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Infrastructure Development and Maintenance in the Oil Producing Areas of Southern Nigeria: Implications, Options and Challenges

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Abstract

Over the years, the people of Southern Nigeria especially the oil producing areas are seen to have been left behind in the provision of basic infrastructures and social amenities. This has always been explained away by the high cost of development in the region brought about by the nature of the terrain. In 1990, the Federal government in an attempt to address this imbalance in the physical development of the region by the development of infrastructures adopted both land mass and terrain types among the parameters for revenue allocation. This did not provide the required cure nor has any so far. The environmental conditions and stability of the area has come under greater examination and scrutiny because of the ever growing signs of deterioration and destruction that tend to follow the continuous exploration and exploitation of the natural resources of the region. This paper examined the myriad of obstacles confronting the development of infrastructures in the oil producing areas of Southern Nigeria. It concluded that the development, improvement and maintenance of infrastructures would lead to revitalizing the national economy and launch Nigeria on a path of rapid economic development to achieve our often touted but much desired vision 20:20-20. The paper recommended options and a framework for developing and maintaining the required infrastructure in the oil producing areas of Southern Nigeria.

Keywords: *Infrastructure, Development, Oil producing areas*

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Background to the Study

Many scholars have attempted in varying ways to define or explain the meaning and concept of the term "infrastructure". Notwithstanding the fact that it is not the intention of this paper to explore or examine the myriad of definitions, the National Research Council of the United States of America captured to a very great extent the totality of the term as referring to "both specific functional modes – highways, streets, roads and bridges; mass transit; airport and airways; water supply and water resources; waste water management; solid waste treatment and disposal; electric power generation and transmission; telecommunication and hazardous waste management – and the combined system these modal elements comprise. A comprehension of infrastructure according to National Academy Press (1987) spans not only these facilities but also the operating procedures, management practices and development policies that interacts together with societal demands and the physical world to facilitate the transport of people and goods, provision of water for drinking and a variety of other uses, safe disposal of societies waste products, provision of energy where it is needed and transmission of information within and between communities. Getis and Fellmann (2002) see Infrastructure as public works comprising transport facilities, social services, public utilities, communication facilities and other installations and services needed to facilitate industrial and other forms of economic development.

Infrastructure is distinguishably classified into Soft and Hard. Hard infrastructure refers to the large physical networks necessary for the functioning of a modern industrial nation, whereas Soft infrastructure refers to all the institutions which are required to maintain the economic, health, and cultural and social standards of a country such as the financial system, the educational system, the health care system, the system of government and law enforcement, as well as emergency services. Fedderke and Garlick (2008) were of the opinion that infrastructural facilities can be grouped into economic and social categories. The economic category includes transport, communication, power generation, water supply and sanitation facilities while the social category includes educational and health facilities.

The examination of infrastructure has been changing over the time in tandem with technological innovations. Implicit in this is that what is regarded as infrastructure in one country may not be so regarded in another. However, certain characteristics are attributed to infrastructural facilities and these include- high sunk costs, non-rivalry in consumption at least to congestion limit, possibility of price exclusion and bestowing externalities on society. These attributes accord with the views of Rangaranjan Commission (2001). According to Okoronkwo and Ezeh (2012), infrastructures are not the things with which nature has endowed man, but the profitable conversion of these natural resources for the advancement of the society and benefit of man. Rainfall for instance is a natural gift from God. It is not an infrastructure. It becomes one when man technically conserves this gift and develops it to serve as regular and functional water supply for agriculture, industries and for domestic uses. Piped water is a basic necessity and infrastructure for modern living. A reliable supply of it brings an immediate and very tangible improvement to the standard of living. The sinking of boreholes, the building of water towers, the reticulation of water to every home; all come under infrastructural development as it concerns water. Rivers are natural reliefs. When they are dammed, they serve not just as nature's gift but provide electricity which also is basic infrastructure that not only improves the standard of living of the people but also increases the efficiency of production system.

The Southern Nigeria Region

The Southern Nigeria region covers all those areas within the Niger Benue trough except the States of Kogi Kwara and Benue. It is characterized by the western highlands, Eastern scarp lands/lowlands and the Niger Delta region which is a triangular, fan shaped deposit of mud, silt or gravel created by the river Niger where it flows into the Atlantic Ocean.

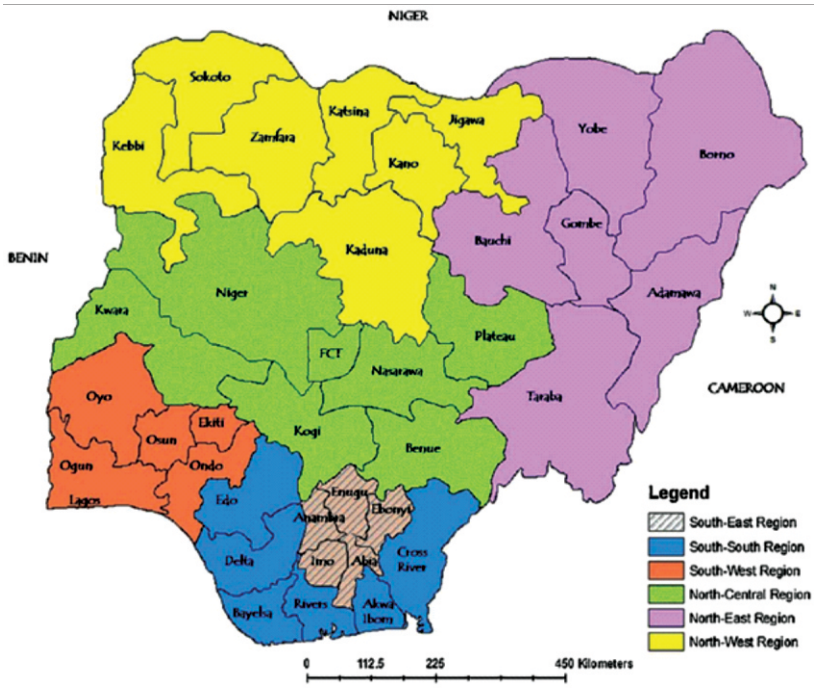

Figure 1: Map of Nigeria showing the six (6) geopolitical zones.
Source: https://www.researchgate.net/figure/51795009

(Note: The thick red line demarcates the northern parts from the southern part.)
Politically, Southern Nigeria comprises the geopolitical zones of South-East, South-West and South-South. The oil producing region of Southern Nigeria includes all the areas structurally covered by quaternary deposits of recent and Pliocene-pleitocene geologic periods. This is home to over seventy percent (70%) of Nigeria's oil and gas deposits. The zone is underlain by sedimentary basins extremely rich in hydrocarbon resources. Burke (1972), (1982) and Knox Omotsala (1989) reports that the sedimentary prism is of the order of twelve kilometers (12km) overall thickness deposited successively in continental crust followed by the ocean crust.

The climate of the region is characterized by a long rainy season from March-April through October. Precipitation increases from the north with an average of 2,500 mm to the coastal area where mean annual rainfall averages around 4,000 mm, making it one of the wettest areas in Africa. The wet season peaks in July, and the only dry months are January and February. However, even during this dry period an average monthly mean of 150 mm rainfall is recorded in the delta area. Relative humidity rarely dips below 60% and fluctuates between 90% and 100% for most of the year. During most of the rainy season cloud cover is nearly continuous resulting in 1,500 mean annual sunshine hours and an average annual temperature of approximately 28° C (Barbour et al. 1982).

The most important determinant of biological variation in Southern Nigeria especially the delta region is its hydrology. In addition to precipitation, the major variation in the hydrological regime comes from the Atlantic Ocean's tidal movements and the Niger River flood.

Figure 2: Typical Southern Nigeria vegetation

Infrastructure Development

The need for the development of infrastructure in any region cannot be overemphasized. This is because infrastructure is the gateway to economic, social and almost unmistakably wholesome political development. Notwithstanding, however, the development of infrastructure is costly. For instance, infrastructure funding in Africa for the first half of 2010 stood at US $3.04 billion. For the same period in 2011, the amount stood at US $4.435 billion. Ever since, there has been an upward trend. Project funding in 2010 increased significantly from 2009, reaching $21.7 billion, up from $18.9 billion.

The scenario justifies the obvious need for the development of infrastructure in the region. According to the United Nations Environment Program (UNEP) and UN-Habitat, Africa is urbanizing at a rapid rate with urban centers growing faster than anywhere else in the world. African cities will grow by 25% by 2025 and 60% of the continent's population will be urbanized by 2050. It is clear from surveys conducted (Dealogic 2010, Okoronkwo &Ezeh 2012, Africa Investor 2011) that an enormous amount of people are moving out from rural areas into urban areas thus putting not only a necessity but also a demand for the provision of infrastructure between nodes as well as in the cities and ultimately the regions.

It is very sad to discover however that out of one hundred (100) bankable infrastructure projects in Africa in 2010/2011, Nigeria had only five (5) sharing one of the five –Main One Undersea Cable project- with Ghana. Of the remainder, two (2) were un-finalized one of which –Niger River Bridge, Delta Region or what is commonly known as the second Niger Bridge, is in the Southern Nigeria region.

Table 1: Some Infrastructural Development Projects in Africa 2010/2011

Infrastructure Project	US $	Country	Infrastructure Project	US $	Country
Northern Corridor Mombasa-Kampala Rail Link	2.1b	Kenya/ Uganda	Main One Undersea Cable	1.5m	Ghana/ Nigeria
Nairobi-Thika Highway project	320m	Kenya	Olkaria 1 Geo Thermal Plant	310m	Kenya
Mombasa Port Container Terminal	161m	Kenya	Lake Turkana Wind Power Project	583m	Kenya
Nairobi Southern Bye-pass Road Project	210m	Kenya	Markala Hydro Power Station	59.3m	Mali
MasaukoChipembere Highway	20m	Malawi	Econet Wireless 3G Network Extension	Un-finalized	Zimbabwe
Kapichira Hydro Power Station	60m	Malawi	Nsenje River Port	6b	Malawi
Benga Power Plant	1.2b	Mozambique	Luderitz Wind Project	150m	Namibia
Anxial Diesel Power Plant	51.9m	Namibia	Ondo-Laje-Ajibandele Auto route	70m	**Nigeria**
Enugu "Red Line" Mono rail Transport Project	250m	**Nigeria**	Lake Kivu Methane Gas Project	325m	Rwanda
Khartoum International Airport	1.2b	Sudan	Tanganyika-Zanziba Power Line		Tanzania
Dar es Salaam Water program	402m	Tanzania	Singida Wind Power Project	92.3m	Tanzania
Fertilizer Terminal Dar es Salaam port	20m	Tanzania	Coal Fired Power Plant and Two Iron Ore projects	3b	Tanzania
Mpanga Mini Hydro Power Plant	26m	Uganda	Bujagali Hydro Dam	860m	Uganda
West African Cable System (WACS)	650m	Regional West, Central and Southern Africa	Limbe Deep Water Project	850m	Cameroon
Caprivi Link Power Interconnector	416.3m	Namibia/ Regional	Dakar-Diamniadio Toll Road	533m	Senegal
National Housing Program	Un-finalized	Gabon	Markala Sugar Project	Un-finalized	Mali
600 MW Power Plant	Un-finalized	Nigeria	First Quantum Minerals Kulambila Copper Project	1b	Zambia
Multi Modal Transport Program	600m	Congo (DR)	Tatu City Urban Development	5b	Kenya
Lower Orange River Hydro Power Program	320m	Namibia	Sangaredi Alumina Refinery Plant	6.3b	Guinea
Arzew Ammonia and Urea Complex Project	2.5b	Algeria	Algeria-Spain Gas Pipeline	1.32b	Algeria
Niger River Bridge, Delta Region	Un-finalized	Nigeria	New Rusumo Bridge	50m	Rwanda/ Tanzania
Eastern Sudan Development Program	4.2b	Sudan	Zanzibar Urban Services Program (Stone Town)	38m	Zanzibar
Mtwara Development Corridor	Un-finalized	Malawi/Moz./ Zambia/ Tanzania	Walvis Bay Port Expansion and Development Plan	97.1m	Namibia
Millennium Hydro Power Dam	4.7b	Ethiopia	Lamu Port	16b	Kenya
National Airports Rehabilitation and Expansion Program	166.6m	Namibia	Nuclear Power Station	Un-finalized	Namibia

Source: Africa Investor 2011. Ai Pubishers Inc. Pretoria

Namibia, one of the poor countries of Africa with a population as low as 45 million engaged in infrastructure development worth US $685.6 million as against Nigeria's US $320 million over the same period (2010/2011). Herein lay the problem. What is wrong? Obviously, there are challenges particularly as it concerns the Southern Nigeria Region.

The Challenges to Infrastructures Development in Southern Nigeria

Restated, infrastructure is the basic structure of services, installations, and facilities needed to support industrial, agricultural and other economic development in a region. Infrastructure is important for improving the quality of life of the people.

a. Geological Challenges: Although the Southern Nigeria region is located outside the major earthquake zones of the world, a number of earth tremors have been recorded in recent times. Most studies –Ajakaiye (1986), Akpati (1989) - have tried to link these tremors to the mid- Atlantic ridge system whose crest is offset by fracture zones with very high seismic activities. In addition to this geotechnical characteristic of the area, is the material composition itself. The base of the sedimentary fill in the delta consists of unifossiliferous sandstones and gravel weathered from the underlying pre-Cambrian basement (Reyment, 1966; Reyre, 1966 and Akpati, 1989). Overlying these materials are marine shells, sandstones and limestone of Albanian and Santorin age which terminated in the series of geomorphic processes of folding, faulting and basic igneous intrusions. It is believed that the next cycle of depositions began with transgression that lasted into the Maestrichtian period. However, the geomorphic processes that resulted in the present Niger Delta is said to have started during a regression that began in the early Eocene period (Kogbe 1965). This basic geologic structure has given rise to three main geomorphic units recognized by Allen (1965). They include the River Flood Plain, which covers an area of Eight Thousand Four Hundred (8,400) square kilometers; the Mangrove Swamp which extends from the Benin River in the West to the Calabar Rio del Rey estuary in the East; and covers a total area of about ten thousand (10,000) square kilometers. Lastly, there is the series of barrier island chains which lie between the mangrove swamps and the sea covering about two thousand (2,000) square kilometers.

The importance of the foregoing description is to point to the total lack of agricultural land beyond the river flood plains. Available geotechnical information shows that the soil underlying the area may be generally characterized as soft, highly compressible organic and inorganic clays overlying fine sand at great depths. The water table within the area is usually close to or above the ground surface, fluctuating in sympathy with the mean sea level. This means that through the entire area, it is impossible to obtain clean portable water. Thus, the two most essential basics of infrastructure development, land and water are the missing link in the quest for development and growth among people of the Niger Delta region.

Coastal subsidence and sea level changes are other geological factors that pose challenges to infrastructure development especially in the Niger Delta region. Geophysical studies have shown strong evidence of both tectonic subsidence and sediment loading and compaction. There are also changes in deltaic site depositions whereby deltaic sediment loading cause the over-lying and pressured shale to squeeze forward and upwards on a slope. Consequently continued overpressure leakage, changes in shale mineralogy and compaction of the sand/shale sequences have led to further subsidence. The consequence of these geological formations is evident in the region during the construction of roads where huge sums of money are first spent on gathering reliable geotechnical information.

b. Climatic Challenges: The Niger Delta Region fall under the tropical climate (semi-hot equatorial zone). This area is influenced by the usual climatic factors of latitude, elevation and in this case nearness to the ocean, wind direction and sunshine. The climate is characterized by two major air masses – the warm and dry Tropical Continental (ct) air mass from the Sahara to the north otherwise known as the harmatan winds; and the hot and humid tropical maritime (tm) air mass from the Atlantic Ocean, otherwise called Tropical Discontinuity which oscillates north – south following the apparent movement of the sun. It is this north – south oscillation of the sun that brings the basic variations to the weather and climatic conditions in the Niger Delta Region.

Table 2: Mean Climatic Parameters of Southern Nigeria Region

Month	Rainfall (mm)	Sunshine (hrs)	Rh @ 10 hrs (%)	Rh @ 16 hrs (%)	Mean Daily Min. Temp (^{0}C)	Mean Daily Max. Temp (^{0}C)	Mean Daily Temp (^{0}C)
January	21.55	154.7	84	60	20.8	31.4	26.1
February	21.17	149.4	83	60	21.4	32.3	26.9
March	117.11	128.5	83	69	22.2	31.7	26.9
April	166.34	137	83	72	22.3	31.4	26.9
May	253.99	139.3	82	75	22.5	31.4	26.7
June	332.93	93.4	86	80	22.2	29.0	25.5
July	364.06	50.7	86	82	21.7	27.9	24.9
August	406.90	77.7	87	81	21.8	27.9	24.9
September	374.78	63.2	87	84	21.9	28.5	25.2
October	276.16	97.2	95	79	21.9	29.5	25.7
November	59.99	104.6	85	75	21.7	30.5	26.1
December	15.98	155	89	72	26.1	31.1	25.8
Month	Rainfall (mm)	Sunshine (hrs)	Rh @ 10 hrs (%)	Rh @ 16 hrs (%)	Mean Daily Min. Temp (^{0}C)	Mean Daily Max. Temp (^{0}C)	Mean Daily Temp (^{0}C)
Mean	200.9	112.6	85	74	22.2	30.2	26.0
Max	406.9	115.0	89	84	26.1	32.3	26.9
Min	16.0	50.7	82	60	20.8	27.9	24.9
STD	151.34	36.52	2.09	7.98	1.31	1.58	0.77

The temperature is dependent on the apparent movement of the sun, wind direction and speed and the location of the area near the Atlantic Ocean. These factors combine to produce a mean annual temperature of about 28.8°C. The mean daily temperature recorded in March (28.8°C) is the highest while the lowest daily temperature of 22.5°C is recorded in the month of July at the peak of the rainy season, instead of December which is the northern winter, and when the chilling north-east trade winds dominate the entire country. Even so, the variation in mean daily air temperature is about 6.3°C (10°F). This very low temperature range is due to the relative location of the area to the sea and its exceptionally flat topography. Thus, the air temperature does not vary much throughout the year.

The rainfall characteristics including the spatial and temporal distributions, its variability, and the length of the sunshine hours, temperatures and evaporation regimes as well as intensity, all depend on the dynamic characteristics of the Inter Tropical Discontinuity (ITD). Thus, the

mean annual rainfall varies between 2,500mm on the Ondo Coastal Zone to 4,500mm in the Niger Delta and decreases slightly as one move inland from the coast. This relative high rainfall is due to the area's coastal location and contiguity with the Atlantic Ocean which complements the ITD initiated rainfall with localized convectional rainfall. The dates of expected start and end of rainy season are February 20 and December, 10 respectively. This puts the mean duration of the season along the coast at 300 days per year. The rainfall regime is characterized by double maxima in the months of July and September, with a short break in the month of August. This is an anomaly that is usually always referred to as "August Break". The break is associated with the brief southward retreat of the ITD. The lowest rainfall figures of 25mm are recorded in the months of December and January. The picture that is painted with this scenario depicts a long term trend based on data collated for over forty (40) years. This does not however mean that there are no variations out of the ordinary. Yes, there are lots of seasonal as well as occasional periods of anomaly in the rainfall regime of the Oil producing areas of Nigeria. Given this level of rainfall activity, the relative humidity is of significant importance since most of the economic activities whether in oil exploration and production; or in local fishing and fish processing such as drying are all outdoor activities.

The relative humidity in this area is high throughout the year with the highest values of eighty percent to ninety percent (80% - 90%) recorded in the month of August and the lowest values of fifty six percent to eighty percent (56% - 80%) between the months of October and March. The wind pattern is in conformity with the dynamic migratory movements of the ITD. The surface wind directions are southwesterly during the rainy season (February – January) but the south easterlies and westerlies depend on the shifts of the pressure belts in the open sea.

The land and sea breezes significant in the generation of convection rains are small in scale because the environmental characteristics of the large swamp flats, lagoons and creeks combine to reduce the factors partially necessary for the development of the land and sea breeze. Consequently, a moderate wind speed of five to ten (5 -10) knots for most of the year. Sometimes the speed could hit a devastating twenty –twenty five (20 – 25) knots during thunderstorms. Sunshine is sometimes rare in this region. The mean annual sunshine hours is 1537 while the mean monthly values vary between 51.6 and 176.7 hours in the month of July and December respectively. The low amount of sunshine in July has been attributed to the greater amount of cloudiness and rainfall characteristics of the region. The high value for December is due to the prevalent clear skies when the ITD starts its migration towards the north.

c. Man-induced Challenges: Perhaps the most dastard of all challenges is the exploitation of oil and gas in the area. It is noted that early in the history of petroleum exploration, canals were constructed with little regard to environmental impact. Canals and spoil levees produce an artificial drainage network, which may interrupt the natural drainage density. In the Niger delta, the canals have created diverse problems of social and economic nature. At Opueka for instance, they have allowed sea water to intrude from the sea thereby destroying the original vegetation of the white mangrove, and encouraged increased traffic by those using high speed outboard motor engine thereby worsening erosion along the canals. The spoils from the canals during construction have also been washed back into the channels, thereby affecting water quality and fishing.

d. Economic/Legal Challenges: There is no gain saying the fact that Nigeria lacks the competence and technology to undertake major infrastructural development programs. This leaves the task to foreign multinational companies who possess the appropriate technology. Undeservedly however, small markets and inadequate tariffs are key economic challenges to investing in infrastructure development in Africa especially by foreign multinational companies. Additionally, investors face other challenges such as exposure to leverage, legal and ownership issues, environmental risks as well as regulatory challenges.

It must be restated that infrastructure development is costly and takes a long time to complete. For instance, the Africa Development Bank approved a US $25million private sector loan for phase I of the KivuWatt Power project in Rwanda which is being developed by Contour Global of New York, USA; China Exim Bank is funding the 50MW Singida Wind Power Project in Tanzania; MotaEngil of Portugal is handling the second Zambezi River Bridge in Mozambique. The Kampala road network in Uganda will last until 2023; Japan will fund the rehabilitation of the Mozambique border-Blantyre rail line; China Exim Bank is examining the possibility of funding the construction of the new Kribi deep water port in Cameroon; Japan Port consultants are undertaking the feasibility study for the construction of the new Lamu port in Kenya.

e. Political Challenges: Nothing kills investment as an inclement political climate. Unfortunately, this is the bane of most African countries especially Nigeria. In North Africa for instance, some projects sponsored by Gulf investors ground to a halt before political instability in the region took its toll. There are so many bankable infrastructural projects in Nigeria but the volatile political climate in Nigeria is the biggest headache for would be investors- boko haram, kidnapping, armed robbery, political agitations and so on. These militate against effective development of infrastructure in Nigeria and the Niger Delta Region.

Conclusion & Recommendations

i.) Infrastructure is not something that is really done by the private sector on a large scale especially across Africa. Government must allow investors to provide these services by promoting a friendly environment in which people can bank upon. Government must become more amenable to partnerships with the private sector as a means to deliver infrastructure development and a tool to create jobs.

ii.) The perception of political risk must be handled appropriately. Indeed, there have been developed a number of products (such as the World Bank Partial Risk Guaranty and MIGA's political Risk Insurance Instruments) to mitigate political risks and to promote an enabling economic environment for capital inflows in Nigeria and the region.

iii.) There is the urgent need for training and retraining of our youth in vocational and technical skills. Adaptive Technology is the answer if our lofty dream of becoming one of the first twenty (20) developed economies of the world is anything to go to sleep with.

iv.) There is a very close link between the resources and infrastructure development. In Mozambique for instance, as the Nacala port is being assessed for rehabilitation and expansion, the natural deep water port will serve as an export outlet for coal from the Zambezi Valley and an anchor project for the Nacala development corridor in which a

Brazilian mining giant "Vale" is a majority shareholder. The Southern Nigeria region is rich in oil and gas resources. It is sad that hitherto, we have not consolidated a number of infrastructure opportunities in this direction.

v.) We have agreed in the course of our discourse that infrastructure projects are costly. Non-the-less we have enough money as a nation and corporate entities to fund the projects. Corruption and nepotism have eaten deep into the fabrics of our society that no project is awarded as it should notwithstanding our "due process". It is suggested that we revert to turn-key projects. Malaysia, Bahrain, United Arab Emirates and many other oil producing states have been doing so with remarkable success.

vi.) Our examination of the geological and climatic challenges confirmed the grip that the geographic environment of the region has on the potential for development. This negative trait can be turned into great advantage given the enormous revenue that the region is generating for the country. The geographic environment of the region is no more hostile than that of the Nile Delta Region in Egypt, the oil producing area in Louisiana in the United States of America, or in Venezuela. What is required is the political will.

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