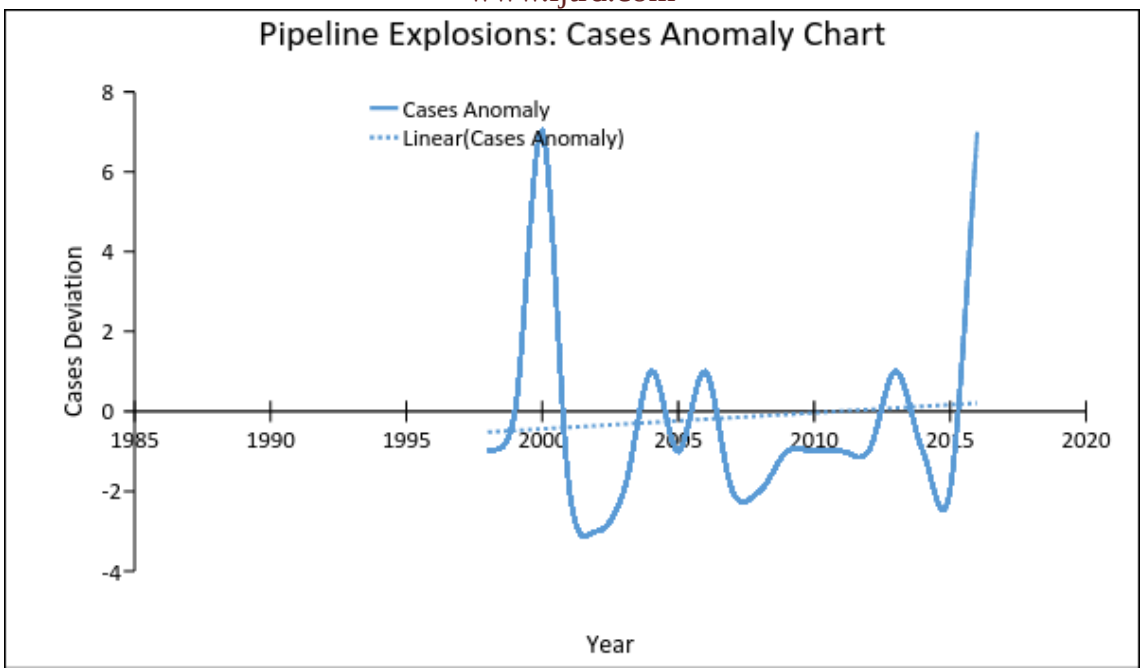


Figure 3: Anomaly in Pipeline explosion within the study area

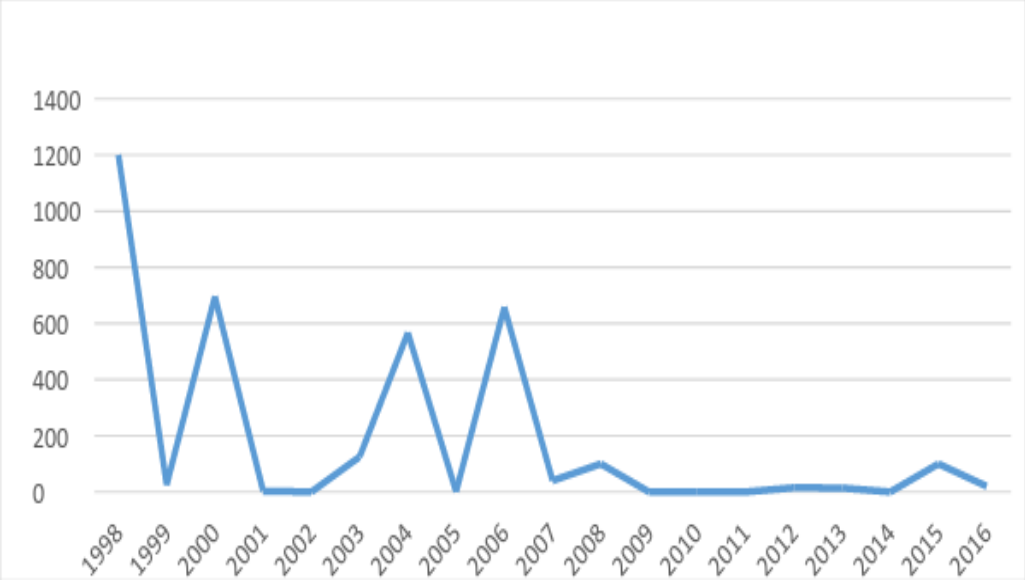


Figure 4: Death Rate Trend Resulting from Pipeline Explosions in Nigeria

From figure 3, (Pipeline explosion case anomaly), It was observed that year 2000 and 2016 witnessed or recorded the highest deviation from normal (cases anomaly) of pipeline explosion and 2015 having the lowest no of cases anomaly. The rise witnessed in 2016 could be attributed to sabotage, an intentional act of the Niger Delta militants .This shows that there is a likelihood for more cases to occur in subsequent years if no serious measure is taken to tackle this disaster.

From the death trend charts, it can be ascertained that there were multiple death resulting from pipe line explosion from 1998 – 2006. It is observed that there was a general low death rate from 2007- 2016. It is also observed that in the year 2016 a low no of death cases was recorded compared to the number of high occurrence.

From figure 5 (the death anomaly chart), the highest death anomaly which was +100 was witnessed in year 1998 and the lowest in year 2014.

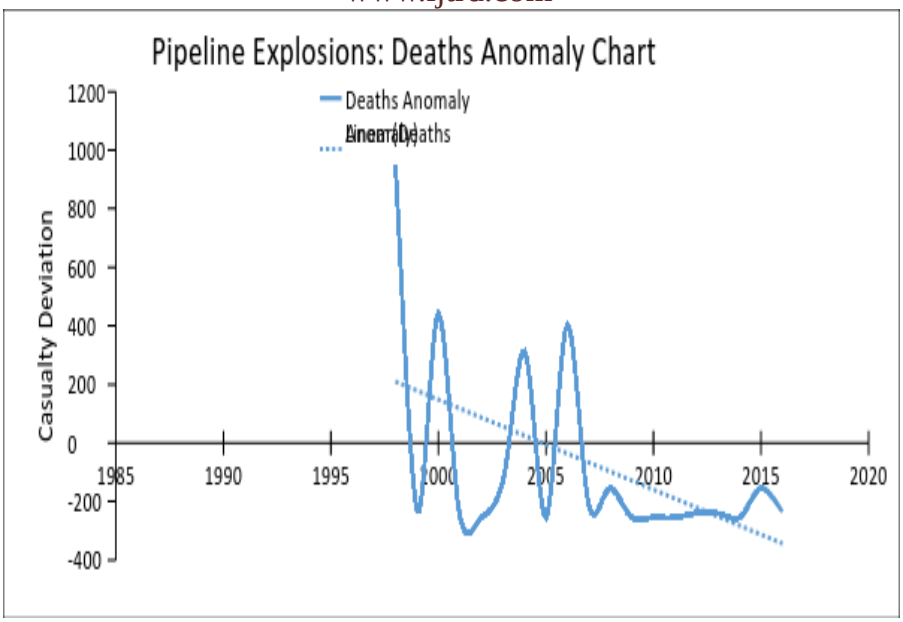


Figure 5: Death Anomaly within the study area

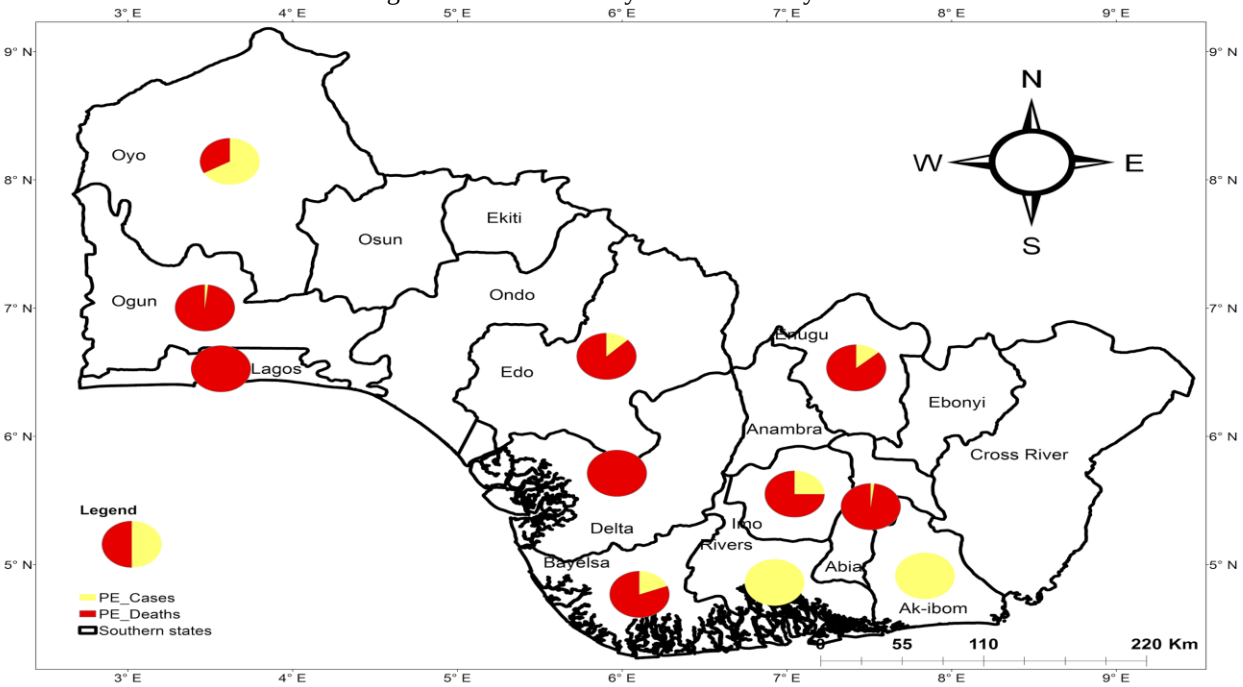


Figure 6: Map showing Rate of Occurrence and Death resulting from Pipeline explosions in Nigeria

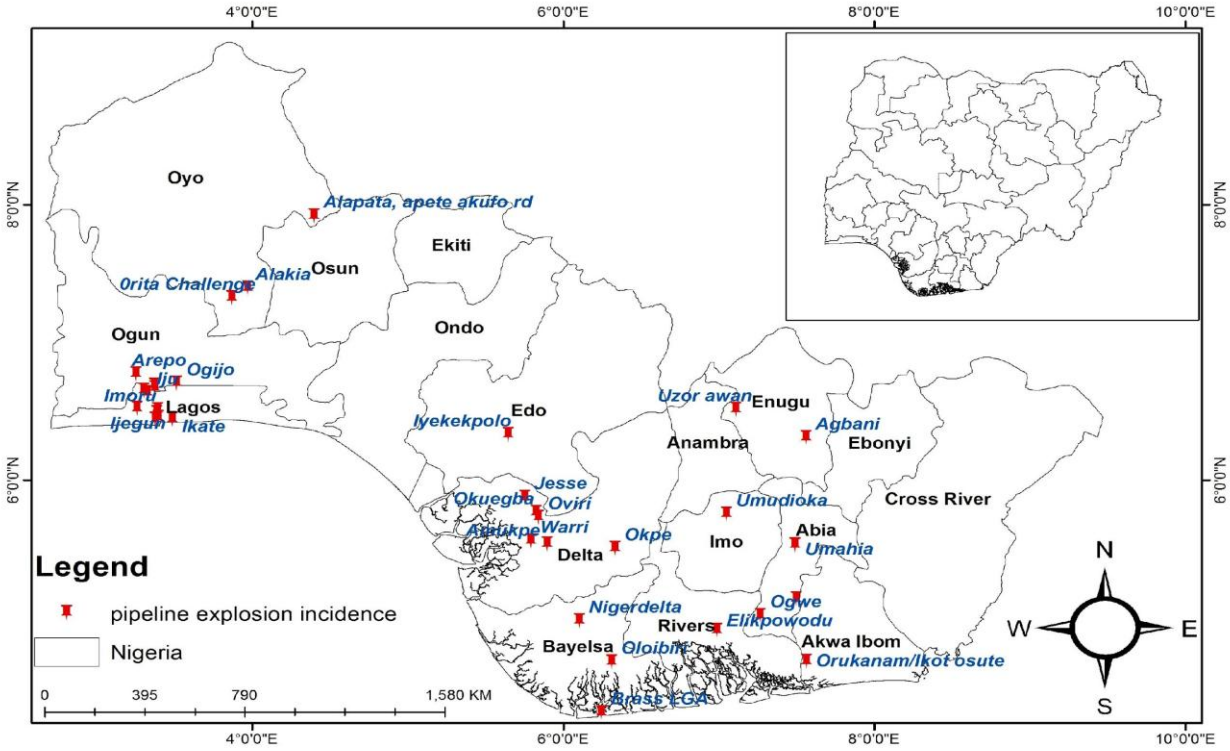
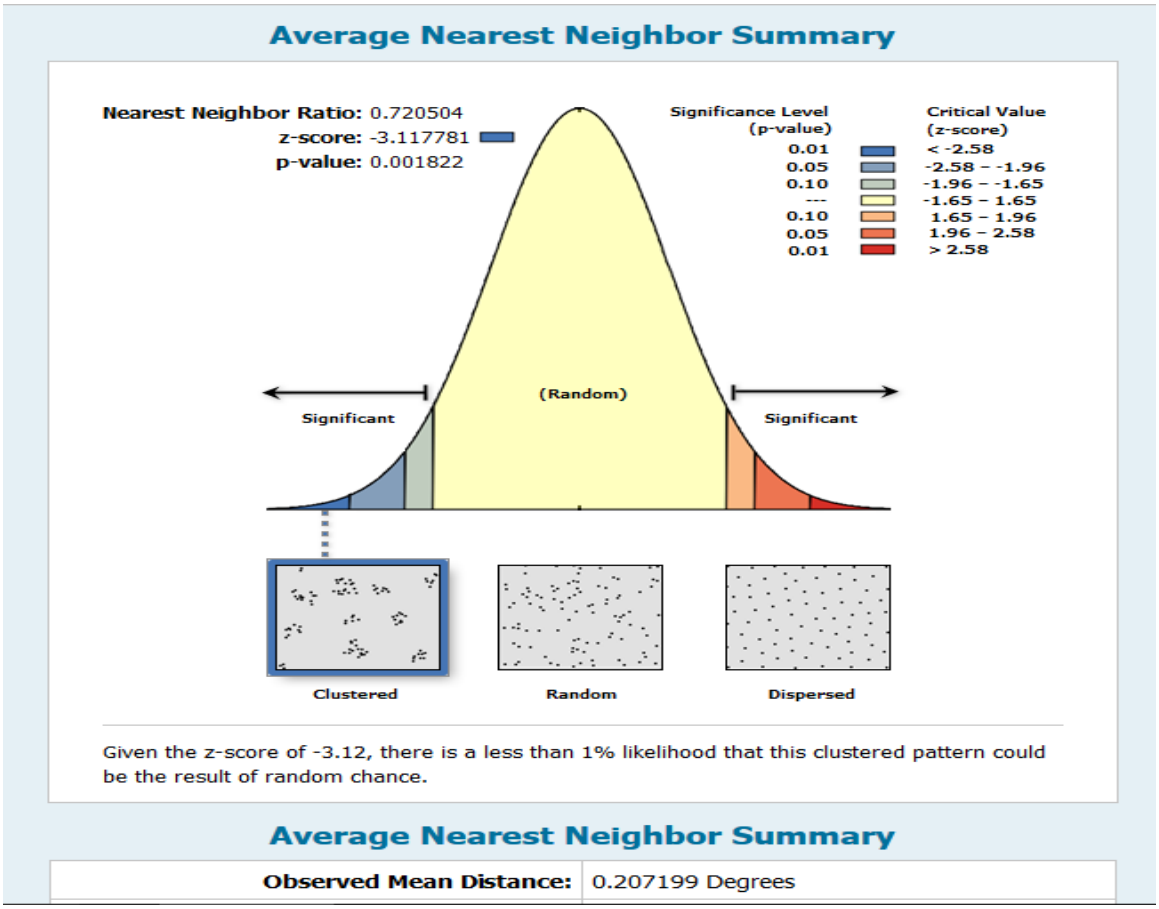
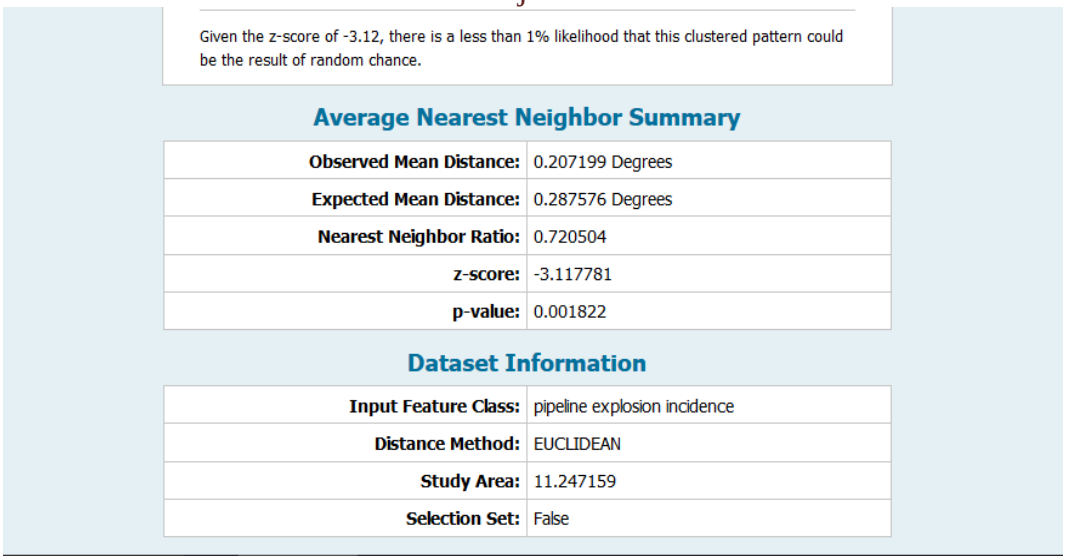


Figure 7: Spatial distribution of pipeline explosion in Nigeria from 1998-2016





Given the z-score of -3.12, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Average Nearest Neighbor Summary

Observed Mean Distance:	0.207199 Degrees
Expected Mean Distance:	0.287576 Degrees
Nearest Neighbor Ratio:	0.720504
z-score:	-3.117781
p-value:	0.001822

Dataset Information

Input Feature Class:	pipeline explosion incidence
Distance Method:	EUCLIDEAN
Study Area:	11.247159
Selection Set:	False

Figure 8: The Average distance Analysis

From the average distance neighborhood analysis of pipeline explosion incidence, it was observed that the incidence is clustered around southern Nigeria as evident from all the maps earlier displayed.

III. MITIGATING AGAINST PIPELINE EXPLOSIONS

Mitigation is the act of mitigating, or reducing the effect or intensity of an unpleasant situation, such as wrath, pain, grief, or extreme circumstances (dictionary.com). Better (Powerful and Sophisticated) tracking system on both human and pipelines conveying the explosive product, enhanced communication and transport infrastructure, as well as the assessment of the existing laid down regulations, and their strict enforcement around all critical infrastructures in reducing pipeline explosions in Nigeria. (Omodanisi et al, 2015). Another measure is the extensive installation of programmed shutoff valves, which can quickly stop the flow of gas or oil in an emergency condition that may initiate pipeline explosions. (Klein, 2009).

Limitations

This research work is limited to the availability of data as regards the records of pipeline explosions.

CONCLUSION

It is observed that from 1998 - 2016 pipeline explosions have only occurred and clustered around the southern part of Nigeria although pipelines also run through the Northern Nigeria with multiple cases recorded in the year 2000 and 2016. The year 2000 case could be attributed to Niger Delta militants seeking for attention from the Government which led to the creation of the Niger Delta Development Commission (N.D.D.C) by General Olusegun Obasanjo. More so, the high rate of occurrence in the year 2016 does not correspond to the low death rate whose cause could be attributed to sabotage (a deliberate act) by the Niger delta militant. Over the years there have different causes of pipeline explosions from Pipeline Vandalism to the activities of the Niger Delta Avengers to accidents and leakages all in Southern Nigeria. Hence Southern Nigeria is vulnerable and states where pipeline explosion has occurred once in this region are more vulnerable while the states where the explosion has occurred more than a time are most vulnerable to the future disaster of pipeline explosion. Pipeline explosions in Akwaibom and Rivers state did not result in any death though there were explosions recorded at a time each from the data obtained . As a result of the analysis of available data of Pipeline explosions in Nigeria “At least Three thousand five hundred and sixty four” (3564) people have died from 1998 till date and several others injured. The study in conclusion predicted a high chance of more occurrences of pipeline explosions in the study area if proactive mitigation measures are not taken toward reducing the disaster, hazards and vulnerability of the populace.

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