THE EFFECT OF PETROLEUM PRODUCT DELIVERY SYSTEM ON THE AVAILABILITY AND EFFICIENCY OF PETROLEUM PRODUCTS DOWNSTREAM DISTRIBUTION IN NIGERIA

MARYAM MUSA SADA

National Institute for Legislative and Democratic Studies

ABSTRACT

This study evaluated the impact of product delivery system on availability of petroleum product in Nigeria. This study covered the relevant stakeholders which included oil workers and downstream agencies within the Federal Capital Territory (FCT). Primary data was adopted using a questionnaire distributed to 374 participants. In achieving this, this study used the discrete choice model which is the multinomial logit model. The results from the analysis of the primary data reveal that 224 (59.9%) of the participants agreed that ruptured pipes affected the time and duration of products getting to consumers while 150 (40.1%) objected to this. 290 respondents (77.5%) believe that there are not enough pipeline networks in Nigeria. Also, 365 respondents (97.6%) also agreed that functioning refineries will positively affect the transportation of petroleum products through pipeline transport mode. The study recommended that the Nigerian Government should revalidate and intensify policy and project to improve and strengthen the petroleum pipeline transportation system, enhancing product distribution and ease of doing business; Focus on upgrading pipeline technology to meet international standards and global best practices, ensuring timely delivery and reducing time and resource wastage; construct more petroleum pipeline networks to link terminals in commercial cities and factory locations, reducing delivery inefficiency and production costs; implementing policy measures to combat oil theft, pipeline vandalism, and ruptures, minimizing production costs and enabling the removal of product consumption and subsidies.

1.0 INTRODUCTION

1.1 Background of the study

Nigeria was predominantly an agrarian society before the discovery of oil in Oloibiri in the present Bayelsa State in 1956. During the pre-1956 era; roads, rail, and water were the major sources of movement of goods to the point of final consumers. This convention changed with the discovery of oil in commercial quantity in Nigeria (Paul, 2014). Nigeria exported her first crude oil in February 1958 from the Oloibiri field to Bonny River in Port Harcourt using the first pipeline system created in the country by Royal Dutch Shell. This was the birth of the pipeline transport mode in Nigeria's freight history.

For safe and efficient transportation of petroleum products, the pipeline transportation system is a preferred option for long-distance transportation of liquid and gas through a network of pipes close to the point of final consumption. One of the major requirements of transporting these products is safety, which the pipeline transportation mode provides (Arosanyin, 2005).

Technological advancement in Information Communications Technology (ICT) has helped to reduce the cost of pipeline maintenance as technology can easily help detect issues with pipelines and correct infractions or errors affecting efficiency.

The downstream petroleum sector deals with refining of crude oil and purifying of natural gas and the marketing and distribution of finished products to final consumers. The sector processes consumer products such as petrol (PMS), kerosene (DPK), jet fuel, diesel (AGO), heating oil, fuel oils, lubricants, waxes, asphalt, natural gas and liquefied petroleum gas (LPG) as well as hundreds of other petrochemicals (Diso, 2012). The distribution channel is always important for final consumption and pipeline has been identified to be playing key role in the distribution of petroleum products. If pipeline networks are closer to filling stations or other outlets that distribute petrochemical products, it will reduce to the barest minimum distance covered by trucks and rail for products to get to final consumers.

This study attempts to examine The effect of the petroleum product delivery system on the availability of petroleum products in Nigeria. This becomes imperative, given the development in the oil sector which has not been able to cope with the volume of products being transported.

1.2 Statement of problem

Over the years, the petroleum industry in Nigeria, which is the backbone of the country's economy, has been facing several challenges, such as inadequate transportation and energy infrastructure, lack of policies that augment private sector development and misappropriation of funds (Elwerfelli & Benhin, 2018). These challenges affect the advancement of the positive impact expected of the industry on the growth of the economy.

One of the critical industry problems is the downstream product distribution which is currently chaotic and ineffective. The distribution process currently is largely by road transportation, technically called "bridging". The established depots serviced by pipelines have been allowed to fall apart and grounded to near non-existence.

This provokes the tenet of this study to the effect of petroleum product delivery system on the availability of petroleum products in Nigeria.

1.3 Objectives of the Study

   i.   Examine the current delivery system and how it impacts the flow of petroleum products in Nigeria.
   ii. Examine how pipeline technology impacts the efficiency level of downstream distribution of petroleum products.

1.4 Significance

The study will help have a good understanding of the relationship that exists between the state of pipeline transportation and economic growth in Nigeria, how pipeline technology impacts efficiency level and translates to increased revenue, analysing how the current inefficiencies from the use of road mode has various negative effects on the Nigerian economy. As stated by Ambituuni, Werner and Amezaga (2015), 79% of road accidents were caused by human

factors, mainly dangerous driving. More than 70% of the accidents resulted in loss of control leading to spills, fires and explosions. 81% of the accidents resulted in either injuries, fatalities or both. In Nigeria, 98% of petroleum products that include fuel components like premium motor spirit, Dual Purpose Kerosene and automotive gas oil's lifting from supply sources to all parts of the country is done by road. This makes the federal roads highly overburdened and overstretched. The above realities have a negative impact on the distribution of petroleum products across the nation.

This research proffered solutions that will assist in the reduction of the use of roads in the transportation of petroleum products which is believed that will help Nigerian roads to last longer thereby creating not only efficiency in petroleum products supply but also in the area of price. Also, more advanced mechanization of the process with little to no hindrance and decreasing the amount of petroleum product wastage. This is because currently, the most used mode of transportation is doing a disservice to the efficiency and the Nigerian economy.

2.0 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Conceptual Review

The Department of Petroleum Resources (DPR) (Chen, 2021) defines downstream as those activities which take place between the fields transfer of crude oil and loading at the export terminal, as well as, the use of the oil by the end-users. This encompasses the ocean transportation of crude oil, supply and trading, refining, distribution and marketing of the oil products.

Good and Jebbin (2015) further define transportation as the port of physical distribution activity that pays attention to the successful movement of goods to their various consumers. Furthermore, Bos (2001) defines transportation as a public utility that aids in the supply of essential goods and services, and in this case, essential means these good and services cannot be cut off without becoming a danger to the economy.

Also, pipeline is a mode of transportation that is much specialised as it satisfies the physical components of any transport, such as, terminal, carriage unit and propulsion unit. Chukwujekwu, Chibuzo and Ekene (2014), define pipeline system as a means of transportation that deals with very delicate products (crude oil, chemicals, natural gas) which require special handling to avoid disastrous situations. While pipeline transportation is a method of transportation which involves movement of solid, liquid or gaseous products over long distances through pipelines.

Furthermore, petroleum is a versatile and powerful source of energy; it fuels the machines of our industrialised society. Petroleum has been the primary driver of the rapid technological and economic growth human civilisation has experienced over the past century. Even more so, many country's economy, including Nigeria, are largely dependent on their petroleum resources. Rahman (2004) described oil and gas as, "the engine of the world economy".

When comparing one period of time to another, economic growth is a rise in the production of economic commodities and services. It can be calculated in nominal or real (inflation-adjusted)

terms. Although other metrics are also employed, gross national product (GNP) or gross domestic product (GDP) are the most common ways to quantify overall economic growth.

2.2 Empirical Review

Arosanyin (2005) analysed the role the pipeline transport mode has played in Nigeria since inception using secondary data to analyse the trends of various variables pertaining to pipeline transportation mode. His research showed that the bulk of Nigerian exports is oil and pipeline as a mode has played a significant role in freighting these export goods to the seaports. Also, Nwokedi and Nnadi (2018) investigated the theoretical and empirical probabilities oil pipeline infrastructure failure modes in Nigeria. They used time series data spanning 10 years that they got from the Nigerian National Petroleum Corporation using a historical research design technique. They used probability analysis, and they discovered that the most likely cause of pipeline infrastructure failure and risk of occurrence is vandalism. Furthermore, Mengqi (2015) investigated the current situation of pipelines of oil and gas storage and transportation in China. He analyzed the significance of strengthening the construction of oil and gas storage and transportation pipeline to Chinese petroleum industry, and then points out the problems and corresponding measures in the oil and gas storage and transportation pipeline construction. In Addition, Nwokedi et al. (2019) examined the economic influence of oil pipeline breakages on economy of Nigeria. Time series data was obtained from the pipeline products marketing company (PPMC) and the Nigerian National Petroleum Corporation (NNPC) on the economic values of crude and refined oil and gas resources lost due to pipeline breakages and the GDP contribution of the oil and gas sector. They applied multiple regression and trend analysis and found that the economic cost of pipeline breakages had significant effect on the GDP contribution of the oil and gas sector. The trend analysis indicates that there is an increases trend in aggregate pipeline breakages inducing economic risks over the period. Also, Achebe et al. (2012) analysed oil pipeline failures in oil and gas industries in the Niger delta area of Nigeria. To ascertain the causes of these failures, they gathered information for the period between 1999 and 2010. Their findings revealed that the major causes of failure include: Ageing, Corrosion, Mechanical failures – welding defects, pressure surge problems, stress, wall thickness, etc. From the data got and results that were obtained. They also found that 42% of failures were mechanically induced, 18% by corrosion, third party activity contributed 24%, 10% through operational error and 6% by natural hazards. They recommended the use of reinforced thermoplastic pipe (RTP) as a good measure against pipeline failures in the Oil and Gas Industries in Nigeria.

From the reviewed empirical studies on the impact of pipeline transportation of petroleum products on the Nigerian economy and using various methodologies for their analyses, it was noticed that most of the studies either analysed petrol, gas or kerosene and its impact on the economy. Also, some studies discussed the problems of using other means of transportation for transporting petroleum products, however, they did not look at the importance of improving and extending the pipelines to various locations in such a way that there will be a reduction to overload and distance of trucks to get to the consumers. This study tends to review the impact of using pipeline transporting these products on Nigerian economy and concentrating on how to improve distribution in the Federal Capital Territory (FCT).

3.0 THEORETICAL FRAMEWORK

This study is based on the location theory of Thunen (1826) and later modified by Weber (1909), Hotelling (1929) and Lösch (1940). The original first proponent associated this theory with agricultural land use, while his followers accommodated the location of secondary industry into the theory. This is because the location of secondary industries depends on human behaviour and decision making, cultural and political factors as well as economic factors. This model assumes that decision makers are trying to maximize their advantage over competitors, that they want to make as much profit as possible, and that they will take into account, variable costs. In calculating efforts to maximize advantages, one of the key issues is the friction of distance. This refers to the increase in time and cost that usually comes with increasing distance. If a raw material has to be shipped hundreds of miles to a factory, rather than being manufactured right next door, the friction of distance becomes apparent.

This model is relevant to this study because the underlining set of assumptions to minimize the complexities of the real world are significant to Nigeria peculiar problems. The resources in Nigeria are located in region far from the Central Business Districts (CBDs) and the need to transport the resources to where they are mostly needed.

4.0 METHODOLOGY

The study used the survey and analytical research designs which are descriptive and quantitative in nature respectively. Survey research design is used to gather information directly from sample/ population while analytical research design focuses on causes and effects which involves primary data to answer the research questions stated and also test the relevant hypotheses of the study. The choice of this technique is to allow for objective representation of the population by the sample and to reduce error or bias that could arise from sample size. Primary data is collected based on the survey research which used questionnaire as instrument of data collection. The questionnaire is administered using Multi-stage random sampling techniques. Multi stage sampling technique is a random sampling technique which involves the application of random sampling more than once to select the participants for the study to respond to the questionnaire (Sedgwick, 2015).

The study is conducted in the Federal Capital Territory covering the relevant stakeholders which included oil workers and downstream agencies within the Federal Capital Territory (FCT).

The target population of interest in relation to the primary data comprise the total population of 2760 staff of Nigerian Pipeline and Storage Company; Pipeline and Products Marketing Company; Ministry of Petroleum Resources; and Department of Petroleum Resources.

The inclusion criterion was all oil workers employed more than six months ago (probationary period) at the agency and were available at the time of the study and willing to participate. The exclusion criterion was those who were employed less than six months ago, those not available such as those who were on leave and those who decided to exercise their right not to participate.

Israel (1992) sampling technique was used in this study. First of all, the precision and the confidence level are specified and then the sample size was calculated as follows: e (error margin) in this case is 0.02; level of significance is 95.5%; and z tabulated value is 2.005.

In the case of a finite population the following formula will be applicable:

$$n = \frac{z^2.p.q.N}{e^2(N-1)+z^2.p.q}$$ --(3.1)

From the equation;

N = 2760;

e = .02 (since the estimate should be within 2% of true value);

z = 2.005 (as per table of area under normal curve for the given confidence level of 95.5%).

Let us assume that p to be p = 0.02

$$n = \frac{(2.005)^2(0.02)(1-0.02)(2760)}{(0.02)^2(2760-1)+(2.005)^2(0.02)(1-0.2)}$$

$$n = \frac{977.3}{1.45} = 674.16394 \equiv 674$$

For a high degree of accuracy and adequacy in presentation of the sample, the stratified sampling method (proportional allocation) was adopted. Using this method, stratification of the oil workers is strictly based on their positions in the respective agency hierarchy: senior and lower levels oil workers respectively.

A structured self-administered questionnaire is used to collect data from the respondents. The questionnaire is modified from the work of Dean, Schachter, Vincent, and Barber (2000) medication error survey. The questionnaire is divided into two parts: Part 1 assessed the Demographic information of the respondents; Part II was made up of a Multidimensional instrument (eight subheadings). The questionnaire included a Binomial Scaling ranging from Yes (=1) and No (=0) to determine respondents' level of agreement on pipeline technology and the Nigerian economy. It was constructed based on the research questions and the objectives of the study.

The reliability of the instrument was ascertained using the internal consistency method. The researcher used the Cronbach's alpha (1951) correlation matrix to test the reliability of the instrument as ranked by the experts and it indicated an index of 0.81 or (81%).

The estimation techniques and procedures used are as follows; unit root test, co-integration test, Augmented Engle-Granger (AEG) co-integration test (Long-Run Test), Augmented Engle-Granger Error Correction Model (Short-Run Test), Co-integration is tested using Autoregressive Distributed Lag (ARDL) limits, Granger Causality Test .

Three stages of estimation evaluation process was used, they are; the economic a priori standard, First-order test statistical criteria and Second-order econometric criteria Test

5.0 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

5.1 The impact of the currently deployed pipeline technology on petroleum product movement in the downstream sector in Nigeria

This section presents the responses of the participants concerning the impact of the current deployed pipeline technology on petroleum product movement in the downstream sector in Nigeria. Table 4.2 presents the results of the analysis of the responses of the participants concerning the impact of the currently deployed pipeline technology on petroleum product movement in the downstream sector in Nigeria.

Table 4.1: the impact of the current deployed pipeline technology on petroleum product movement in the downstream sector in Nigeria (N=374)

Variables	No		Yes		Total	
	n	%	n	%	n	%
Is technology used in the operation of pipeline transportation in Nigeria	25	6.7	349	93.3	374	100
Do you think our current technology matches with international best standards	207	55.3	167	44.7	374	100
Does technology positively affect the distribution of petroleum products through pipelines	153	40.9	221	59.1	374	100
Are there any alternative method or technology that can be utilized to transport petroleum product through pipelines	167	44.7	207	55.3	374	100
Can the available pipelines transport enough petroleum products to meet current demand	309	82.6	65	17.4	374	100

Source: Researcher's fieldwork, 2022

As shown in Table 4.2, most of the participants (n=349; 93.3%) agreed that technology is used in pipeline transportation in Nigeria while 6.7% (n=25) disagreed that technology is used inpipeline transportation in Nigeria. This infers that various types of technologies are deployed in the pipeline transportation in Nigeria. 207 participants (55.3%) disagreed that the current technology utilized matches with international best standard, on the other hand, 44.7 (167) respondents agreed that the current technology deployed matches international best standards. This also infers that the current technology used can be improved to meet up with international best standards at different aspects of pipeline transportation.

Also, most of the participants (n=221; 59.1%) agreed that technology positively affect the distribution of petroleum products through pipelines while 153 respondents (40.9%) objected to this. 207 respondents (55.3%) agreed that there any alternative method or technology that can be utilized to transport petroleum product through pipelines. In line with this, 309 respondents (82.6%) disagreed that the available pipelines transport network is enough to supply petroleum products to meet current demand in Nigeria.

5.2 The effect of petroleum product delivery system on product availability in Nigeria.

This section presents the responses of the participants concerning the effect of petroleum product delivery system on product availability in Nigeria. Table 4.3 presents the results of the analysis of the responses of the participants concerning the effect of petroleum product delivery system on product availability in Nigeria.

Table 4.2: the effect of petroleum product delivery system on product availability in Nigeria (N=374)

Variables	No		Yes		Total	
	n	%	n	%	n	%
Have you heard of pipeline as a means of transporting petroleum products in Nigeria	0	0.0	374	100.0	374	100
Do you believe that majority of the pipelines in Nigeria are functioning	240	64.2	134	35.8	374	100
Are the pipelines available used efficiently	245	65.5	129	34.5	374	100
Do you believe that proper use of pipeline network across Nigeria will make distribution effective	49	13.1	325	86.9	374	100
Does pipeline have a link with petrol scarcity in Nigeria	38	10.2	336	89.8	374	100

Source: Researcher's fieldwork, 2022

As shown in Table 4.3, all the participants (n=374; 100%) agreed that they are aware pipeline is a means of transportation in Nigeria. This infers that pipeline is a major form of transportation such as air, water, land and rail transport. On the other hand, 240 participants (64.2%) disagreed that that majority of the pipelines in Nigeria are functioning, while, 134 (35.8%) respondents disagreed that that majority of the pipelines in Nigeria are functioning. This also infers that majority of the pipelines are not functioning which which is an indication of inefficiency in petroleum product distribution in Nigeria.

In line with this, most of the participants (n=245; 65.5%) disagreed that pipelines available are efficient while 129 respondents (34.5%) objected to this. 325 respondents (86.9%) believe that proper use of pipeline network across Nigeria will make distribution effective. In line with this, 336 respondents (89.8%) also agreed that pipeline have a link with petrol scarcity in Nigeria.

5.3 Regression Analysis

The result of the regression analysis showed that the independent variable Current Pipeline Technology (CPTD) is positive while Petroleum Product Delivery System (PPDI) is negative which satisfy a priori expectation. From the result, an increase in CPTD (Current Pipeline technology) on the average holding other independent variables constant will increase petroleum product delivery by 0.4147183 percent. This implies that pipeline technology has a positive impact on petroleum product delivery in Nigeria. In line with this, the result is

statistically significant as indicated by the probability of the Z- statistics given as 0.001 which is lower than 0.05 (5% level of significant).

In the same vein, an increase in PPDI (petroleum products delivery inefficiency) will lead to a decline in petroleum product availability by 0.3804369 percent. This implies that improving petroleum delivery efficiency will make petroleum product more available in Nigeria. In line with this, the result is statistically significant as indicated by the probability of the Z- statistics given as 0.012 which is lower than 0.05 (5% level of significant).

Furthermore, an increase in UPL (use of pipelines) on the average will lead to an increase in petroleum product delivery by 0.1411625 percent. This further shows that the use of pipeline will affect petroleum product delivery positively in Nigeria. However, this result is statistically insignificant as indicated by the probability of the Z- statistics given as 0.239 which is higher than 0.05 (5% level of significant).

Finally, an increase in EG (petroleum products pipeline transportation) on the average holding other independent variables constant will increase economic growth by 0.0156878 percent. This implies that the pipeline just like other means of transportation has a positive impact on economic growth. However, this result is statistically insignificant as indicated by the probability of the Z- statistics given as 0.889 which is higher than 0.05 (5% level of significant).

The model is statistically significant as shown by, the Chi Sq-statistic which supports this position with its result showing that the model is significant and well specified. From the result the Chi Sq-Statistics is given as 17.60 which is high. The probability value is 0.0015 which is less than 0.05 (5% level of significance), leading us to reject the null hypothesis of insignificant model implying that the model is significant.

5.4 Testing of Hypothesis

The Z statistics is used to test the significance of each of the parameter in the model. Z-values for CPTD, PPDI, UPL and EG are 3.41, -2.50, 1.18 and 0.14 respectively.

For CPTD (Current Pipeline technology) the Probability values of the Z-statistics is given as 0.001 which is less than 0.05 (5% level of significance) as such CPTD is statistically significant at 5% level of significance.

Concerning PPDI (petroleum products delivery inefficiency) the Probability values of the Z-statistics is given as 0.012 which is less than 0.05 (5% level of significance) as such PPDI is statistically significant at 5% level of significance.

For UPL (use of pipelines) the Probability values of the Z-statistics is given as 0.239 which is more than 0.05 (5% level of significance) as such UPL is statistically insignificant at 5% level of significance.

For EG (petroleum products pipeline transportation) the Probability values of the Z-statistics is given as 0.889 which is more than 0.05 (5% level of significance) as such EG is statistically insignificant at 5% level of significance.

6.0 DISCUSSION OF RESULT

One of the key industry problems in Nigeria is the downstream product distribution which is currently chaotic and ineffective. The process of distribution currently is largely by road transportation and the established depots serviced by pipelines have been given less attention and allowed moribund. This led this study to investigate the impact of downstream pipeline transportation of petroleum products on economic growth in Nigeria by asking four research questions. The first is whether there is a long-run relationship between petroleum product pipeline transportation and Nigerian economic growth? The responses from the questionnaire suggest 52.9% of the respondents disagreed while 47.1% agreed that pipeline transportation sector contribute to the GDP of Nigeria. Inferentially, the result depicts a positive and insignificant relationship between petroleum products pipeline transportation and economic growth. This result agrees with the null hypothesis which state that "there is no significant relationship between petroleum pipeline transportation and the Nigerian economic growth. Comparing the result with previous studies, the study finds the work of Ewing (2020) on pipeline crude oil transport and economic stability of US having similar finding.

The study also analyzes the impact of the currently deployed pipeline technology on petroleum products movement in the downstream sector in Nigeria and finds that pipeline technology has a positive impact on petroleum product delivery in Nigeria. This finding can be linked to the study done by Gao (2014), Hastriawan (2013), and Saniere et al. (2004). Gao posited that the introduction of new oil and gas production technologies has created a new energy boom for the United States. Hastriawan on Coal slurry pipelines technology, shows that technology in pipeline whether for transport of coal or petroleum is economical and efficient. Saniere et al. study the use of various technical solutions and innovations such as heating, dilution, oil-in-water emulsion, core annular flow and upgrading, in pipeline transportation and find that these technologies are possible for high viscosity to counteract its effect.

In evaluating the effect of petroleum product delivery inefficiency on product availability in Nigeria, the study arrives at a negative and significant relationship between the variables. That is, as petroleum products delivery inefficiency decreases, product availability increases and vise-versa. This finding conforms to Arosanyin (2005); and Ameri and Askari (2013). Arosanyin addressed the role the different transport system for oil transport and found that pipeline transport played a significant role in moving the product to the seaports. Ameri and Askari on the other hand found that energy and exergy efficiencies of crude oil increases.

Lastly, this study investigates the extent to which the pipeline network coverage affects the cost of petroleum products in Nigeria and the result reveals that petroleum pipeline usage is insignificantly and negatively related to the cost of petroleum products. This result is not different from the finding of McRae (2017) who show how the expansion of the crude oil pipeline network in the United States reduced oil price differentials.

6.1 Implication of Findings

Our findings have serious implications for policy particularly in the ongoing discussions around oil subsidy removal, public private partnerships and economic diversification in the country. Summarily, the finding can be interpreted in two ways. On the one hand this may depict that the current pipeline total network coverage is inadequate to meet up the demand for

www.ijssmr.org

Page 54

petroleum product within the country, thereby cost and price reduction. On the other hand, it may also imply that the incessant oil theft and pipeline vandalism may limit the delivery of petroleum product through the pipelines. However, the implications on each of the findings are as follows:

The first finding of this study reveals that majority of respondents disagree that petroleum pipeline transportation has a long run relationship with economic growth. This preliminary or descriptive statistic is not different from the affirmation of Logit result. That is, an insignificant positive relationship exists between petroleum pipeline transportation and economic growth in Nigeria. The implication is that, the movement of petroleum product in Nigeria through pipeline is inadequate and inefficient in promoting economic activities that will in turn result in economic growth. This is not surprising because, the pipelines are constructed majorly to move crude oil from the sea to dry land and perhaps refineries and not the refined products that have direct impact on industries and firms' productivity. Though, the result suggests a linear positive relationship between pipeline transport of petroleum product and economic growth which means that the importance of this mode of transport cannot be overlooked. All the nation needs, is to optimally take advantage of this mode of transport.

With respect to the level of technology deployed in pipeline transportation in Nigeria, 93.3 percent of participants agreed to technologies deployment in pipeline transportation has impact on petroleum products movement which conforms with the regression result that pipeline technology has a positive impact on petroleum product delivery in Nigeria. The implication is that the deployment of technologies in petroleum pipeline transportation enhances flexibility in loading and eases the movement of the products to its destination on time with less human involvement. Thus, no delay in getting petroleum products to firms and industries for production and usage. Technologies saves time and wastage, hence, increase in productivity and economic growth thereof.

Regarding the relationship between inefficiency of petroleum product delivery and petroleum product availability, the finding indicates that people are aware of pipeline as a means of transportation but are not functioning optimally in Nigeria. This is because of the frequency of scarcity of petroleum product resulting from incessant failure of supply and distribution chain. Statistically, the result reaffirms that, petroleum product delivery inefficiency has negative and significant relationship on product availability. The implication is that, frequent shortage in supply of petroleum product to industries and businesses for their daily operation, reduces their capacity in production, thus leaving workers idle and inefficient, and hence lowers productivity and economic growth.

Finally, the study finds that petroleum pipeline network/usage is insignificantly and negatively related to the cost of petroleum products. This is so because majority of the respondents agreed that the nation's pipeline network is inadequate and yet oil theft, pipeline vandalism and ruptured pipes among others are factors contributing to the costs of petroleum product in Nigeria. The implication is that, if these challenges persist on the inadequate pipeline network, the costs of petroleum product will be raised for firms and industries who use the product, thereby, reducing productivity of manufactured products, hence, fall in economic growth.

7.0 CONCLUSION AND RECOMMENDATION

7.1 Conclusion

Pipeline transport is unique among modes of transport in that the pipe, which facilitates freight movement, is both the way and the vehicle, and it is permanently connected to terminals, which facilitate freight storage. This feature makes it the only mode of transport that does not require any materials or goods handling.

Against this backdrop, the study investigated the impact of pipeline transportation of petroleum product on the economy of Nigeria. The literature reviewed guided the study to pursue the validation of two specific objectives and hypotheses. To proffer solutions to the objectives, primary data was sourced through the administration of questionnaire to staff of Nigerian Pipeline and Storage Company; Pipeline and Products Marketing Company; Ministry of Petroleum Resources; and Department of Petroleum Resources. Out of 2760 total staff across these agencies, 674 sample was randomly selected using Israel (1992) procedure. Applying simple percentage method and Logit probability model, the study therefore concludes from the findings that:

It was observed that petroleum pipeline transportation contributes positively to economic growth through firms and industries that particularly demand petroleum product to power machines needed for production and distribution of commodities. Though, the result was insignificant and that reflected the opinion of majority of the respondents regarding the low standard level of technology involvement and the inadequate pipeline network coverage. The result also validated the theoretical postulation of location theory in which resources are spatially located and, in most cases, far away from the central business districts for which firms are to transport such resources to their production factories. That is, due to inadequate pipeline network, the ease of transport and the extent of using refined (petroleum) product in production and distribution is undermined, hence fall in economic growth.

This led to the conclusion that pipeline transportation of petroleum products did not impact on economic growth due to the low level of pipeline technology application, poor pipeline network across the length and breadth of cities and problems of oil theft, vandalism, and rupture undermines the efficiency and effectiveness of the available network.

7.2 Recommendation

Given the finding that pipeline transportation of petroleum product has positive and insignificant relationship on economic growth, the study advises that Ministry of Transportation and Nigeria National Petroleum Corporation (NNPC) Limited should design a policy and a project that will drive the improvement of petroleum pipeline transport system so that the distribution of petroleum product is aided and the ease of doing business is enhanced. This will eventually raise the productivity of firms and hence economic growth.

Rooted from the finding that pipeline technology deployed has positive and significant relationship on petroleum product movement, the Ministry of Transportation and NNPC Limited should focus more on improving the technology to meet international standard such that petroleum product delivery is on time. This will in turn reduce wastage of time and resources, thus increasing workers' productivity, firms' productivity, and economic growth.

Relying on the finding which postulated that petroleum product delivery inefficiency has negative impact on product availability, the Ministry of Transportation and NNPC Limited should construct more petroleum pipeline network to link many terminals in commercial cities and factories locations. This will lower the inefficiency level of delivery, costs of production and hence economic growth.

REFERENCES

Achebe, C.H., Nneke, U.C., & Anisiji, O.E. (2012). Analysis of Oil Pipeline Failures in the Oil and Gas Industries in the Niger Delta Area of Nigeria. Proceedings of the International MultiConference of Engineers and Computer Scientists, 2, 14-16, Hong Kong.

Ameri, M., & Askari, M. (2013). Enhancing the efficiency of crude oil transportation pipeline: A novel approach. International Journal of Exergy, 13(4), 523-542.

Arosanyin, G.T. (2005). Pipeline transportation of petroleum products in Nigeria: Threats, challenges and prospects. CBN economic & financial review, 43, 1-36. http://library.cbn.gov.ng:8092/jspui/bitstream/123456789/323/1/Pipeline%20transportation%20of%20petroleum%20products%20in%20nigeria%20threats%20challenges%20and%20prospects.pdf

Chen, J. (2021). Downstream. Retrieved December 12, 2021, from https://www.investopedia.com/terms/d/downstream.asp

Dean,B., Schachter, M., Vincent, C, & Barber (2000). National Center for Biotechnology Information. 11(4): 340–344. doi: 10.1136/qhc.11.4.340

Diso, N.T. (2012). Quantitative determination of trace metals and Sulphur content in Nigerian petroleum products using AAS and gravimetric analysis technique.

Elwerfelli, A. & Benhin, J. (2018). Oil a blessing or curse: A comparative assessment of Nigeria, Norway and the United Arab Emirates. Scientific research publishing. 8, 1136-1160.

Ewing, B. (2020). Crude Oil Pipeline Capacity and Economic Stability. Energy Research Letter, 1(3), doi.org/10.46557/001c.17133

Gao (2014). Oil and Gas Transportation. Highlights of GAO-14-667, a report to congressional requesters

Good, W., & Jebbin, M. F. (2015). Transportation and national development. Journal of Economics and Sustainable Development, 6, 300-307.

Hastriawan, H. (2013) Coal Transportation Technology with Pipeline System: a Step towards National Energy Independence. Indonesian Student Association in Thailand (PERMITHA)

Mengqi, T. (2015). Current Situation and Suggestions of Pipelines of Oil and Gas Storage and Transportation in China. International Conference on Education, Management and Computing Technology. 14-17. Published by Atlantis Press.

Nwokedi, T.C., & Nnadi, K.U. (2018). Estimating the Theoretical and Empirical Probability Coefficients of Oil Pipeline Transport Infrastructure Failure Modes in Nigeria's Coastal Ecosystem: Panacea for Non Optimal Deployment of Pipeline Safety and Security Management Systems. LOGI – Scientific Journal on Transport and Logistics, 9 (2), 38-50. DOI: 10.2478/logi-2018-0017

Nwokedi, T. C, Chinedum, O., Ehileme, I., Okafor, C., Okonko, I., & Ndubisi, L. (2019). An Assessment of the Influence of the Economic Cost of Oil Pipeline Transport Infrastructure Breakages on GDP Contribution of the Oil and Gas Logistics Sector in Nigeria. International Journal of Latest Technology in Engineering, Management & Applied Science, 8(1), 76-85. ISSN 2278-2540 www.ijltemas.in.

Paul.I.A. (2014). Petroleum and Nigeria's economy: A paradox of global reality since 1956. Research on Humanities and Social Sciences, 4, 94-101.

Rahman, M. (2004). Oil and gas: the engine of the world economy. Retrieved July 13, 2021, https://www.opec.org/opec_web/en/900.htm

Saniere , A., Hénaut, I., & Argillier, I.F. (2004).Pipeline Transportation of Heavy Oils, a Strategic, Economic and Technological Challenge. Oil & Gas Science and Technology – Rev. IFP, 59 (5), 455-466.