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# ANALYSIS OF THE FACTORS LIMITING PERFORMANCE IN THE LOWER RIVER NIGER DREDGING PROJECT, NIGERIA

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## ABSTRACT

Inland water transport has, prior to the 1980s, received little attention from the Nigerian government. Very little investment was made to develop inland water transport facilities. Conversely, land and air transport received priority attention. However, due to rapid growth of urbanization, population, commercial units, institutions and vehicular traffic leading to congestions and stress on the nations roads, inland water transport is now receiving more attention from both the government and the private sector. This growing awareness motivated the federal government to embark on the Lower Niger River dredging to boost the movement of goods and services from the coast to the interior. Meanwhile, this popular initiative has contrary to earlier proposals, targets and expectations, progressed very slowly. This paper investigates the physical and socio-economic factors militating against the dredging project using primary and secondary data collected from diverse sources, including the inland waterways department of the Federal Ministry of Transport. Analysis of the factors constraining the performance of the dredging activities is presented. Principal Component Analysis (PCA) reduced the 28 respondents identified constraining variables to four underlying components, which explained 73.74% of the variance leaving 26.26% to other variables not used in the analysis. The underlying components are; non-use of professional studies, inadequate resource base, physical or environmental constraints and technical difficulties. Based on the finding of the study, strategies which can facilitate the development of the dredging project and enhance planning procedure in the water transport sector were advanced.

**KEY WORDS:** Constraints, Impact, Lower Niger River, Inland water transport, Nigeria, River dredging.

## INTRODUCTION

River dredging refers to the removal of soil or other materials from the bottom of a river, lake, or ocean harbor [1]. The materials removed from underwater are called *spoil.* The machines used for dredging are called *dredges,* which generally consist of hoisting of suction equipment and are usually powered by a diesel engine, mounted on a barge like float. Dredges are used to deepen and/or widen waterways, to facilitate navigation, provide fill material for raising submerged land above water, build dikes or prepare for the installation of underwater foundations, as well as to dig up underwater deposits of precious metals or valuable marine life [2]. Various types of dredges are currently in use. Dipper or bucket dredges have a bucket on the end of a movable arm that scoops up underwater material. Grab-bucket dredges are similar but use a bucket swung by cables from the end of a boom. These two types of dredges are useful for dredging in deep water. Elevator dredges use an endless chain of small buckets. Hydraulic dredges suck the spoil into a pipe, and are commonly fitted with a floating pipeline through which the spoil is discharged on the shore. Mining dredges usually separate the precious material from the rest of the spoil, which is discarded. Stirring dredges are used to open passages for navigation by agitating soil until the current carries the soil away [7]. Available literature suggests a global increase in the frequency, magnitude and geographic extent of river dredging mainly to open up the economic and settlement frontiers of hitherto depressed areas. In Asia and Africa, for instance, there were over 386 cases of river dredging from 1995 to 2005, (an increase of 400% over equivalent past period), with over 75% of the dredging activities aimed at reducing the stress of road use [9]. Although, not all cases of dredging are to facilitate inland water transport, a strong correlation exists between efficient transportation system and economic development can not be challenged [4]. Global factors accounting for increases in river dredging include rapid population growth, relative high cost of overland and air transport, increased manufacturing activities, the existence of numerous successful models, improved dredging technology and favourable government policies [3].

In Nigeria, attempt by the government to develop inland waterways transportation through the dredging of her rivers dates back to 1958 when it was initially proposed [4]. The dredging of the major rivers, particularly the River Niger which is the longest in West African, measuring about 4200 km and running through the Republic of Benin, Niger, Mali, Guinea and Nigeria has been placed at forefront of the Nigerian capital and physical budgets since the early 1990s [9]. In 1996 the federal government, approved a dredging project of the lower Niger which covers 572 kilometers and awarded the contract. The implementation of this initial contract failed and government revoked the contract citing irregularities in the award process [11]. The project was put on hold for 12 more years (until December 2008), when the government of late Yar'Adua directed its reactivation and increased the length of the river to be dredged to 575 kilometers, cutting across Rivers, Bayelsa, Imo, Delta, Anambra, Edo, Kogi and Niger states. The project was awarded at a contract sum of ₦34.8 billion and ₦1.2 billion for consultancy, for the capital and maintenance dredging. The project included the construction of modern river ports at Lokoja, Idah, Baro, Oguta and Onitsha [7]. The objectives of the dredging project according to records available in the inland waterways department of the Federal Ministry of Transport include to:

i. promote water transportation and navigation of inland waterways in the country.
ii. promote riverine commerce and intermodal transport of persons and cargos
iii. generate industrial development within the inland waterways sub-sector
iv. promote tourism as well as create job opportunities
v. reduce congestion on roads and dramatically improve road safety.
vi. encourage investment by the private sector in the inland waterways transport sector
vii. facilitate agricultural production especially within the low lying regions in the lower Niger River
viii. assist industrialists transport heavy goods, particularly petroleum products through the water channel so as to check the pressure on the nation roads and to

ix. enable farmers transport farm produce from their farms/homes to markets and to move to and from their places of work at very affordable costs.

Apart from these, respondents in the National Inland Waterways Authority (NIWA) also opined that the dredging project will facilitate habitant development, shoreline protection, erosion control and provide materials (e.g. sand) for construction purposes. It is also hoped that the project will help to foster peace and co-operation between the neighbouring communities who jointly use the Niger water for domestic, industrial and agricultural and other purposes. In addition, the natural resources of the river (e.g. fish, crabs, crayfish, periwinkles, oysters etc) which will become more abundant will bring enormous economic benefits to host communities. The capital dredging was to be completed in June 2010 however only lots 1-4, (from Warri [Delta state] to Jamata [Kogi state]) have been completed presently. Lot 5, which runs from Jamata to Baro, (Niger state), remains uncompleted. Maintenance dredging is yet to start. Against this background, it is obvious that there are critical challenges or constraints which currently confront the implementation of the Lower Niger Project. Previous workers have observed that inland waterways transportation in Nigeria has not developed at all over the past decades compared to the ones in some developed and even developing countries[ 6]. Few attempts have been made to analyze the existing constraints to river dredging in Nigeria in a systematic and quantitative framework. Our primary goal in this work is, therefore, to identify and describe the critical physical and socio-economic challenges limiting the lower River Niger dredging project. Secondary goals are to evaluate the potentials for improved dredging activities.

**The Study Area**

The well watered and elongated lower Niger river basin is situated strategically on both sides of the Niger river and behind the tributaries of the river down south of Baro in Niger state [5]. The river basin lies between $6^0$.03' to $6^{0.}$18'N and $6^0$.01' to $6^0$.48' E longitude (Fig.1). It runs about 672kms from north to south and about 42kms from east to west at its widest section [8]. It has an estimated area of about 42,874km$^2$. Warri and Baro are the lower and upper limits of the catchment area respectively [9]. It is bounded the north by Niger State, northwest by Edo and Kogi states, south by Rivers/Delta States, east by Anambra state and west by Delta state. Wide and extensive floodplains are formed by the Niger, Anambra, Benue, Gurara and Asse rivers both in the north and south. The general elevation of the floodplain ranges from less than 20m in the west to 550m above sea level on the north eastern side. The western extension of Ekiti-Kabba highlands touches the area on the eastern side and from this upland, several rivers such as Oyi, Ebba and Teshi spurt out. Western Kabba, the highest peak, with an elevation of about 450m serves as a water divide between the North flowing and South flowing rivers. The general slope of the area in the north part is from south to north while in the southern part it is from north to south as indicated by the major drainage. The area falls within humid tropical climate or the rain forest area with hot sunny summers and general wetness over two thirds of the year (April-November) [5]. The short dry season and the dry harmattan winds prevail over the area between December and March. The average annual rainfall is 2000mm of which about 80% is temperatures of 25.8$^0$C and 22.7$^0$C are observed in winter while during summer it is 26.9$^0$C and 22.4$^0$C respectively [6]. The catchment is an area of hydromorphic and ferruginous soils and mudstones, which is influenced by sheet wash and fluvial action, contributing to the development of extensive floodplains [8]. The floodplains are characterized by meandering scars, isolated lakes and elongated island bars indicating the incidents of deposition due to breakage of slope. The rich, thick deposits of the rivers make the region very suitable for agriculture.

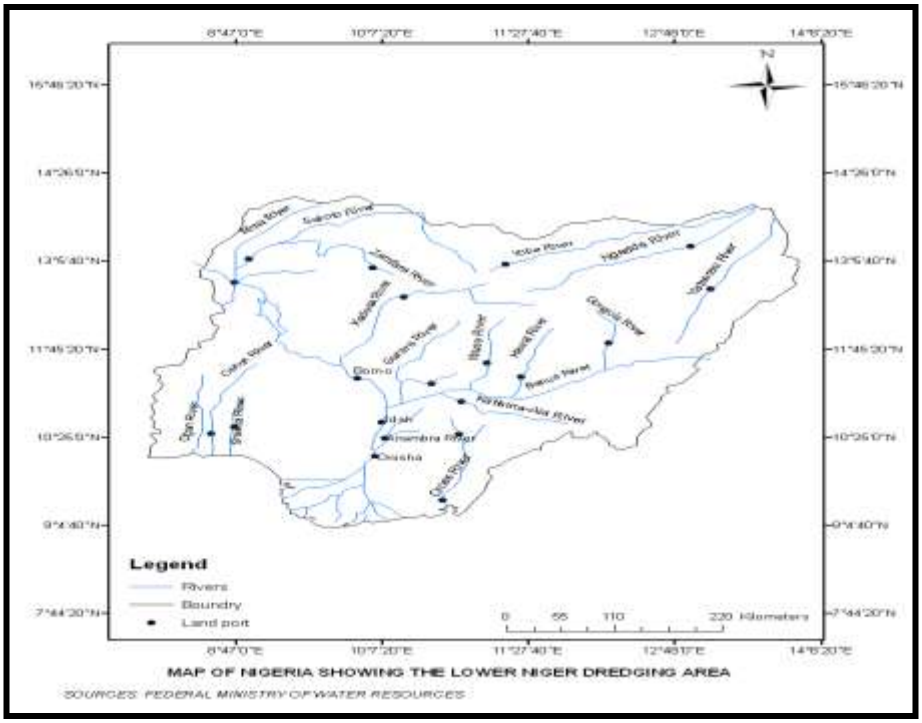


**Fig.1: Map of Nigeria Showing the Lower Niger Dredging Area**

**METHODOLOGY**

The data used in this study were collected from diverse sources, which are as summarized below:

(i) Information on the current governmental involvement in river dredging projects in Nigeria, including the details of the funding, evaluation and monitoring pattern by the Federal government were obtained from the inland waterways department of the Federal Ministry of Transport Abuja Nigeria.

(ii) Progress report on the dredging of the lower Niger River including the objectives of the dredging projects, distance covered, name of the dredging companies, water front infrastructure development, consultancy arrangements, management of dredgers, etc. were obtained from the records of National Inland Waterways Authority, Abuja.

(iii) Information on the current constraints facing the project, their magnitude, governmental response to constraints, future targets, estimates of the potentials of the project on the national economy as well as emergency conditions which face the dredgers were obtained from the staff of both the dredging companies and that of the federal agencies cited above – particularly officials of the inland waterways department.

(iv) In addition, visits were also made to the sub-stations and operational sites of the dredging companies at Warri, Jamata, Onitsha, Idah, Lokoja and Baro to obtained relevant information on site- specific activities and constraints.

(v) Finally, other relevant information used in the research was obtained from diverse sources, including maps and library materials obtained from the agencies mentioned above.

The data collected from all these sources were first edited and arranged properly for easy presentation, and then analysed through the use of basic and inferential statistics such as totals, means, percentages, tables, and Principal Component Analysis (PCA). PCA was used to reduce the variables constraining in dredging project to significant underlining dimensions.

**Variables Used in Analysis**

In order to establish the factors limiting the performance in the Lower Niger River dredging project, our respondents were asked to identify and describe the causes of the slow pace or non-realization of government targets in the inland water transport sector. The respondents identified variables as shown in table 1. The identified variables incorporate physical, human, economic and institutional factors. These respondents arbitrarily identified set of constraints were transformed into numerical variables and used for analysis.

**Table 1: Respondents Identified Variables Used in the Analysis**

| S/No | Variable Name | Variable Label |
|---|---|---|
| **1** | Difficult topography | **DITO** |
| **2** | Limited understanding of the magnitude of work load | **LUWIO** |
| **3** | Non-favourable geology | **UFGO** |
| **4** | Prolonged rainy season | **RASE** |
| **5** | Frequent rainstorm | **RAS** |
| **6** | Constant flooding episodes | **COFO** |
| **7** | Unusual sediment load | **SELO** |
| **8** | Presence of heavy rocks and boulders | **HERBO** |
| **9** | High rate of sediment generation | **SEDIG** |
| **10** | Poor remuneration of workers | **REMOW** |
| **11** | Lack of required engineering skills | **REEQ** |
| **12** | High cost of labour | **HICOL** |
| **13** | High cost of required equipment | **HICEQ** |
| **14** | Lack of required equipment | **LEQI** |
| **15** | Frequent alteration of work plan | **AWOP** |
| **16** | Limited use of experts | **LIXPE** |
| **17** | Poor funding | **POFU** |
| **18** | Work institutional framework | **WIFAW** |
| **19** | Inadequate motivation of workers | **MOTOW** |

| | | |
|---|---|---|
| **20** | Interference by fishermen/miners | **FISEM** |
| **21** | Interference by companies using the river | **ICOM** |
| **22** | Unrest in and or uncooperative attitude of host communities | **ATUH** |
| **23** | Expansive waterways | **EXWA** |
| **24** | Inadequate transport system | **TRAN** |
| **25** | Harsh weather | **HAWE** |
| **26** | Language barrier | **LABA** |
| **27** | Prevalence of mosquitoes | **MOSQ** |
| **28** | Excessive weed infestation | **WEED** |

**Source: Fieldwork,2011**

These 28 respondents identified predictor variables were transformed into a matrix of inter-correlations through the aid of Statistical Package for the Social Sciences (SPSS). The lower diagonal of the correlation matrix is presented in table 3.

As shown in table 2, some of the predictor variables are strongly correlated with each other (example, non favourable geology (UFOG) and high rate of sediment generation (SEDIG); prolonged rainy season (RASE) and excess weed infestation (WEED); lack of required engineering skills (REED) and high cost of labour (HICOL). However, many other show very little or no inter-correlation. To remove these weekly correlating or redundant variables we transformed our 28 predictor variables into orthogonal values by PCA. PCA is a statistical technique which is helpful in dealing with large statistical aggregates, described by a number of variables. It allows the isolation of multi-variable groupings of units and the reduction of the original set of variables into a smaller number of underlying components. It is, therefore, helpful in identifying certain links or dependencies which might otherwise go unnoticed. The present analysis involved orthogonal varimax rotation to maximize variable groupings and aid interpretation. Computations were again performed through the SPSS. The result of the analysis is shown in table 3. The sum of the squared loading on each component (i.e. the eigen value) indicates the total variance accounted for by the component. Based on the size of the loading and in order to ease interpretation, we regard only variables with loadings greater than + 0.70 as important

**Table 3: Varimax Rotated Component Matrix of the Variables**

| **Variable** | **Component 1** | **Component 2** | **Component 3** | **Component 4** |
|---|---|---|---|---|
| DITO | .532 | 005 | -632 | -013 |
| LUWIO | **(.720)** | 267 | -.026 | 200 |
| UFOG | .554 | -076 | 617 | -.265 |
| PROR | .554 | 0.75 | .305 | 012 |
| RAS | . 435 | -117 | .110 | 352 |
| COFO | .486 | -254 | .617 | -.047 |
| SELO | . 232 | 020 | .159 | -063 |
| HERBO | .130 | .675 | **(0.889)** | -132 |

| | | | | |
|---|---|---|---|---|
| SEDIG | .580 | -0475 | **(0.759)** | -055 |
| REMOW | .163 | **(.777)** | .1 86 | -.027 |
| REEQ | .085 | **(0.90)** | .044 | **(-814)** |
| HICOL | .530 | .097 | .143 | .052 |
| HICEQ | .327 | -.0575 | -.378 | .007 |
| LEQI | .5 95 | **(.712)** | .012 | **(.702)** |
| AWOP | **(-761)** | 080 | -.174 | . 222 |
| LIXEP | **(.764)** | -094 | -.039 | .1 79 |
| POFU | .012 | **(0.940)** | .000 | .003 |
| WIFAW | .377 | .135 | .042 | .-060 |
| MOTWO | .2 96 | .106 | .509 | .001 |
| FISEM | .505 | .062 | .333 | -.045 |
| ICOM | .344 | .034 | .5 07 | -130 |
| ATHC | .133 | .045 | .368 | .1 80 |
| EXWA | .062 | 012 | .4 85 | .085 |
| TRAN | .220 | -202 | -.035 | -.034 |
| HAWE | .298 | -104 | 0.880 | .231 |
| LABA | .096 | 110 | 135 | .300 |
| MOSQ | .484 | 003 | -.107 | .264 |
| WEED | .305 | -.140 | **(.-771)** | .400 |
| **Eigen value** | **5.431** | **2.835** | **2.35** | **1.665** |
| **% of explained variance** | **28.3** | **20.3** | **16.8** | **8.34** |
| **Cumulative (%) variance** | **28.3** | **48.6** | **65.4** | **73.74** |

As shown in table 3 PCA has assisted as to identify four underlying component explaining 73.74% of the common variance.

**Component I:** Component I which explains 28.3% of the total variance is the major component, and, at the same time, one very difficult to interpret because it comprises three, non-physical and highly inter correlated variables. Among the features correlated positively with the component are those pertaining to the planning and implementation structure (and feasibility basis) of the project – limited understanding of the magnitude of work involved by the dredging companies, delays and frequent alteration of workplans, and limited use of experts. These variables relate to operational difficulties resulting from unanticipated obstacles, incomplete assessment of the work loads, and initial poor preparation. Generally, the component describes planning difficulties, unbudgeted demands made on the dredging companies and reflects the impact of poor initial planning on the Lower Niger River dredging. It is therefore named as limited planning and non-use of professional studies.

**Component II:** Component II explains 20.3% of the total variance and is positively correlated with variables referring to the funding pattern and equipment maintenance. Negatively correlated variables include those describing the impact which poor resources base may have on the working population. We can therefore label this component as inadequate resources base.

**Component III:** Component III accounts for 16.8% of the common variance and is positively correlated with five physical variables; presence of heavy rocks and boulders, high rate of sediment generation, excessive weed infestation, constant flooding episodes and harsh weather. It can be denominated the environmental or physical obstacles limiting the dredging operation.

**Component IV:** Component IV accounts for only 8.3% of the common variance. This component has no loading values of over 0.500 except on two variables: (13, and 14). When we taken into account the variable with the highest loading we can easily identify this component as the non-availability or use of desired dredging equipment.
On the basis of their analysis the component structure shown in table IV were obtained

**Table 4: Component Structure**

| Component | Eigen value | % explained | Cumulative % explained |
|---|---|---|---|
| Comp. I: Limited or non-use of professional studies | 5.431 | 28.3 | 28.3 |
| Comp. II: Inadequate resource base | 2.835 | 20.3 | 48.6 |
| Comp. III: Environmental or physical obstacles | 2.352 | 16.8 | 65.4 |
| Comp. IV: Non-availability or use of desired dredging equipment | 1.665 | 8.34 | 73.34 |

## DISCUSSIONS

In order to confirm the accuracy or impact of the above components we further requested the stakeholders to describe the extent to which the identified components impact on the dredging activities. Respondents in National Inland Waterways Authority and the Federal Ministry of Transport confirmed that:

(i) the development of inland water transport facilities in Nigeria has been adversely affected by insufficient and erratic funding, except perhaps in 2009 when the regime Yar'Adura allocated over ₦12.3 billion river channel dredging. Previous governments were not favourably disposed to funding inland water transport development.

(ii) the issue of poor service delivery in the inland water transport sector in Nigeria is not just that of limited resources, but of a host of other variables including how available resources are allocated and managed. They observed that one would indeed expect that with the current frequent release of fund and the input of external assistance in the inland water transport sector, infrastructural availability would have remarkably improved but this has not been the case. This shows that there are several other factors responsible for the slow pace of development of inland water transport facilities in Nigeria

Other institutional deficiencies confirmed by the respondents in the above agencies included the:

1. none development of specific work schedules and project targets
2. poor co-ordination with the project client
3. poor expenditure monitoring and budget management
4. non-review of progress and revision of workplans and
5. poor planning and non-use of experts

Signs of inadequate planning were deduced from the reactions of the field staff on operational modalities at the dredging sites. First, many field staff noted that they lacked detailed knowledge of the characteristics of both the project and environment prior to the flag off of the project in October 2009. None of them admitted seeing or using the EIA report. River dredging all over the globe demand that the working staff have experience in the geological and hydrological sciences. Channel development requires rigorous engineering, ecological and landscape assessment skills [7]. Apart from experience requirement, planning also help forms to establish the role of individuals, machinery and agencies in the project and environment. Because this was largely lacking, the dredging companies have had to complain of several things; the magnitude of work involved, the quantity of sand to be excavated, the low contract sum, the short time line for the project frame etc – all evidence of poor planning. The impact of delays on the project implementation was also highlighted. For instance, they noted that the original survey of the project was done in 2002 based on which the contract was later awarded in 2008. The survey grossly underestimated the actual quality of sand to be dredged. The difference in time between the survey and the contract award gave room for more siltation to settle or the river beds. This forced the NIWA to request for additional ₦10 billion.

## CONCLUSION AND RECOMMENDATIONS

From the above analysis, it is evident that the low pace of progress in the Lower Niger River dredging project and the inadequate development of required river port facilities generally are not the result of a single cause but it is the effect of a number of associated causes. Without isolating and considering each of these problems no meaningful progress will occur in the nation's inland water transport sector. It is therefore, being suggested that the following strategies may solve the basic malady of the Lower Niger River dredging as well as the development of associated facilities.

### Introduction of a realistic transport policy

A policy which will ensure speedy and sustainable development of all modes of transport is necessary to ensure the overall growth of the nation's economy. Through the policy government will take cautious, timely and sustainable steps to bring development in the inland water transport sector at par with the modern standards.

## Improved funding and efficient utilization of resources

Government should provide especial fund through increased budgetary allocation for inland waterways development. In addition government should realize that awarding a contract for project development is not enough – that the monitoring and evaluation component is an essential ingredient. Without this, resources may be misapplied or misappropriated.

## Capacity Building

Government should provide capacity building in the inland water transport sector and in addition prioritize equipment acquisition in order to ensure sustainable development in this sector of the nations economy

## Proper Planning

Detailed fea**s**ibility and professional studies are essential to ensure rapid and sustainable development of government projects. They help to identify constraining obstacles, estimate the magnitude of work involved and amount of resources needed for project implementation.

## Impact Assessment

Certain criteria against which the importance of the Lower Niger River dredging can be assessed may take the form of project/institutional information e.g. loss of habitat, consent limits, international guidelines or standards on dredging activities. Other criteria include professional judgment, comparisons with previous or other existing models, concerns expressed by the riverine communities and the views of would be users – firms inclusive.

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