



## **DESIGN, ANIMATION, COSTING AND INNOVATIONS OF SMART TOILET PRODUCTS IN BAUCHI METROPOLIS**

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### **Abstract**

*The design, animation (using Google Sketch up, BIM and Lumion), costing and innovations in the provision of Smart Toilets can never be underestimated in Bauchi, of which most African countries, especially some states in Nigeria have not actually migrated to the next higher level in terms of hygiene as open defecation is still a norm. To overcome this challenge there is the need to shift from the use of local unimproved pit latrines to something innovative and have suitable latrine designs that would not only be cost-effective, environment-friendly and easy to construct but also would be acceptable to people especially less privileged arise the concept of low-cost but high-quality toilets called 'SMART TOILETS'. As a result of this, the Federal, State and Local governments are presently trying to achieve safe hygiene practices for a collective responsibility, sustainable waste management and benefits to the society. Bauchi is one of the thirty-six political administrative states in Nigeria offering good opportunity for human settlement due to its peaceful atmosphere with less security challenges, attractive terrain and moderately open defecation free area which paved way for adequate market for toilet business to thrive, in order for the community to migrate from OD to ODF. The non availability of a well fitted squat pan and a trap with a good super and substructure as collection point coupled with lack of ceramic solution that combines squat pan and trap as a monolithic structure is still a mirage, despite the introduction of plastic SATO (Squat and Stool). Hence, the contribution of this work can never be over emphasized as the results and findings of relevant to professionals in design, animation and ceramics with other future possibilities will provide a lasting solution. It has been recommended that government and stakeholders should strictly enforce and implement the laws that will promote 'Use The Toilet*

*Campaign' towards positive development in the state by providing more improved Smart toilets products for cost effective toilet structures.*

**Keywords:** *Development, hygiene, open defecation, squat pan, toilet*

## **Introduction**

In reality, open defecation remains a huge obstacle for people and is responsible for thousands of unnecessary deaths and unhealthy situations. Eradicating it is crucial to achieving Global Goal number 6 on sanitation. Some Bauchi communities were triggered effectively with community led total sanitation (CLTS) and embark on a journey of rapid collective behavioral change, achieving open defecation free (ODF) status and getting certified as such are important milestone in the process rather than the end of the journey. Therefore, toilet architecture changes with situations and conditions, needs and requirements of the community in order to migrate from OD to ODF using locally sourced materials such as ceramics.

Sanitation and hygiene is a public health issue not just an individual household concern. Even if only a few families do not practice safe sanitation and hygiene, the whole community is at risk. Therefore the aim is to achieve 100% coverage of improved sanitation and safe hygiene practices, the achievement of which is both a collective responsibility and benefit. According to the UNICEF/WHO (2012), 82% of the 1.1 billion people practicing open defecation live in 10 countries and Nigeria is one of them. The others are India, Indonesia, Pakistan, Ethiopia, Nepal, China, Sudan, Niger and Mozambique. It means that to continue with the use of un-improved pit latrines that become a reservoir of open defecation with flies in and out, cockroaches in multitudes, smell from kilometers, impossible to wash, maintenance is close to zero, easy to collapse, un friendly to children, adults skeptical to get injured we can to shift the paradigm. To overcome this challenge there is the need to shift from the use of local unimproved pit latrines to something innovative and have suitable latrine designs, animation, construction, supervision and maintenance that would not only be cost-effective, environment-friendly and easy to construct but also would be acceptable to people especially less privileged arise the concept of low-cost but high-quality toilets called 'SMART TOILETS'. Sensitization and promotion of durable but affordable toilet facilities is very important. This is a

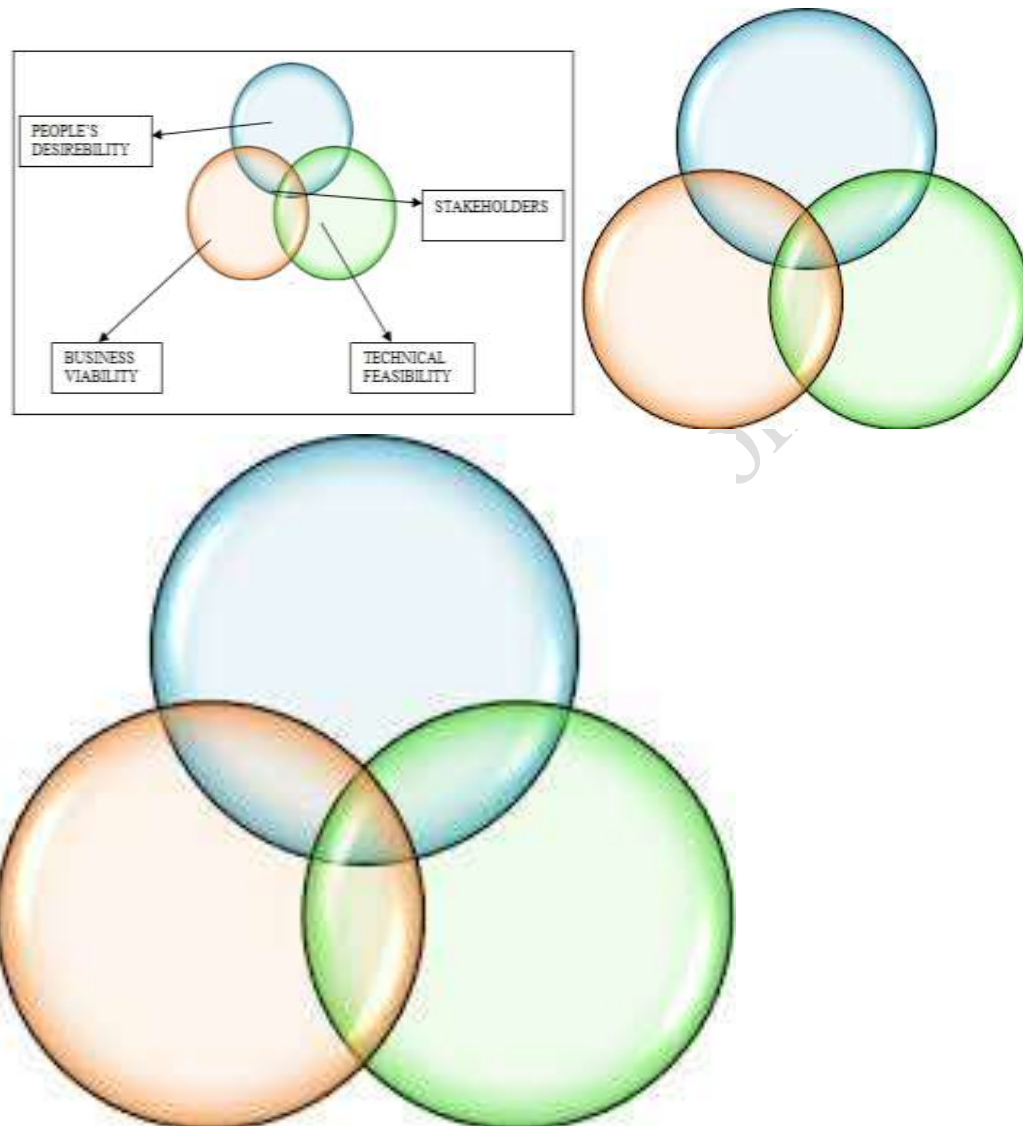
situation of improved toilet designs that fits into all socio-economic standard of a household and at the end achieves an assured privacy, free from contamination and infections as well as total demarcation of feces to human contact. Smart toilet is easy to clean and maintain, it uses less water to flush, free from cockroaches, houseflies, nesting ground for mosquitoes, smell and irritation to use. It is more of a comfort toilet and easy to use by all age groups. It ensures hygienic separation of human excrete from human contact. Is an array of latrine options that are of varying cost especially super structure to suit all financial status ranging from permanent to temporary but all have features of an improved latrine. The availability of a well fitted squat pan with trap of a good superstructure, mid structure and substructure as collection point coupled with affordable privacy wall will guarantee a sustainable toilet.

Smart toilet development in relation to the economy is a move towards toilet investment and not liability. Also, real assets are anything with value – stocks, bonds, mutual funds, income-producing real estate, notes, royalties from intellectual property, etc (Kiyosaki, 2000). The Nigerian government and policy makers have come up with various strategies over the years on how the nation's social and economic potentials can be harnessed (Isa and Jimoh, 2013).

As a result, there is market in sanitation. Sanitation marketing (SanMark) and finance is an approach to household sanitation promotion that aims to create sustained and effective sanitation by stimulating household demand for sanitation products and services (Scott, Jenkins & Kpinston, 2011). In most African countries, especially some states in Nigeria and particularly Bauchi have actually migrated to the next higher level in terms of hygiene as open defecation free (ODF) area. The types of toilets are as a result of different spaces (open/close, public/private, internal/external, tangible/intangible) and levels (upper/lower, large/small, necessity/luxury) are: Traditional pit toilets, San Plat toilets, Conventional improved pit toilets, VIP toilets, Pour-flush toilets, Compost toilets, Mobile toilets, Smart toilets, Other toilets.

As a result of these, the Federal, State and Local governments are presently in partnership with the Federal Government of Nigeria, Multinationals and stakeholders to achieve safe hygiene practices for a collective responsibility, memorandum of understanding and benefits to the society. One of the nagging problems confronting the Nigerians apart from poverty is deteriorating sanitary facilities. Hence, there is the need for people's centred toilet aspirations such as

the people's desirability, business viability and technical feasibility that will be explored as remedies as in **Figure 1**. These are necessary in order to create conducive environment for a healthy living in Bauchi metropolis.



**Figure 1:** People's centered toilet aspirations

**Source:** Developed by the Authors, 2020

The objectives of this paper are to:

1. Assess the design, costing, construction, supervision and maintenance of improved toilets in Bauchi State.

2. Identify opportunities in building Smart toilets using ceramic products at substructure, mid-structure and superstructure.
3. Showcase the various types of Smart toilet technology options and innovations for the household and public places.

In 2018, Nigeria was highlighted as the 2nd worst country in terms of open defecation, apart from India. 71% of the population does not have access to toilets. Nigeria also has the highest rate of under-5 deaths caused by diarrhoea – 11 children in every 1,000 die of diarrhoea illnesses each year in Nigeria. Diarrhoea is one of the three most common killers of young children globally yet 58% of these deaths could be prevented through access to clean water and sanitation. The removal of open defecation has wider implications too. It improves the education and safety of girls and women. In many schools there is a lack of toilet facilities for girls. This means, particularly when they reach puberty, girls often stop attending because they have nowhere to go to the toilet. There is also the darker side to this with reports of rape and attacks of women and girls venturing out into the bushes to go to the toilet. Often they go after dark for privacy – which leaves them vulnerable to attacks. Hence, we need solutions like the smart toilets using ceramic products at substructure, midstructure and superstructure. These are necessary in order to create conducive environment for a healthy living in Nigeria.

Nigeria is a country which places a great emphasis on cleanliness. A decree from the days of military government which is still in force mandates that the final Saturday of every month is [Sanitation Day](#), meaning that travel is banned and a curfew enforced until 10 am. Families are told to use the time when they are confined to tidy the home. Unfortunately, once household waste is tidied, the problems begin. Nigeria's booming population, an asset in economic growth terms, is placing great pressure on solid waste management (SWM) systems which are in many cases already either antiquated, informal or non-existent (Guardian News, 2016).

About 70 million people, out of a population of 171 million, lacked access to safe drinking water, and over 110 million lacked access to improved sanitation in 2013. Open defecation rates, at 28.5 per cent pose grave public health risks. Every year, an estimated 124,000 children under the age of 5 die because of diarrhoea, mainly due to unsafe water, sanitation and hygiene. Lack of adequate

water and sanitation are also major causes of other diseases, including respiratory infection and under-nutrition (World Bank, 2009).

The aim of the health sector reform is to improve efficiency in performance, ensure transparent and responsible management, limit political interference, eliminate government's involvement in utility management, management and technical operations, encourage private investment in generation to address inadequate supply and free government funds to finance other critical welfare programmes. The need to examine how the reform has fared in some other countries cannot be underscored (Asimiyu and Francis, 2011). As a result, Bio-Power Environmental Solutions Ltd says the establishment of high-quality public toilets can generate revenue, create 11,000 jobs and promote a healthier environment in the country (The Cable, 2017). There are ways in which the public and private sectors can join together to complement each other's strengths in providing education services and helping developing countries to meet the Sustainable Development Goals (SDG) waste management and to improve learning outcomes which can even be tailored and targeted specifically to meet the needs of low-income communities (World Bank, 2009). Recently, an interesting alternative to creating septic tanks with re-use materials (such as ceramics) has proven to help in controlling sanitation problems and regulate waste disposal at low cost (thedomesteadsurvival.com, 2015).

### **Methods**

The research methodology entails case study qualitative method of design (using Google Sketch up, BIM and Luimion), costing and construction analysis using the typical six toilet design iterations via a users' experience survey. In addition to the processes above, the produced results will be subjected to qualitative analysis by both compare and contrast method by looking at the possible use of ceramics at substructure, midstructure and superstructure.

### **Construction Stages, Operations and Procedures**

Toilet is a space for comfort zone, used for defecating which can be built from different materials chosen according to availability, cost of materials, skills available, and soil type. The squatting platform is the next activity that must be carefully designed and installed above the substructure as a receptacle for either permanent or temporary structures with the use of ceramics.

### **Site considerations**

After obtaining the needed tools, materials and equipment, the first procedure is the site considerations which include the site selection criteria, the site location, the site analysis and therefore the clearing of the site. Excavation works with a keen interest on the special positioning of the toilets and joining the squat pan and trap together with adhesive for both the permanent and temporary direct pit toilets will be followed by foundation with 150mm thick or 6'' sandcrete blocks to prevent weathering and termite attack.

### **Platform works**

Formwork preparation will set the ground well for casting the slab covered with polythene to make sure that the ground was flat and levelled properly. Several sets of formworks were constructed, for the two main slabs (permanent and temporary direct pit toilets) which is 1.1m x 1.1m x 50mm and the form for the squat pan which is made of wood with inner dimensions of 525mm x 275mm and fitted together by hammering nails at the corners; alternatively, screws could be used to facilitate assembly and breakdown. The form is easy to assemble and dismantle for portability and is re-usable over a long period of time. The inner frame is to shape the concrete to support the pan. The other formworks were for the top and bottom chambers with another 6 slab covers for both permanent and temporary toilets offset pits.

The reinforcement work/arrangement was such that 6mm  $\Phi$  bars were used and cut into short pieces to be accommodated by the formwork. The 6mm  $\Phi$  bars were tied together using binding wire according to the approved dimensions. Standard length of 6 mm  $\Phi$  rod into was cut by iron bender using uniform lengths of 1 metre each on the ground to prepare the reinforcement for the slab. The ceramic pan along with the trap (water seal) will have to be held in the middle of the slab. Also, the pan was fixed in such a way that the exit of the trap is in the exact centre of the slab when it is placed on the pit. As at the time form work was in progress, foundation footing and foundation works will continue. The concrete production made use of a concrete mix of 1: 1½: 3 are prepared with 0.7 water/cement ratio by mixing the concrete according to the ratios provided. The mixing of the concrete was carried out by hand, to mix the sand and cement well, and then add the aggregate. Placing of the concrete continues to the necessary point of use.

## Curing and Carpentry works

Curing of the various slabs started later in the day before closing.

## General Finishing and Cleaning

The roofs (burnt ceramic) will be tightly anchored using metal strips to the bricks and 6 mm  $\Phi$  rods to the hollow blocks. Plastering and tiling works will follow. Final finishing works of painting the structures and their doors will also be accomplished in relation to **TABLE 1** and **TABLE 2** below:

**TABLE 1: APPROXIMATE ESTIMATES OF PERMANENT SMART TOILET OPTIONS AT A GLANCE**

S/NO	PERMANENT SMART TOILET OPTIONS	CONSTRUCTION MATERIALS	APPROXIMATE COST (N)				
			SUBSTRUCTURE	CONCRETE PLATFORM	SQUAT	SUPERSTRUCTURE	TOTAL
1.	I. Single Direct Pit	I. HOLLOW BLOCK	5,000	X		X	5,000
		II. BRICKS	X	X		11,000	11,000
		III. ZINK & TIMBER	X	X		9,500	9,500
		IV. DOOR & CO.	X	X		12,000	12,000
		V. PLUMBING, SQUAT & TRAP	X	10,000		X	10,000
		VI. FINISHING (PAINT & TILES)	X	2,000		9,000	11,000
		VII. CONC./ RINGS	12,000	X		X	12,000
		VIII. AGG. & REINFORCEMENT	1,750	3,500		X	5,250
<b>TOTAL</b>	N.B N12,000 Contingency for other unlisted works		18,750	15,500		41,500	<b>75,750</b>
2.	II. Double Offset Pit	I. HOLLOW BLOCK	X	X		19,000	19,000
		II. ROOF DECK	X	X		8,000	8,000
		III. DOOR & CO.	X	X		12,000	
		IV. PLUMBING, SQUAT & TRAP	X	17,000		X	17,000
		V. FINISHING (PAINT & TILES)	X	3,000		5,000	8,000
		VI. CONC./ RINGS	26,000	X		X	26,000
		VII. AGG. & REINFORCEMENT	10,000	X		3000	13,000



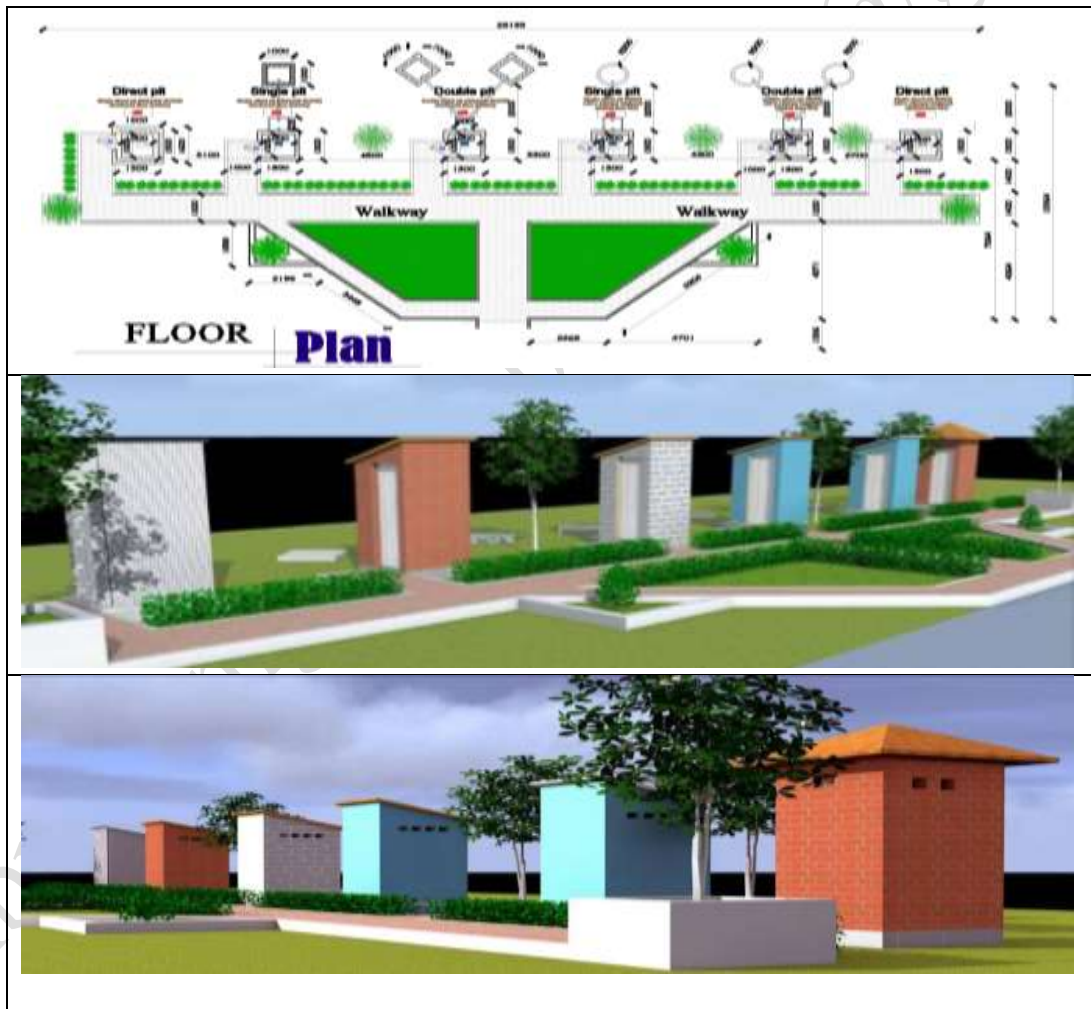
<b>TOTAL</b>	N.B N12,000 Contingency for other unlisted works		36,000	20,000	49,000	<b>103,000</b>
<b>3.</b>	III. Single Offset Pit	I. HOLLOW BLOCK	X	X	19,000	19,000
		II. ZINCK ROOF	X	X	6,000	6,000
		III. DOOR & CO.	X	X	12,000	12,000
		IV. PLUMBING, SQUAT & TRAP	X	16,500	X	16,500
		V. FINISHING (PAINT & TILES)	X	3,000	5,000	8,000
		VI. CONC. / RINGS	19,000	X	X	10,000
		VII. AGG. & REINFORCEMENT	10,000	X	3,000	13,000
<b>TOTAL</b>	N.B N12,000 Contingency for other unlisted works		29,000	19,500	45,000	<b>93,500</b>

**TABLE 2: APPROXIMATE ESTIMATES OF TEMPORARY SMART TOILET OPTIONS AT A GLANCE**

S/NO	TEMPORARY SMART TOILET OPTIONS	CONSTRUCTION MATERIALS	APPROXIMATE COST (N)			
			SUBSTRUCTURE	CONCRETE SQUAT PLATFORM	SUPERSTRUCTURE	TOTAL
<b>1.</b>	I. Single Direct Pit	I. ZINK & TIMBER ROOF/WALL	X	X	21,000	
		II. DOOR & CO.	X	X	12,000	12,000
		III. PLUMBING, SQUAT & TRAP	X	9,000	X	9,000
		IV. CONC./ BLOCKS	15,000	X	X	15,000
		V. AGG. & REINFORCEMENT	8,000	3,500	X	11,500
<b>TOTAL</b>			23,000	12,500	33,000	<b>68,500</b>
<b>2.</b>	II. Single Offset Pit	I. HOLLOW BLOCK	X	X	9,675	9,675
		II. ZINK ROOF	X	X	6,000	6,000
		III. BRICKS	X	X	11,000	11,000
		III. DOOR & CO.	X	X	12,000	12,000
		IV. PLUMBING, SQUAT & TRAP	X	10,500	X	12,500
		V. CONC./ BLOCKS	12,000	X	X	12,000
		VI. AGG. & REINFORCEMENT	7,675	X	1,000	8,675
<b>TOTAL</b>			19,675	10,500	39,675	<b>69,850</b>
<b>3.</b>		I. HOLLOW BLOCK	X	X	10,000	

	III. Double Offset Pit	II. ZINK ROOF	X	X	6,000	
		III. DOOR & CO.	X	X	12,000	12,000
		IV. PLUMBING, SQUAT & TRAP	X	12,500	X	
		V. CONC./ BLOCKS	30,000	X	X	
		AGG. & REINFORCEMENT	10,000	X	1,000	
<b>TOTAL</b>	N.B N12,000 Contingency for other unlisted works	40,000	12,500	29,000	<b>81,500</b>	

**FIGURE 1:** AS IT IS PRESENTATION & WORKING DRAWINGS OF THE 6 SMART TOILETS



**Source:** Existing Smart Toilet options developed by the Authors, 2020

## RESULTS

- Physical visitations to the case study area at RUWASSA office in Bauchi by carrying out interviews shows that existing toilet facility are of different construction materials.
- Interviews carried out with stakeholders in the community to know how they perceive healthy living suggested that there is little awareness to the concept of using ceramic products in Smart toilets which can boost the health and economy sector.
- Design and costing of various toilet features in Bauchi metropolis showcased that their conditions can be better improved upon to enhance sustainable, clean water, plumbing, innovations, local content, using indigenous construction materials, methods and technology in ceramic products.

## **CONCLUSION AND RECOMMENDATIONS**

The present low participation in improved toilet practices, using ceramics could be linked to lack of awareness, poverty, attitude, mindset of the people and non implementation of government policies. It was maintained by Nakpodia (2007) that there is also evidence to suggest that the government is not adopting policies that encourage the private participation in health funding. ‘Toilet money does not smell shit’ means that there is a huge amount of benefits in toilet design, construction and promotion opportunities are lying down unaccessed. Also, the opportunities and the need to participate in waste management; of waste to wealth, useless to useful, unwanted to most wanted and nothing to something will ensure achievement on the national health objectives means that there has to be a collaborative efforts by Government, stakeholders and non-Government organization in order to safe guard the major parameters raised in this paper.

The following recommendations will be very important in the present and future situations:

1. The government of the day should provide enabling environment to allow for the private sector to inject funds into the health sector which will in turn provide adequate job opportunities toilets with the use of ceramics as the country can progress positively.
2. Stakeholders in Public and Private Participation should sponsor and organize massive enlightenment programmes, workshops, promotions,

conferences, seminars and symposia in collaboration with all the media houses so that training and re-training will take place while health and economy is revamped.

3. If all the above are well implemented to its fullest, such a system of opportunities in toilets would yield better sanitation markets, better toilet structures, better youths' employment and better communities.
4. Schools toilet trade/Business as EED should be implemented so that youth empowerment toilet schemes can spread to Politicians and Parastatals.
5. Camps (IDP, Hajj, Christian Pilgrimage, Research, NYSC,) and Public Spaces (Hospitals, Markets, etc.) stakeholders should be trained to meet up the 2025 open defecation free deadline.

## REFERENCES

- Fatile J.O. (2014) Public Private Partnership as a Tool For National Development. A Conference Paper Presented at The International Institute For Policy Review & Development Strategies, Akwa Ibom, December 4, 2014.
- Guardian News (2016) Time to Flush Away Nigeria's Sanitation Problems, available online in an extract retrieved from: <https://www.theguardian.com/global-development-professionals-network/adam-smith-international-partner-zone/sanitation-problem-nigeria-kaduna>
- Isa R.B., and Jimoh R.A. (2013) An Overview of the Contribution of Construction Sector to Sustainable Development in Nigeria'. Net Journal of Bussiness Management, Vol. 1 No 1 Pages 1-6: <http://www.netjournals.org/pdf/NJBM/2013/1/13-017.pdf>
- Nakpodia (2007) Approaches for Enhancing Private Sector Participatioon in the Funding Of Secondary Schools In Delta State, Nigeria: <http://www.icidr.org/regd/Approaches.....pdf>
- OECD (1996) The Knowledge-Based Economy: General Distribution: <https://www.oecd.org/sti/sci-tech/1913021.pdf>
- Kiyosaki R.T (2000) Poor Dad Rich Dad. Retrieved from [http://www.lequydonhanoi.edu.vn/upload\\_images/.../Rich%20Dad%20Poor%20Dad.pdf](http://www.lequydonhanoi.edu.vn/upload_images/.../Rich%20Dad%20Poor%20Dad.pdf)
- Scott B., Jenkins M. and Kpinsoton G. (2011) Experiences from Rural Benin: Sanitation Marketing At Scale, A World Bank Water and Sanitation Programme: <http://www.wsp@worldbank.org>
- The Cable (2017) Public toilets can create 11,000 jobs: <https://www.thecable.ng/public-toilets-can-create-11000-jobs#share>
- UNICEF&WHO(2012).WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, Progress on drinking water and sanitation.
- World Bank (2004) Deloitte Emerging Markets Group. Submitted to: US Agency for International Development (USAID)
- World Bank (2009) The Role and Impact of Public-Private Partnerships in Education. International Bank for Reconstruction & Development (IBRD).