An Examination of Drill Rig NOx Emission

P. N. Onwuachi-Iheagwara

***Abstract**: This article creates awareness of greenhouse gases (GHG). The greenhouse gases play a significant role in climate change. The GHG includes NOx which is N2O, NO, and NO2. NOx can be produced from several human activities, including agricultural practices and drill rigs engine activities. However, drill rig emissions have received limited attention in Nigeria compared to agricultural emissions. This article addresses this research gap by examining the production of NOx emissions from drill rigs in Nigeria and its contributing effects. It also discusses the effects of climate change, which include increases in temperature, rainfall, rising sea levels, and the incidence of flooding. Storm aberrations, shortages of usable land, and potable water accompany this. The study adopts a methodology based on the correlation established by Russell (2006) to derive formation emission factors for onshore, offshore, and deep offshore Nigerian wells. The formation emission factors are based on the number of wells drilled in these locations from 2002 to 2004 and the average depth of wells in these locations. The analysis reveals that while NOx levels in Nigeria are currently low, they exhibit a constant upward trend. This observation is significant for a country heavily reliant on the petroleum industry for foreign exchange earnings and economic stability. Furthermore, considering Nigeria's vulnerability to the impacts of climate change and associated hazards, understanding the effect of drill rig NOx emissions and its production becomes crucial. By shedding light on this overlooked aspect, this research contributes to a more comprehensive understanding of the environmental implications and sustainable practices in Nigeria's petroleum sector.*

***Keywords:** Climate change, Drill Rig Emission, Nitrous oxides, Nitrogen pollution, NOx emission in Nigeria.*

I. INTRODUCTION

The planet is getting hotter; the effects of climate change are inescapable. According to [1], there is a 0.7ºC rise in average global temperature. The Intergovernmental Panel on Climate Change (IPCC, 2007) Assessment Report Four (AR4) [2] recognize a warmer future climate. According to the IPCC 2007 report, the change would involve increase episodes of extreme weather, intense, longer-lasting heat waves droughts, and floods. The rates of change would be significantly different in various parts of the world. This phenomenon is associated with the levels of carbon dioxide, nitrogen, and methane in our planet. The culprit gases (carbon dioxide, nitrogen, methane, hydro fluorocarbon, sulfur hexafluoride, and water vapor) are known as greenhouse gases. This in an allegory to greenhouses that trap air inside confined spaces. Greenhouse gases trap heat within the Earth's atmosphere thus; the planet behaves like a large greenhouse. To describe the destructive nature of greenhouse gases the GWP was constructed. The "global warming potential ", (GWP) is the destructive nature of 1 (one) molecule of a greenhouse gas compared with the destructive nature of 1 (one) molecule of carbon dioxide. The GWP for carbon dioxide, nitrous oxide, and methane, and sulfur, and hexafluoride are 1, 298, 25, and 22,800 respectively. For hydro fluorocarbons, GWP can range from 1,430 to 14,800.

Carbon and nitrogen are essential nutrients for life. They are cycled through the biosphere in various organic and inorganic forms by several processes. Carbon dioxide is emitted into the atmosphere when fossil fuels are burned. It is cycled by the carbon cycle. Nitrogen is cycled predominantly by nitrogen fixation, mineralization, nitrification, immobilization, and denitrification processes in the nitrogen cycle. Unfortunately, as noted by [3] disturbances to the global nitrogen cycle receive less attention than disturbances to the carbon cycle; although the nitrogen cycle is more out of balance than the carbon cycle. While disturbance to the global nitrogen cycle is not treated as aggressively as the carbon cycle; its implications are more profound.

As stated in the study by the European commission, in a 2013 report; on a mass basis, nitrous oxide has GWP that is approximately 300 times more destructive than carbon dioxide; [3]. To tackle anthropogenic climate change aggressively; more robust methods must be initiated to address the nitrogen and carbon problems. This includes for example, agricultural, industrial and commercial activities such as the Haber-Bosch process. Processes which remove un-reactive nitrogen from the atmosphere, increase the flow of reactive nitrogen into global nitrogen cycles and impact the planet adversely as nitrogen pollution. Such activities contribute to global warming, acid rain, and eutrophication [4]. Industrial and agricultural practices such as the burning of fossil fuel and the indiscriminate use of fertilizer are implicated in nitrogen pollution. [5]. Seventy-eight percent of the world's atmosphere is composed of "un-reactive" nitrogen. The industrial Haber-Bosch process, which captures nitrogen and is used to make chemicals, fertilizers, creates a problem as most of the reactive nitrogen leaks back into the environment. Excess nitrogen leads to eutrophication and biodiversity loss.

An easily overlooked source is NOx emission from drill rigs engines used in the oil and gas sector. Their contribution to total NOx could be substantial in petroleum-based economies.

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Table- I: Number of well-drilled 2010-2018 by terrain

Year	Onshore	Offshore	Deep offshore	Total
2010	30	62	15	107
2011	44	64	12	120
2012	74	65	15	154
2013	59	61	30	150
2014	49	50	43	142
2015	41	27	45	113
2016	39	15	23	77
2017	37	20	15	72
2018	44	23	20	87

Data from the "DPR, Nigerian oil and gas industry annual report", And the "Nigerian oil and gas industry annual report'.

https://www.dpr.gov.ng/wp-content/uploads/2020/01/2018-NOGIAR.pdf,

The implication of NOx emission on air quality was studied by [6]. In 2015, [7] considered the best approaches for its calculation and deliberated on three methodologies that can be adapted to the calculation of drill rig NOx emission. [8], presented inclusive sets of regulated and non-regulated emission factors for the main propulsion engine, auxiliary engine, and auxiliary boiler on tanker operating at sea.

This article aims to increase the knowledge of drill rigs' emissions in Nigeria. It also calculates the generic NOx emission formation factor for onshore, offshore, and deep offshore wells in Nigeria. Finally, the paper aims to understand how NOx moves through time and be able to predict the future.

Nigeria is notorious for natural gas flares. Gas venting and flaring by refineries are a key driver of methane and CO2 emission in Nigeria. Re-injection of associated natural gas during production is often not done; the associated gas is flared [9].

She has the 10th largest oil reserve in the world; as the global demands for oil in the 20th and 21st centuries grew; so had her flares increased Fuel for transportation and most industries' needs are derived from crude oil. Modern societies depend largely on fossil fuels for energy and power. Nigeria is a net exporter of crude oil; over 90 percent of her export and 35 percent of total GDP comes from the oil industry. She is also in the natural gas business. In all these, drilling is the first step. Exploration for crude oil or natural gas involves drilling "exploratory, appraisal, and development wells". According to the department of petroleum resources, DPR, from 2010 to 2022 several oil and gas wells were drilled in Nigeria and her territorial waters (Table 1). According to [10], climate change in Nigeria would involve increases in temperature, rainfall. Rising sea levels should also be expected in the twenty-first century (Figure 1). The greenhouse gas emission in Nigeria had steadily increased in 2017 to 293,790.01; and in 2018 and 2019 to 299,620.00 and 308,179, respectively. This represents a 1.47%, 1.98% and 2.86% increment from the previous year respectively. The total greenhouse gas emissions in KT of CO2 equivalent are composed of CO2 totals excluding short-cycle biomass burning. The recorded high occurred in 2021 (127029.25KT) and the lowest was in 1960 (3406.64KT).

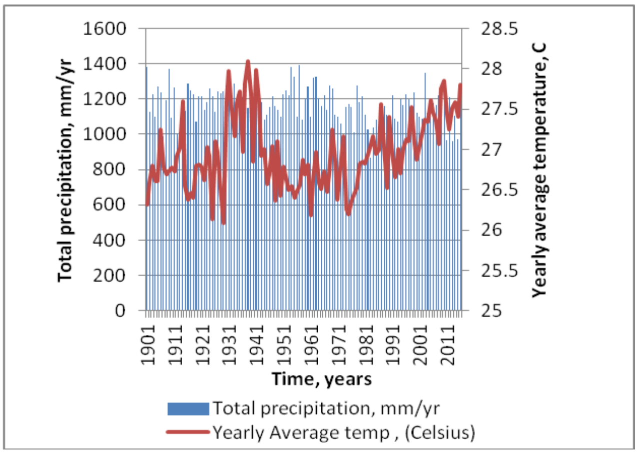

Figure 1:The change in total rainfall and average temperature with time. Data from http://www.globalcarbonproject.org

In 2016, Nigeria was the third biggest emitter of greenhouse gases in Africa after South Africa and Zambia and in 2019; she became the second biggest emitter of greenhouse gases after South Africa.

As Nigeria's GHG continues to rise, it is expected to influence the climate negatively. It is expected to be accompanied by storms aberrations, shortages of usable land, and potable water, with resultant negative secondary impacts (sickness, hunger, and joblessness) if fundamental issues are inadequately addressed.

Harsh living conditions, increasing population, rising nitrous oxide levels, and high oil/ gas production occasioned by climate change may fuel conflicts, and invigorate existing local and regional conflicts with devastating consequences for West Africa.

Despite, the threats extreme events pose to population, health, and property, not many quantitative studies are available. Many Researchers have not studied the frequencies and magnitude of extremities in Nigeria, or the implications of rising nitrous oxide on the atmosphere. The report on the atmospheric impact (changing temperature and rainfall) of oil exploitation in Nigeria is largely unexplored.

The incessant gas flares also contributes to the raise in outdoor temperature, [11]. These findings are critical in the design of national policies that strike a defensible balance between economic growth and the sustainability of the environment for future generations. This article focuses on emissions induce by oil and fuel related activities such as drill rig NOx, although several other GHG exists. NOx is a common designation of nitrogen oxides N2O, NO and NO2.

The primary emitting sources are transportation sources, on-road and off-road motor vehicles and engines, rail and fossil-fuelled electric power plants. NOx is also produced during drilling by the drill rigs' engine. There are two principal mechanisms of NOx formation in steam generation: thermal NOx and fuel NOx. Thermal NOx are NOx formed through high temperature oxidation of the nitrogen found in the combustion air. The formation rate is a function of temperature as well as residence time at temperature.

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Industrial activities (including drilling) largely contribute to nitrous oxide emissions. Models of drilling-induced nitrous oxide emissions are necessary for mono-economies based on hydrocarbon exploitation. According to the AR4's definition, and stipulation, "climate change" involves changes in the state of the climate. Changes must be identified by statistical examinations and persist for an extended period typically decades or longer. In this research, the researcher hypothesized that a positive relationship exists between climatic change in Nigeria and her oil-based mono-economy. Nigeria by her policies had necessitated continuous, constant search and drilling of crude oil and natural gas beneath her soil. This according to the Author has negatively impacted the climate. The climate is hotter with violent extreme torrential rains.

To the best of the author's knowledge, there is no previous study that examined the link between NOx emissions, hydrocarbon drilling and exploitation activities, and economic growth in Nigeria. This study analyses the climatic consequences of over-reliance on crude oil production as the primary source of national income. It evaluates existing climatic information and measurements on NOx visa-a-via drill rigs' NOx production levels. NOx emissions are less likely to spread beyond borders, unlike CO2, [12] and the stark absence of country-specific literature on nitrogen pollution necessitated this study.

II. MATERIALS AND METHODS

A. Materials

Data used in this study are ascribed in several websites and are available for free download by the public. No experimental investigations were done. Public, freely available records were collected from their respective custodians via internet downloads. The data downloaded includes the yearly (1901-2016) temperature and precipitation records of Nigeria from [13] and Nigeria's carbon and nitrogen data from [17] and [14] respectively, and Nigeria's crude oil production histories as a member of the organization of petroleum exporting countries, OPEC) [15]. These data were plotted and analyzed using statistical tools

B. Time-series analysis

An investigation by time-series analyses was done on a formatted MS Excel spreadsheet. The aim is to understand the relationship of NOx emission with time and then be able to predict or extrapolate into the future. The plots were deseasonalized; seasonal irregularity and trend components extracted, intercept and slope determined by simple regression analysis. The time-series analyses of data established the relationships between NOx levels and time. The significance was confirmed by the p-value. The drill rigs NOx emission were based on the Russell's (2006) [16] methodology. Finally from historical data, prediction/ forecast of the future NOx production was developed.

C. Model design for drill rigs engine's emissions factor

An emission factor is a representative value that relates the quantity of a pollutant released to the atmosphere to an activity. The activity is associated with the release.

The Russell's (2006) [16] methodology for drill rigs engine's emissions factor estimation was used. James Russell determined the emission factor in Jonah-Pinedale, USA. In his work, he used data of 218 wells drilled by 10 drilling companies. The wells were drilled in 2002 - 2004. He observed that emission factors were dependent on the depth of wells, the composition of the formations, duration, and characteristics of the rig's engines. He made two key assumptions; first, completion dates and cessation dates are the same and drilling rigs' capacities were determined solely by the depths of wells. He calculated the average wells' depths and duration of drilling (in days) as 11,896 ft. and 80.6 days, respectively. He later created a formation-specific emission factor, which as noted in Russell (2006) [16] can be scaled to represent drilling in other locations by (1).

Where the formation emission factor is calculated as:

$$EFa=[EFj*(Da/Dj)*(Ta/Tj)] \qquad (1)$$

Where:

EFj = Jonah-Pinedale emission factor, 13.5ton

EFa = Location, a, emission factor, 13.5ton

Da=Average well depth in location, "a"; ft.

Ta=Average duration of drilling in location, "a"; days

Dj =Average well depth (Jonah-Pinedale formation)

Tj=Average duration of drilling (Jonah-Pinedale)

In this article the variable, "average well depth", was determined based on terrain and the average depth was considered to be the arithmetic mean of the shallowest and deepest well of that terrain type divided by 2, as expressed in (2); where well depth is:

$$Di=(Dmin + Dmax)/2 \qquad (2)$$

Where:

Di = Average depth of wells

The suffix, i, denotes the type of well. This is based on terrain as land, offshore and deep offshore.

And, Dmin, Dmax are the minimum and maximum depths for the respective wells types, i

To determine the drill rig NOx emission (3) is used.

$$AmtNOx=EF*N \qquad (3)$$

Where:

AmtNOx =the amount of NOx gas emitted

EF =Emission factor of the formation

N=Number of wells drilled.

To quantify the total GWP attributed to drill rig activities:

$$Total\ GWP=AmtNOx *GWP\ 100 \qquad (4)$$

Where:

GWP 100 =100 year 'global warming potential value

D. Assumptions and limitations in model

The following are the limitations associated with the method and model used in this investigation:

- The values for the well-depths were averages and not determined by actual calculation.

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- The average drill times were arbitrarily set and not determined experimentally.
- Nigeria produces sweet crudes. Sweet crudes are crude oil with little or no sulfur content. Hence, no correction was done for sulfur and its oxides.
- Furthermore, it was assumed that the drill-rigs' engines were operated solely on Nigerian fuel.

E. Error/uncertainty associated with the method

Drill rig NOx emissions were calculated using Russell's (2006) correlation. Russell (2006) derived his correlation from the Jonah-Pinedale formation, USA drill data. The Jonah-Pinedale formation varies from the Niger delta formation; thus, additional conversion factors may be necessary for more exact solutions. The solutions proffered in this article paper for drill rig NOx emissions are generic and not specific solutions for onshore, offshore, and deep offshore wells in Nigeria.

III. RESULT AND DISCUSSION

The following were observed from the analysis:

1) The differences from 2021 OWID forecast and 2023 OWID observed values are minuscule. Thus 2023 data were used in forecasting (Appendix; figure 3).
2) The 2023 OWID observed a steady increment in NOx gas emission; this incidentally corresponds with raising population, increasing precipitation and temperature. All physical signs of climate change.
3) The analysis of data reveals a visible cyclic nature when plots of NOx emission data are plotted; without any prominent dip. (Appendix; figure 3).
4) The trend component is observed to be increasing in an overall direction. (Appendix; figure 3).

IV. CONCLUSION

The contributory effect of drilling-induced NOx to the total NOx produced in Nigeria was studied in this article.

It specifies the effect attributable to the drill rig engine emission in Nigeria. NOx level traditionally has increased with production. According to approximately, 5,284 wells have been drilled in the prolific Niger Delta region with currently, 1,481 wells in operation in the highly productive South-south coastal region of the Niger Delta Basin. Incidentally, this area is most prone to climate variation, flooding, and erratic meteorological conditions, and patterns.

The formation emission factors calculated in this investigation are first approximations. The adaption of Russell's model offers a rudimentary method to quantify actual NOx productions by activities associated with drill rig operations. With adjustment for well re-entry operations such as fishing operations, additional drilling time due to" time-down", the calculation of a more accurate formation-specific emission factor is possible.

The role of NOx emissions in economic growth remains a considerably less researched subject than CO2. From 1956 to the present, Nigeria's crude oil production grew from a few barrels to over 2 million barrels a day, NOx productions also grew and, temperatures increased. This may be the consequence of incessant drilling. Nigeria's contribution to global NOx emission is low.

However, it is never too early to sound the alarm bell on the consequences of unremitting, relentless petroleum exploitation.

In conclusion, the importance of the checkmating the effect of climate change cannot be over emphasized. Nigeria is regarded as one of the ten most climate-vulnerable countries globally.

Recommendations for the alleviation of the effects of climate change include:

1) Green house gas emission in Nigeria has progressively increased from 2019. In 2021, methane emission increased by over 3.7%, this was due to the increasing demand for natural gas. This is probably due to the full return of economic activates after the pandemic imposed lockdown. The use of renewable solar energy should be rigidly encouraged.
2) The largest contributor of carbon dioxide emission from fossil fuels remains the transportation sector. Nigerian should be encouraged to embrace the use of buses instead of cars. As buses have greater carrying capacity, this would obviously translate to a win for the environment.
3) Gas flaring and venting should be actively discouraged

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DECLARATION

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Authors Contributions	I am only the sole author of the article.

REFERENCES

1. Meehl, G.A., Stocker T, Collins W.D, Friedlingstein, P., Gaye, A, Gregory, J.M., Kitoh, A., Knutti, R, Murphy J.M., Noda, A.; Raper S.C.B., Watterson, I.G., Weaver, A.J., Zhao, Zong-Ci; (2007) Global Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge
2. IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (Eds.)]. IPCC, Geneva, Switzerland, 104 pp

3. European Commission, 2013; Science for Environment Policy Nitrogen Pollution and the European Environment Implications for Air Quality Policy: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM%3A2013%3A0918%3AFIN%3AEN%3APDF
4. Rockström, J., Steffen, W., Noone, K.(2009). A safe operating space for humanity. Nature 461, 472–475 (2009). https://doi.org/10.1038/461472a [CrossRef]
5. About greenhouse gas, https://www.icos-cp.eu/science-and-impact/climate-change/ghgs Date accessed: 17 April 2021
6. David T. Allen (2016) Emissions from oil and gas operations in the United States and their air quality implications, Journal of the Air & Waste Management Association, 66:6, 549-575, DOI: 10.1080/10962247.2016.1171263 [CrossRef]
7. Stuver Susan, Jesse R. Alonzo, Richard C. Haut, David B. Burnett, and Forrest H. Cobb(2015); A Comparison of Air Emission Estimation Methods for Drilling Rig Emissions, *Environment, and Natural Resources Research*; Vol. 5, No. 2; 2015 ISSN 1927-0488 E-ISSN 1927-0496, doi:10.5539/enrr.v5n2p158, URL: http://dx.doi.org/10.5539/enrr.v5n2p15 [CrossRef]
8. A g r a w a l H, W W e l c h, J. W M i l l e r, and D R. Coccker (2008), Emission Measurements from a Crude Oil Tanker at Sea, Environ. Sci. Technol. 2008, 42, 7098–7103 [CrossRef]
9. Idigbe Koso I & Onwuachi-Iheagwara P.N. (2014). “Driving sustainable growth through natural gas assets in Nigeria’, Journal of Emerging Trends in Engineering and Applied Sciences, UK, Vol. 5(2) pp. 145-147. Scholar link Research Institute Journals, ISSN: 2141-7016, UK
10. Aaron Sayne (2011), Special report: Climate Change Adaptation and Conflict in Nigeria, United States Institute of peace, https://www.usip.org/sites/default/files/Climate_Change_Nigeria.pdf
11. Idigbe Koso I, P N. Onwuachi-Iheagwara (2013), “Growing Local Content in the Energy Industry in Nigeria: A Sustainable Development Opportunity”. International Journal of Research and Advancement in Engineering Science, Vol. 3(1).pp. 124-131 ISSN: 2276 – 8149
12. Azad Haider, Muhammad Iftikhar ul Husnain, Wimal Rankaduwa, and Farzana Shaheen, Nexus between Nitrous Oxide Emissions and Agricultural Land Use in Agrarian Economy: An ARDL Bounds Testing Approach, *Sustainability* 2021, 13, 2008. https://doi.org/10.3390/su13052808 [CrossRef]
13. Climate Change Knowledge Download Data World Bank Climate Change Knowledge Portal, https://climateknowledgeportal.worldbank.org/download-data Date accessed: 17 April 2021
14. Our world in data, Date accessed: 20 April 2021. https://ourworldindata.org/antibiotics-livestock
15. jmOPEC, Date accessed: 20 April 2021: https://www.opec.org/opec_web/en/6363.htm
16. Russell J, Alison P, and Greg Y ;(2006), An Emission Inventory of Non-point Oil &Gas Emissions Sources in Western Region, ENVIRON International Corporation. https://www3.epa.gov/ttnchie1/conference/ei15/session12/russell.pdf
17. NNPC, Date accessed: 15 April 2021. https://cms1977.nnpcgroup.com/uploads/NNPC_CONSOLIDATED_AND_SEPARATE_FINANCIAL_STATEMENTS_AS_AT_31_ST_DECEMBER_2022_0de3c4c7e0.pdf

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APPENDIX

Table- II: Time series analysis of 2023 OWID NOx emission data

			Yt	Moving average	Centre moving average	seasonal & irregular components					
t periods	Sexennial	Year	Historical NOx Emission (MtCOe)	Meaning Average [MA(6)]	CMA(6)	StIt [seasonal & irregular components]	St [seasonal component]	DE seasonalized	Tt [trend component]	Prediction	Forecast
1.	1	1990	21.02				0.995177	21.12	21.30	21.19	
2.	2	1991	21.47				0.983696	21.83	21.89	21.53	
3.	3	1992	21.93				1.010404	21.70	22.48	22.71	
4.	4	1993	22.53	22.16	22.61	1.00	1.01765	22.14	23.07	23.48	
5.	5	1994	22.92	23.06	23.50	0.98	1.012145	22.64	23.66	23.95	
6.	6	1995	23.11	23.94	24.50	0.94	0.973635	23.74	24.25	23.61	
7.	1	1996	26.42	25.07	25.57	1.03	0.995177	26.55	24.84	24.72	
8.	2	1997	26.71	26.07	26.60	1.00	0.983696	27.15	25.43	25.02	
9.	3	1998	28.71	27.13	27.44	1.05	1.010404	28.41	26.02	26.30	
10.	4	1999	28.56	27.75	27.81	1.03	1.01765	28.06	26.62	27.09	
11.	5	2000	29.25	27.88	28.01	1.04	1.012145	28.90	27.21	27.54	
12.	6	2001	26.87	28.15	28.12	0.96	0.973635	27.60	27.80	27.06	
13.	1	2002	27.15	28.09	28.27	0.96	0.995177	27.28	28.39	28.25	
14.	2	2003	28.37	28.44	28.54	0.99	0.983696	28.84	28.98	28.51	
15.	3	2004	28.35	28.63	28.88	0.98	1.010404	28.06	29.57	29.88	
16.	4	2005	30.66	29.13	29.42	1.04	1.01765	30.13	30.16	30.69	
17.	5	2006	30.4	29.70	29.83	1.02	1.012145	30.04	30.75	31.13	
18.	6	2007	29.85	29.96	30.29	0.99	0.973635	30.66	31.34	30.52	

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19.	1	2008	30.59	30.62	30.84	0.99	0.995177	30.74	31.93	31.78	
20.	2	2009	29.92	31.07	31.40	0.95	0.983696	30.42	32.52	31.99	
21.	3	2010	32.32	31.74	32.21	1.00	1.010404	31.99	33.12	33.46	
22.	4	2011	33.31	32.69	33.14	1.01	1.01765	32.73	33.71	34.30	
23.	5	2012	34.45	33.59	34.11	1.01	1.012145	34.04	34.30	34.71	
24.	6	2013	35.52	34.62	35.15	1.01	0.973635	36.48	34.89	33.97	
25.	1	2014	36.02	35.68	36.23	0.99	0.995177	36.19	35.48	35.31	
26.	2	2015	36.11	36.77	37.24	0.97	0.983696	36.71	36.07	35.48	
27.	3	2016	38.69	37.71	38.11	1.02	1.010404	38.29	36.66	37.04	
28.	4	2017	39.81	38.51			1.01765	39.12	37.25	37.91	
29.	5	2018	40.09				1.012145	39.61	37.84	38.30	
30.	6	2019	40.36				0.973635	41.45	38.43	37.42	
31.	1	2020					0.995177		39.03		38.83741
32.	2	2021					0.983696		39.62		38.97069

Regression Statistics	
Multiple R	0.973869
R Square	0.94842
Adjusted R Square	0.946578
Standard Error	1.319276
Observations	30

Table-IV: ANOVA

	df	SS	MS	F	Significance F
Regression	1	896.0834761	896.0835	514.8455	1.44526E-19
Residual	28	48.73372129	1.74049		
Total	29	944.8171974			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	20.30012749	0.494033115	41.09	1.42308E-26	19.29	21.31	19.29	21.31
t periods	0.631428797	0.027828252	22.69	1.44526E-19	0.57	0.69	0.57	0.69