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THE IMPACT OF PIPELINE RELATED PROBLEMS ON PETROLEUM PRODUCTS DISTRIBUTION IN NIGERIA

by

NWACHUKWU, MAXWELL UMUNNA BURP, MURP, MRT, RPP

1. INTRODUCTION

Abstract
The severe scarcity and shortage of petroleum products in Nigeria has been attributed to pipeline related problems ( sabotage, break down, leakage and prolonged routine maintenance). This research investigated the impact of these problems on petroleum distribution in Nigeria.

Severe shortage of petroleum experienced in the 1970's was attributed to poor distribution system. In a bid to tackle the problem, the then Federal Military Government set up in 1975, the Justice Ojuta Commission of Inquiry to examine the incidence of petroleum products shortage in all its ramifications. The Commission identified inadequate local refining capacity and inadequate distribution facilities as the key causes of fuel scarcity in Nigeria. According to the Commission:

"As long as our internal refining capacity is limited and in-adequate to cope with out growing demand for petroleum products, for so long shall we be compelled to rely on field importation with all its uncertainties of inaccurate forecasting and slippages of tankers."

However, following the recommendations of the commission for prompt implementation of refinery construction, as well as the petroleum pipeline and associated depots project, a machinery was set in motion for the construction of petroleum pipeline system in Nigeria.

Initially, the project was intended to cover the southern part of the country where the highest levels of consumption were recorded. However, the decision to build an inland refinery in Calabar by the Federal Military Government necessitated the setting up of a committee to review the scope of the project. The committee, having considered several factors, recommended that Petroleum Pipeline System should transcend all parts of the country. (Akpabiyi, 1987).

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In 1976, the construction of a network of about three thousand kilometers of Petroleum Pipeline System began at an initial cost of five hundred million Naira (₦500m), and was completed in 1980. At present, Nigeria has a total of 5,822 kilometers of Petroleum Pipeline System.

After the construction of Petroleum Pipeline System in 1980, it appeared to have effectively tackled the problem of severe shortages of petroleum products experienced in the 1970s, since queues and all forms of scrambling for petroleum products at the service stations and other market outlets completely disappeared. However, this situation did not last as Nigeria witnessed another severe state of petroleum products shortages between 1989-1994.

Some experts have attributed the severe scarcity and shortages of petroleum products in Nigeria to pipeline-related problems, such as sabotage, break-downs and leakages (Agha 1991). (This opinion is speculative in nature and vastly lack empirical evidence). Although these are notable problems in the Nigeria’s petroleum pipeline system, no empirical evidence has yet linked them to scarcity and shortages of petroleum products. It is therefore inappropriate to implicate or exonerate pipeline-related problems from this critical problem of fuel scarcity without an in-depth investigation into their impact on petroleum products distribution in Nigeria. This poses enormous challenges, which this study intends to address.

2. **The Scope of Study**

This study is concerned with determining the impact of pipeline-related problems on petroleum products distribution in Nigeria. The pipeline-related problems referred to in this study are sabotage, breakdowns, prolonged routine maintenance and leakages. Furthermore, the petroleum products used for this research are petrol, diesel, and kerosene.

This study covers a fifteen-year period, from 1980 to 1994. The two definite time phases, 1980-1988 and 1989-1994 were determined in this study. The 1980-1988 period was a nine-year period following the commissioning of the petroleum pipeline system during which there was little or no fuel scarcity in Nigeria. The 1989-1994 period spanning six years was dotted with frequent fuel shortages in the country.

3. **Literature Review**

There is diversity of opinion on the causes of fuel scarcity in Nigeria as expressed in this literature review. Ode (1996), attributed fuel scarcity in Nigeria to the continued negligence of the nation’s refinery. According to him, "the
frequent fuel scarcity in Nigeria since 1996 is as a result of declining production levels in the nation's refineries. Adeniyi (1996) blamed smuggling on fuel scarcity. He observed that the insecurity of petroleum products is very frequent because the difference between the prices in Nigeria and other countries is so enormous that it created avenues for smuggling petroleum products out of the country. He advocated for appropriate pricing of petroleum products through subsidy withdrawal to tackle the problems of smuggling.

Agiba (1991) presented yet another view. He identified pipeline related problems as being responsible for fuel scarcity situation in Nigeria. He noted that certain "bottlenecks" (pipeline related problems), which are essentially logistical in nature, affect the capacity utilization of the existing petroleum pipeline system in Nigeria.

Adelabosile (1996) opined that low capacity utilization of the nation's refineries is responsible for fuel scarcity in Nigeria. In other words, low capacity utilization of the nation's refineries causes a severe strain on the supply of petroleum products, especially when smugglers take advantage of the situation to further dissipate the even low supply. Adigun (1997) ascribed frequent fuel scarcity in Nigeria to panic buying and hoarding by consumers, which create excesses of impending scarcity. The Editor (1992a) expressed regret at the absence of a consensus on the causes of fuel scarcity. It noted that "some opinions based on the intimate knowledge and experience of the petroleum industry are expressed to be factual and reliable. Yet, they differed markedly in some important respects and conflicted strongly in other views".

4. METHODOLOGY

4.1 Method of Data Collection

The data used in this study were collected from secondary and primary sources. Data from secondary sources were extensively used in this research. The sources of the secondary data were the Pipeline and Products Marketing Company (PPMC), Lagos, Nigerian National Petroleum Corporation (NNPC) Lagos, Central Bank of Nigeria, Lagos and nation's refineries.

Data from primary sources were used in this research to identify the period of severe fuel scarcity in Nigeria after the 1970's episode. These data were sourced through face-to-face interviews with the officials of the Pipeline and Products Marketing Company, Lagos.

4.2 Sample Size and Sampling Population

The stratified random sampling
technique was employed to sample the population that was interviewed for this research. The nation's petroleum pipeline system was first divided into three strata based on the organic three sub-pipeline network that constituted Nigeria's Petroleum Pipeline System. (2A/2B, 2D and 2E). Two depots were later drawn from each of the three sub-pipeline systems, using random sampling technique. The six drawn depots are Accra, Mosim, Kaduna, Jos, Port Harcourt and Enugu. Two most senior staff from each depot were interviewed. Thus, in all a sample size of twelve people were interviewed.

5. Analysis

The two statistical techniques used in this study are Simple Linear Regression (SLR) and Analysis of Variance (ANOVA). Simple Linear Regression was used in testing the first hypothesis, which determined relationship between the dependent variable (\( y \)) which is quantity of petroleum products from the nation's refineries and the independent variable (\( x \)) which is quantity of petroleum products moved through the pipeline system. The test (1980-1994) were divided into 1980-1988 and 1987-1994 periods.

Single Factor Analysis of Variance was used in testing the second hypothesis. The test involved the determination of the difference (whether significant or not) in the percentage volume of petroleum products from the nation's refineries moved through the pipeline system between 1980-1988 and 1989-1994 period. The dependent variable (\( y \)) is the percentage volume of petroleum products from the nation's refineries and the independent variable (\( x \)) represents the periods under study (1980-1988 and 1989-1994).

The findings helped the researcher to develop a petroleum pipeline efficiency model to determine the efficiency of the nation's petroleum pipeline system during the periods under study. The model is stated below:

\[
ELPPS = \frac{AQPPN}{AI.FPP} \times 100
\]

Where

\( ELPPS = \) Efficiency level of the petroleum pipeline system per annum.

\( AQPPN = \) Average quantity of petroleum products moved through the pipeline system from the nation's refineries during the entire period under study.

\( AI.FPP = \) Average installed flow capacity of the Petroleum Pipeline System during the entire period under study.

The analysis in the above table shows that the number of lines, and op-
Critical clays lost by pipeline system as a result of sabotage, leakages and breakdowns were higher in 1989-1994 period than in 1980-1988 period.

**Efficiency Level of Petroleum Pipeline System Per Annum (1980-1994)**

Efficiency level = Average quantity of Petroleum Products moved through the pipeline system per annum divided by average installed flow capacity of pipeline system per annum.

\[ \text{Efficiency level} = \frac{\text{Quantity moved}}{\text{Capacity} \times \text{Period}} \]

For 1980 - 1994 entire period under study, efficiency level =

| TABLE 1: THE NUMBER OF TIMES PETROLEUM PIPELINE SYSTEM WERE DISRUPTED THROUGH SABOTAGE, LEAKAGES AND BREAKDOWNS FROM 1980 - 1994 |
|-----------------|-----------------|-----------------|-----------------|
| Year | Number of times | The affected system | Days it lasted | Causes |
| 1980 | NA | NA | NA | NA |
| 1981 | NA | NA | NA | NA |
| 1982 | NA | NA | NA | NA |
| 1983 | NA | NA | NA | NA |
| 1984 | 2 | 2A/2B | 25 | Sabotage, Breakdown |
| 1985 | 1 | 2A | 11 | Breakdown |
| 1986 | 1 | 2E | 10 | Breakdown |
| 1987 | 1 | 2D | 14 | Leakage |
| 1988 | 1 | 2E | 7 | Sabotage |
| 1989 | 1 | 2E | 10 | Sabotage |
| 1990 | 2 | 2B and 2D | 16 | Leakage, Breakdown |
| 1991 | 2 | 2B and 2E | 19 | Leakage, Breakdown |
| 1992 | 3 | 2B and 2E | 25 | Sabotage, Breakdown |
| 1993 | 4 | 2A and 2E | 31 | Sabotage |
| 1994 | 3 | 2E | 45 | Sabotage, Breakdown |
| Total | 21 | 213 |

Note: NA = Data Not Available

Source: Pipeline and Products Marketing Company (PPMC), Lagos, 1986.
The Impact of Pipeline-Related Problems On Petroleum Products Distribution in Nigeria

6.115.695.1m³
18724500m³ = 0.327 -32.7% efficiency level per annum

b. For 1980 - 1988 period,
efficiency level =

1951232m³
18724500m³ = 0.265 - 26.5% efficiency level per annum
c. For 1989 - 1994 period,
efficiency level =

7,016,642
18724500m³ = 0.423 - 42.3% efficiency level per annum

6. DISCUSSION

The result of above shows that the average installed flow capacity of the nation's Petroleum Pipeline System during the entire period under study (1980 - 1994) was 18,724,500m³ per annum. The Pipeline System actually transported an average of 6,115,695.1m³ of Petroleum products per annum representing an efficiency level of 32.7 percent. During the 1970 - 1991 period alone, the average installed capacity was 18,724,500m³ per annum and the actually average quantity of Petroleum Products transported through the Pipeline System was 4,915,647.1m³ per annum representing 26.2 percent efficiency level.

Whereas during the 1989 - 1994 period alone, the average installed flow capacity was 18,724,500m³ per annum, the actual average quantity moved increased to 7,910,647.1m³, which represents an efficiency level of 42.3 percent.

6.1 Results of the First Hypothesis

The results of the tests show that there existed a significant relationship between the quantity of petroleum products from the nation's refineries and the quantity that was moved through the pipeline system during the entire periods under study (1980-1994), (X² = 909.10; Adjusted X² = 0.399; Standard Error = 56713; F-calc = 399.42; F-sign = 0.000; at P<.01). When this same hypothesis was tested for the 1980-1988 period only, the strength of relationship (r²) between the quantity of petroleum products from the nation's refineries, and the quantity that was moved through the pipeline system decreased slightly (r² = .93112; Adjusted r² = .92129; Standard Error = 245226; F-calc = 94.62; F-sign = .000; at P<.01). However, when the test was repeated for the 1989-1994 period alone, the strength of relationship (r²) increased, (r² = .99997; Adjusted r² = .98634; Standard Error = 234487; F-calc = 362.66; F-sign = .0000; at P<.01). Thus, the null hypothesis was rejected.

6.2 Results of the Second Hypothesis

The result of the test shows that there is no significant difference existing...
in the capacity utilization of the nation's refineries between the 1980-1988 and 1990-1994 periods (F-value 1.386, and F-sign = .2832 at .05) Hence, the null hypothesis was accepted.

6.3 Results and Findings

The Efficiency Level or Capacity Utilization of the Existing Petroleum Pipeline System in Nigeria

The findings of calculation 4.60 reveal that the efficiency level or capacity utilization of the petroleum pipeline system was higher in the 1989-1994 period than in the 1980-1988 period; even though the figure for both periods were generally low. The frequent fuel scarcity witnessed during the 1989-1994 period, (when the capacity utilization was more than 1980-1988 period at 42.3% per annum), could be attributed to other reasons. First, the imported Petroleum Products and the locally refined ones distributed through the pipeline system did not satisfy the domestic demand, which had at that time shown an unprecedented increase. Second, the imported Petroleum Products may have been smuggled outside the country. And, third, it is possible that the quantity of products that the government claimed to have imported into the country may have been exaggerated.

The little or no fuel scarcity witnessed during the 1980-1988 period, at the time when the pipeline system was at about its lowest efficiency level (26.8 per annum) can be ascribed to the large scale importation of the products, which was meant to supplement the then low level output the nation's refineries. Apparently, the resultant quantity, (both the imported and locally refined Petroleum Products), easily met the prevailing domestic demand which communities classified as moderate at that time.

The result of hypothesis II suggests that the expected difference in the rate of production of petroleum products by refineries in relation to their installed capacity during the 1980-1988 and 1989-1994 period was insignificant. This is surprising given the major improvement on the installed capacity utilization of the nation's refineries during the 1989-1994 period (examination of an additional refinery — second Port Harcourt). This is an evidence that the poor utilization of the nation's refineries resulted in the under-utilization of the Petroleum Pipeline System during both periods. Therefore, the low capacity utilization of the refineries is a major contributory factor to the frequent fuel scarcity in Nigeria as was demonstrated during the 1989-1994 period.
The Relationship Between Quantity of Petroleum Products from Nation's Refineries (Locally refined) and Actual Quantity Moved Through the Pipeline System

The results from Tests 1 indicate that there is a very strong relationship between the volume or quantity of Petroleum products from the nation's refineries and actual volume or quantity that is distributed through system in both periods under review. While the 1980-1988 period shows a very strong relationship of 93.1 percent, the 1989-1994 period shows an even stronger relationship of 98.9 percent. In other words the existing pipeline system were efficiently utilized in Petroleum Products distribution during both periods under study. Hence, the volume of direct output of Petroleum products from the refineries determines to a large extent the quantity that will be distributed or moved through the pipeline system. However, although the pipeline system was considered highly efficient in both periods, the quantity distributed or moved still fell short of the installed capacity. This implies that the pipeline system have the capacity of moving as much as twice the quantity it moved in the 1989-1994 period.

The Impact of Some Pipeline Associated Problems on Petroleum Pipeline System

The pipeline associated problems (shutdown, breakdown, prolonged routine maintenance and lines) may also bear no serious impact on the nation's petroleum pipeline system. This is likely due to two reasons. Firstly, the efficiency level calculation above have indicated that in spite of these factors, the capacity utilization efficiency level of the petroleum pipeline system was higher during the 1989-1994 period (42.3 % per annum) than in the 1980-1988 periods (26.5% per annum). Second, the results of the tests 1 and 11 as already stated, reveals that the pipeline system was more efficiently utilized (signifying higher dependence) in moving locally refined petroleum products to the various depots, during the 1989-1994 period (92.9%) than the 1980-1988 period (93.1%).

Third, test II revealed that the low capacity utilization of the nation's refineries consequently resulted in the under utilization of the petroleum pipeline system in Nigeria, thereby causing fuel scarcity.

Therefore, this is an indication that the impact of these factors on the efficiency of the petroleum pipeline system in the 1989-1994 period may have been exaggerated.
7. **Recommendations**

1. The petroleum pipeline system should be maintained regularly and safeguarded against vandalism. The incidence of rampant tampering with pipeline system by vandals' intent on stealing the petroleum products must be checked effectively. The route of the pipeline system should be cleared to at least width of 25 meters and monitored from both land and air.

2. The frequency of inspection group and number of the group should be increased to three times of what is done. Also, marking indicating the positions of the pipeline should be increased and made more visible. This will go a long way in reducing the frequent incident of pipeline breakage by construction firms.

3. Maintenance response rate should be improved upon. Therefore, more maintenance staff of all categories should be stationed at the area offices. There should be enough provision of all equipment at each station, which will be protected by parts and major components of the system from being overworked to the point of exhausting their physical limit. The maintenance should be well monitored by the government to check fraudulent practices that have marred the exercise in the past.

4. There should be immediate restoration of the nation's refineries at their operational fuel capacities. In other words, they should undergo the mandatory routine maintenance immediately, and also as at when due. This is to avoid frequent breakdown of the nation's refineries, which is principally, responsible for fuel scarcity in Nigeria.

8. **Conclusion**

The pipeline system in Nigeria, in spite of its problems, is still the most efficient means of distribution of petroleum products. The findings show that the pipeline-related problems are not the major causes of frequent fuel scarcity in Nigeria, and that the impact of these on pipeline system may have been exaggerated.

Therefore, in order that the pipeline system should continue to pay a strategic role in petroleum products distribution in the country, its present level of utilization must be increased in line with national energy demand. This will make hitch-free distribution of petroleum products in Nigeria a practical reality.
REFERENCES


