

## APPLICATION OF MODELS IN RESTRUCTURING WATER SUPPLY AND SANITATION PROJECTS FOR SUSTAIBLE DEVELOPMENT

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### Abstract

Restructuring water supply and sanitation projects delivery was carried out in this research through investigation the already existing process of management coordination and sectorial sustainability in relation to steady access to water supply and sanitation facilities. This investigation also covered laboratory analysis of groundwater as a major source of drinking water in the area to ascertain the quality of water supplied to the people and found out that the water samples were actually contaminated with values that were greater than the WHO acceptable standard for water quality. The water samples were analysed to check for microbial constituents for total bacteria count and only two samples out of the 12 samples had values below WHO accepted standard, while the result for other microbial parameters showed had values that were above WHO acceptable standards which shows that the water samples were all contaminated. This contamination was an outcome of leachate infiltration into groundwater and solute transportation of contaminants from pit toilets and soak away pits into groundwater sources as a resultant effect poor access to public toilets and poor provision sanitation facilities and generally poor sanitary conditions. Therefore, restructuring the sector became necessary to help separate the joint management of water supply and sanitation so that the federal ministry of water resources would be completely responsible and accountable to water supply while the federal ministry of water resources would handle the sanitation section thus, the application of business and governance models became the tools used in restructuring the system. In that case, it was stipulated that part privatization (deregulation) should be part of the new structure to still allow government ownership of the sector with the responsibilities of receiving tax from contractors and monitoring the implementation process to ensure a result oriented system that would sustainably grant regular access to water supply and sanitation in the system. The new structure suggests that the management, coordination and sustainable maintenance of the system would be contracted to private companies that would take over such functions from government agencies but would be subject to paying tax to the government depending on what the contract agreement will stipulate in relation to government financial interest as well as contractors interest too. These contractors from the inception of the contract, handle the steady supply of water repairs and maintenance of the system which include the sanitation sector. This is targeted towards solving the problems of poor access to water supply and sanitation that would create a satisfactory consumer feedback that would display a sustainable standard water supply and sanitation project delivery in Nigeria.

**Key Words:** Restructuring, Water Supply, Sanitation Sector, Government, Contract, Deregulation.

## **Introduction**

Globally, the importance of water supply and sanitation sectors cannot be over emphasized due the roles they play in sustainable economic development and human health protection that relates to control and reduction of high morbidity and mortality rate. Restructuring water supply and sanitation projects in Nigeria, using Business and Governance Model, can only stand as a tool to sustainable development if the already existing structures are x-rayed to find out the possibilities of filling up the gaps in areas of government policy and inadequacy of operational and implementation processes that Nigeria water and sanitation sector should have accommodated for effective and efficient day to day running of the system. Bakker (2003) identifies that, for water supply management to have a sustainable improvement process, there has to be presence of government reforms and possible adjustment in structure of the utility section of the systems.

The water supply and sanitation systems in Nigeria have been basically left in the hands of the government to be managed. The government agencies are Federal and state ministries of water resources and Environment, as well as the local government systems. This has made the system to almost collapse because government pattern of funding and bureaucracy in the distribution and management of the resources within the sector sets back the rate of improvement and management of the system.

This research basically wants to fill the gap arising from not incorporating private participation into water and sanitation sector to aid the efficient supply of water and sanitation facilities to the rightful and certified experts for proper and effective execution of realizable projects in this sectors. Enyinna (2018) on his research on impact of proliferation of bore hole development projects in Abia state, Nigeria stated that borehole development projects which should have been executed by government agencies as stipulated by the government policies are left in the hands of individuals who consult any available borehole driller irrespective of their qualifications to drill water wells and carry out borehole development projects without government agencies monitoring them and the resultant effect of such is provision of contaminated water with its corresponding water related diseases occurrences in the state. The study conducted by the national bureau of statistics in Nigeria (2005) shows the total number of households in Abia State was 1,034,100.00 and the percentage distribution of water for drinking and cooking from different sources were; pipe borne water (treated) 1.5, pipe borne water (untreated) 5.5, borehole/ hand pump 33.5, wells/spring protected, 7.1 well/springs unprotected, 6.0, rainwater, 2.2 Rivers, ponds and streams, 31.5 and others, 0.5. Abia State as one of the five states in South Eastern Nigeria also recorded 2,165 cases of diarrhoea watery without blood in 2003, 1,434 in 2004 and zero case in 2005; federal ministry of water resources, (2006). I am wondering how a State with some percentage distribution of untreated water supply to its residents, who also consume water from streams rivers and ponds likewise rainwater even as at present, could be free from water related disease. These streams and rivers are mostly polluted with human faeces and leachate from waste dumps. How is possible that such a state will have only 9 cases of cholera in 2003 zero case in 2004 and 2005?

AfDB/OCDE in USAID (2010) stated that water scarcity has been ravaging Nigeria due to variation in occurrence of rainfall in some areas and very low water distribution standards. The water and sanitation infrastructure has also suffered from low level maintenance due to lack of strong institutions and technical inputs. These mentioned issues all boil down to restructuring the existing systems to accommodate a sustainable approach that can facilitate the active functionality of newly incorporated structural input.

Restructuring water and sanitation systems in Nigeria will involve understudy the already existing structures to ascertain the lapses that make the system inefficient so as to have very good knowledge of where and how to restructure the sector. According to African economic outlook, Nigeria (2007) Lurching of Nigeria's National Water Supply and Sanitation Policy was geared towards cartographic development for hydrogeological locations and development of laboratories for water quality analysis likewise adoption of private-sector water project development and expansion of rural water supply and sanitation projects. Despite this government efforts to strengthen the institution of water supply and sanitation, Nigeria still lagged behind in attaining MDG target 2015 and still lags behind in meeting with vision 2020 and MDG projection for 2025. World Health Organization (2008) stated that MDG target for

Nigeria in water supply and sanitation did not show accuracy in data presentation with fluctuation in presentation of figures by the then minister of water resources, stating that there was an improvement in quality of water supplied to the public from 35% in 1999 to 65% in 2004 which he reversed to 68% in 2005 bringing about doubt within the actors that monitor MDG realization programme with WHO reporting that the figures were about 58% for improved access to best quality water and 32% for sanitation facilities in 2008 but, in 2015, water resources per capita in meter cubed per day was estimated to about 1,219<sup>d</sup>. Figure 1 below shows the existing structure for water supply and sanitation in Nigeria.

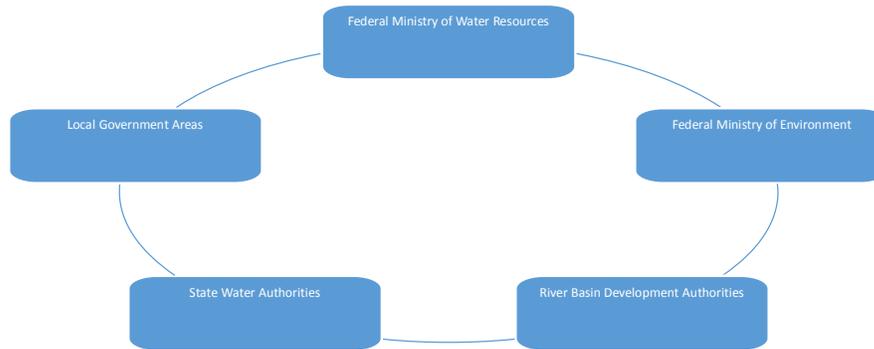


Figure 1: Existing water supply and sanitation structure in Nigeria

This structure has the federal ministry of water resources (FMWR) with the functions of policy development, acquisition of data, coordination and overseeing distribution of water resources and overseeing development projects, and ensuring availability of research funds as well as research development.

The ministry also works in collaboration with Ministry of Environment (FME) regarding water sanitation issues like sewage system projects, storm water control projects including quality control and assurance of sources of water distributed to the state.

RBDAs is accountable to the FMWR on the volume of exploited water, marketed or distributed to the consumers. They also take care of reservoirs project development, functioning and management for distribution of large volumes of water within areas allocated to them.

The 37 state water agencies (SWAs) are involved in development, functionality, quality assurance and control, and maintaining water distribution in urban and semi-urban areas. They also operate in line with civil service rules, AfDB/OCDE (2007).

The 774 Local government Areas (LGAs) are involved in rural water and sanitation (WSS) projects in the individual LGAs and for developing local water, sanitation and hygiene (WASH) sections. They also execute small water system toilet projects. Water aid, National water sector assessment Nigeria (2006).

The structure on ground in the state does not permit the private sector to participate in water supply and sanitation projects and this causes lots of privately inexperienced persons who are not properly monitored by the government to dabble into such jobs leading to the presence of so many failed borehole projects and non-functional and low standard sanitary facilities like public toilets. Enyinna et al (2019) researched on development groundwater prospect model in the face of lots of failed water projects in the state to assist the actors in water sector identify areas of prolific groundwater before going into un-surveyed exploitations that end up in dry wells after a while especially during dry season. These failed projects reflected in Millennium development goal target (MDG) for 2008 as stated by WHO/UNICEF (2010) that access to water for urban and rural areas were 16% and 42% while the expected target was 85% but on the sanitation side, urban and rural MDG record was 42% but it was expected of the system to attain up to 70% MDG target. The federal ministry of water resources (2004) stated that the expected target of the federal republic of Nigeria for access to water and sanitation 2007, was 60%, 2010, 65%, 2015, 80%, 2020%, 2025, 100% and 2025 and above will

be concentrating on sustainability of 100% for the entire system. Enyinna et al (2019) also argued that groundwater vulnerability index model was also needed to identify possible areas in Abia state that are vulnerable to groundwater contamination due to low poor sanitation attitudes in the area that leads to occurrence water related diseases and low level water distribution efficiency. Nkemdirim et al (2020) in a research on microbial examination of groundwater supply sources in Abia state, Nigeria, found out that the poor sanitary condition of the state affected groundwater sources since the water quality analysis in the area showed that only one sample from one location in the state had coliform count below WHO standard while others had coliform count above WHO recommended standard. Restructuring water and sanitation sector would drastically reduce the incidence of occurrence of water related diseases and improve access to water and sanitation for sustainability of the viability of these sectors.

## **Materials and Methods**

Primary and secondary data was used in other the carry out this research to restructure and already existing structure for efficiency and effective functioning of water and sanitation sector. Primary data was adopted from water samples collected from sources that are close to landfills waste dumpsites soak away pits and pit toilets to ascertain if microbial parameters where transported into these water sources via these landfills and waste dump sites while the secondary that was collected from federal ministry of water resources on the already existing structure in the water and sanitation sector in other to assist this research to develop a better structure that can facilitate an urgent improvement in access to water and sanitation in the state. Water samples were collected directly from well heads and properly flushed before collection. This was done for all the research sample locations using newly purchased sterilized sample bottles and samples were collected after using disposable rubber covered with gloves. The gloves were disposed after using them at each sampling point. The sampling bottles were labelled in line with the sampling location. Sampling locations names were documented on the analysis request form. We preserved the samples in an iced cooler and took them to the laboratory for analysis within the expected time. These samples were collected from 12 different locations and were analysed in the laboratory using these microbial analytical methods. The basic medium of *nutrient agar* for culturing, sub-culturing and for total viable bacteria count were 28.0g of mac-conkey agar that was dissolved in 100ml of distilled water and was gradually heated and sterilized for 15 minutes by autoclaving at temperature of 121<sup>0c</sup> The medium was thereafter, dispensed in the plate as expected for result documentation.

Total coliform counts process involved the dissolution of 52.5gms powder of Mac-conkey agar in 1000ml of distilled water mixing and heating before autoclaving for 15 minutes at temperature of 12<sup>0c</sup> in a Petri dish in other to be documented. Media preparation of *Eosin Methylene blue agar*, which is used for differential isolation of gram-negative ureteric bacteria and total fecal count. 36gms of this medium was put in 1000ml of distilled water where it was heated for it to totally dissolve and after which it was dispensed and sterilized by autoclaving at 121<sup>0c</sup> temperature for 15 minutes, it was also dispensed in Petri dishes and result wasrecorded.

The procedure for Salmonella shigella agar medium for selection and for isolation involves 60gms in 1000ml of distilled water, the mixture was heated for it to properly dissolve with total dispensation, then sterilization was also done by autoclaving at 121<sup>0c</sup> in 15 minutes and was dispensed into the plate then results was extracted for documentation.Cetrimide agar base was applied for cultivation pseudomonas species and was also applied in cultivation of hydrocarbon utilizing bacteria. 46.7gms of the substance was dissolved in 1000ml of distilled water and was heated for the solution to dissolve totally, we added 10ml of glycerol and heated with frequent agitation, it was allowed to boil for one minute and was also

sterilized by autoclaving at 121<sup>0c</sup> temperature at a time frame of 10 minutes after, results were documented. In the case of Thiosulphate – Citrate-bile salt TCBS, this selective agar was used to isolate and count the Vibrio Cholera. It was done by dissolving 89gms in 1000ml of distilled water which was heated and boiled continuously so as to dissolve the medium totally and the medium was dispensed in petri dish and results wererecorded.

**Results and Discussion**

Table 1: Laboratory Results for microbial contamination of groundwater samples in Abia state

Parameters	WHO	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Borehole 5	Borehole 6	Borehole 7	Borehole 8	Borehole 9	Borehole 10	Borehole 11	Borehole 12
TBC	30	36	32	34	40	43	32	33	39	29	38	30	36
TCC	10	18	34	34	19	11	15	18	13	12	27	19	23
TFC	0	15	22	10	13	19	11	14	11	27	23	15	15
TEC	0	8	11	21	10	9	7	12	20	17	15	19	17
TVC	0	13	3	17	5	11	10	1	8	11	12	10	7
TSC	0	25	24	31	21	12	11	3	9	23	28	19	14
TPC	0	2	5	6	16	14	13	11	6	2	4	7	5
TFUGC	0	1	8	11	2	6	4	1	3	16	14	15	18

Table 2: Abbreviations and meanings

Abbreviations	Parameters	Unit
TBC	Total bacteria count	cfu /100ml
TCC	Total Coliform count	cfu /100ml
TFC	Total fecal count	cfu /100ml
TEC	Total E coli count	cfu /100ml
TVC	Total Vibrio count	cfu /100ml
TSC	Total Salmonella count	cfu /100ml
TPS	Total Pseudomonas Count	cfu /100ml
TFUG	Total Fungal Count	cfu/100ml
WHO	World health organization	cfu/100ml
Borehole 1-12	Borehole 1-12, which represents the sample locations	

Results below displayed graph for laboratory results of microbial constituent of groundwater

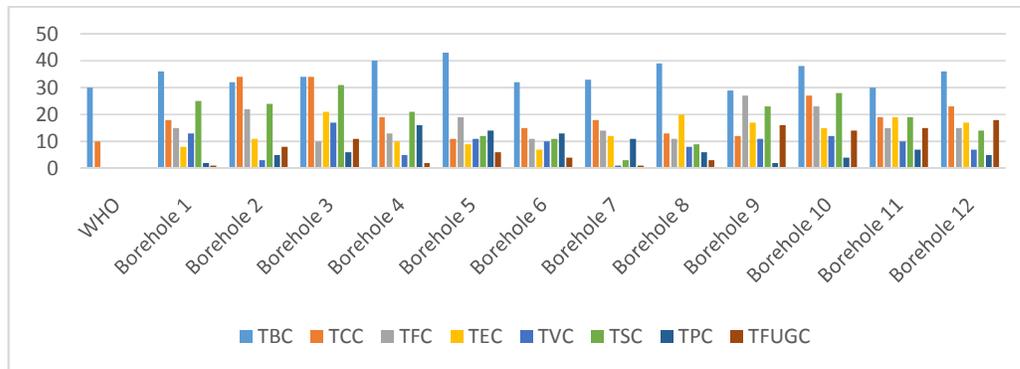


Figure 2: Laboratory analysis of microbial constituent of groundwater.

## Restructuring water supply and sanitation projects

Water supply and sanitation projects could be said to undergo restructuring when changes are effected in the already existing organizational modus operandi and operational standards in relation to project utilities like the organizational structure of water supply and sanitation sector projects, style and process of operations and management, stakeholders participation, sectorial decision making allotment and sectorial accountability Bakker (2003).

### Restructuring water supply and sanitation project using Business and Governance Model

This research will make use of combination A business model and water governance model to restructure water and sanitation sector projects in order to cooperate sectorial project deficient possibilities that would boost access to water supply and sanitation. Figure 3 below shows the restructured water and sanitation sectorial projects.

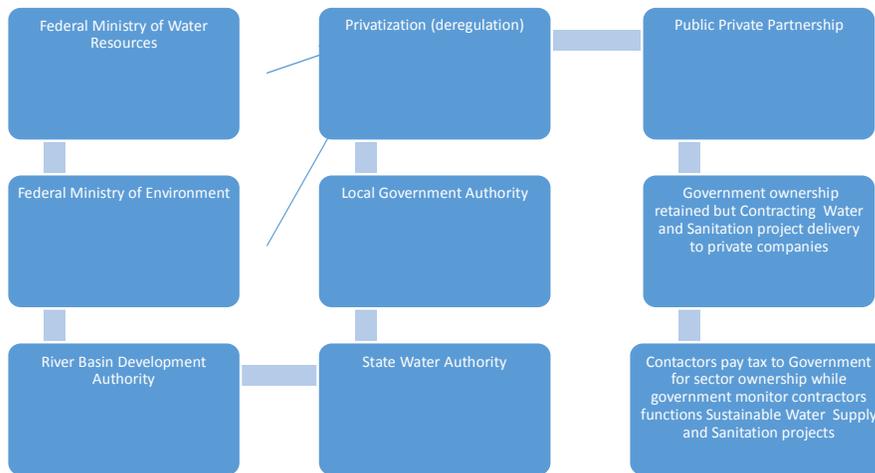


Figure 3: Restructuring water supply and sanitation project delivery

## Discussion

The present water supply and sanitation structure in our study area was examined to ascertain the human health associated risk of consuming contaminated water supplied to the system as an after effect on poor sanitary conditions due to poor access to water quality standard water and sanitation facilities. The laboratory results from analysis conducted using groundwater samples to ascertain the level of microbial contamination in water shows that only two water samples from boreholes nine and eleven were below or within world health acceptable standards for groundwater for total bacteria count. The rest of the water samples from 12 different boreholes had values that are more than world health organization standard for other microbial parameters that were scientifically analysed. Several literature in the state library has shown that large amount of money has been spent in water and sanitation projects Abia state ministry of water resources (2017) despite this claim, access to water and sanitation still remain poor with high rate of mortality and morbidity arising from water related diseases and poor sanitary conditions in the state. African development fund (2007) stated that, due to insufficient safe water supply and

sanitation facilities, Nigerians became victims of water related diseases like cholera, diarrhoea, guinea worm, and typhoid fever, in many areas. The mortality rates report was high in figure, to the tune of 110.6 for infants and 193.6 for under-five per 1000 live births, comparatively to the average of 83.6 and 139.6 All over Africa.

This line of thought has necessitated the policy support decision making tool for restructuring water supply and sanitation from its orthodox fully government ownership and total management, distribution and maintenance of water resources and sanitation facilities to deregulation of the water and sanitation sector so as to accommodate public private partnership with delegated responsibilities of distribution management coordination and maintenance of the system, with tax returns to the government, government ownership of the system and monitoring the companies that are given these contracts to ensure a systematic drastic reduction of misappropriation, as well as ensuring the maximum inputs for standard quality output, as outcome of private companies incorporation for sustainable development of water and sanitation project delivery. There is one problem with water supply and sanitation sectors in Nigeria. This problem emanates from not isolating water supply projects from sanitation projects possibly because the global view of water and sanitation as one sector. I am wondering why Nigeria cannot operate the system they established by themselves which has the water supply sector under Federal ministry of water resources and Sanitation sector under Federal ministry of Environment instead having two different independent ministries merged into one in terms of water and sanitation. This restructuring incorporates separation of functions by this two ministries so that when water project development, maintenance and management are contracted to private company, it will be independent while contracts for sanitation project development, maintenance and management will also be handled by the federal ministry of environment as independent body. In the course of award of these contracts, the following should be considered (1) name of company that got the contact should be Identified (2) Type of contract (3) Operators (4) Start date (5) End date (6) Duration of contract. Thus, application of Business and Governance Model in this restructuring act entails defining the structure of ownership and organizational framework in water supply and sanitation sector as well as allocating duties to the responsible entities and risk of managing operation processes, maintenance of water and sanitation facilities and maximization of business opportunities while governance model involves explanation of principles behind best governance practices and distribution of functions likewise defining relationships between stakeholders involving their individual functions and expected mode of practice for good water supply and sanitation governance.

## **Conclusion**

The water supply and sanitation sector in Nigeria, that has been in operation over the years, with heavy funding from both the Federal government, State government and Local government authorities coupled with management corporation from federal ministry of water resources, federal ministry of environment, River basin development authorities, state water authorities and local government areas has left high percentage of the growing population with limited access to water supply and sanitation facilities which necessitated this research with findings that shows high level groundwater contamination, with microbial constituents that caused regular occurrences of water

related diseases thus the need for restructuring the system for sustainable development and maximization of opportunities in the management processes that will improve on water supply and sanitation project delivery. This brought about the application a Business model and Governance model in the restructuring process that incorporates public private partnership that entails government ownership of the system with responsibilities of receiving taxes from contractors and monitoring their over site functions to moderate contractors excesses that could hamper successful delivery of result oriented outcome in the water supply and sanitation projects in Nigeria while these contractors are saddled with the responsibility of risk of management, coordination, maintenance, marketing and effective distribution of water and sanitation facilities to the satisfaction of the consumers and every other stake holder in the water and sanitation sector.

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