Water, Sanitation, Hygiene and Climate Change Adaptation in Nigeria

By

Babatope Babalobi

Paper presented at the " WATER AND HUMAN HEALTH: Challenges in Fast Growing Economies " workshop, 29th---30th November 2012 Center for Development Research (ZEF), University of Bonn, Germany

Key words: Water supply, sanitation, hygiene, Climate Change Adaptation, Health, Nigeria

1. Introduction

The World Health Organisation (WHO) in the year 2000 estimated that up to 2.6 billion people or 39 per cent of the world's population still live without access to improved sanitation, while nearly a billion, (884 million) people do not have access to clean and safe water. Thirty seven (37%) of these people live in Sub-Saharan Africa.[1]

Access to water supply and sanitation is generally poor throughout Africa. In 2006, this was estimated to be 64% for water supply and 38% for sanitation, which compares unfavorably with corresponding world averages of 87% and 62% respectively.

The United Nations Development Programme (UNDP) in its 2006 Human Development Index (HDI) report states that: "*On current trends Sub Saharan Africa will reach the Millennium Development Goals (MDG) water target in 2040 and the Sanitation target in 2076."* These targets were supposed to be

[1] WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation. (2010) "*Progress on Sanitation and Drinking Water"* Available at www.wssinfo.org/

reached by 2015. A 2011 report of the African Ministers Council on Water (AMCOW) also confirms that all but four countries in Africa remain off track to meet the sanitation MDG. The report shows in 2008, 584m people in Africa did not have an improved sanitation facility, and of those, 231m practiced open defecation.

2. Water and Health

Lack of access to unimproved water and sanitation services have several health implications. Eighty eight (88 %) per cent of cases of diarrhoea worldwide leading to two million deaths of children yearly are still attributable to unsafe water, inadequate sanitation or insufficient hygiene.

Childhood malnutrition also causes about thirty five (35%) per cent of all deaths of children under the age of five years worldwide; it is estimated that fifty (50%) per cent of childhood malnutrition is associated with repeated diarrhoea or intestinal nematode infections.[2]

Hard facts that highlights the health impacts of poor water and sanitation services including the following:

a. *In developing countries, as much of 80% of illnesses are linked to poor water and sanitation conditions.*[3]
b. *Nearly 1 out of every 5 deaths under the age of 5 worldwide is due to a water-related disease.*[4]

[2]UNICEF. See: *http://www.unicef.org/media/media_45481.html*

[3] WHO/UNICEF: (2009), "*Diarrhea: Why children are still dying and what can be done."* Available at http://www.unicef.org/health/index_51412.html

c. *By investing in clean water alone, young children around the world can gain more than 413 million days of health United Nations.*[5]

d. *Diarrhea kills more young children than AIDS, malaria, and measles combined.*[6]

e. *Every day, four thousand children die of water-related diseases.*[7] *As reflected in the following table, water-related diseases caused an estimated 3.4 million deaths in 1998 alone.*

Disease	**No of deaths 000**
Diarrhoeal Diseases	2,219
Malaria	1,110
Trypansomiasis	40
Intestinal worm infestation	15
Dengue	15
Schistosomiasis	7

Table 1: No of estimated deaths from water related diseases 1998
Source: WHO 1999

f. *Approximately 443 million school days each year are missed due to water-related illnesses.*[8]

g. *Many children in the developing world live with constant diarrhea caused by lack of safe water and sanitation, and each year over 1.5 million children die from diarrheal diseases.*[9]

---

[4] World Health Organization. "*Costs and benefits of water and sanitation improvements at the global level."* http://www.who.int/water_sanitation_health/wsh0404/en/

[5] Koffi Annan, (June 2003).

[6] UNICEF and World Health Organization, (2009). *Diarrhea: Why children are still dying and what can be done"* (New York: UNICEF; Geneva: WHO)

[7] World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation." *Progress on Drinking Water and Sanitation: Special Focus on Sanitation*" (New York: UNICEF; Geneva: WHO)

[8] United Nations Development Program (UNDP) (2006) : '*Beyond Scarcity: Power, Poverty and the Global Water Crisis',* Human Development Report.

The poor, vulnerable and marginalised groups, women and children bear the brunt of the global drinking water and sanitation crisis. The UNDP HDI report 2006 report noted: "*The crisis in water and sanitation is—above all— a crisis for the poor. Almost two in three people lacking access to clean water survive on less than $2 a day, with one in three living on less than $1 a day. More than 660 million people without sanitation live on less than $2 a day, and more than 385 million on less than $1 a day.*

In 60 countries in the developing world, more than half of primary schools have no adequate water facilities and nearly two thirds lack adequate sanitation[10]. In a survey conducted by UNICEF[11], in a group of developing countries, less than half of all primary schools have adequate water facilities and nearly two thirds lack adequate sanitation -- even where facilities exist, they are often in poor condition. The study revealed that more than 40 per cent of diarrhoea cases in schoolchildren result from transmission in schools rather than homes. Damage to children's mental and physical health and development is comprised due to disease such as diarrheal.

It also revealed that worms affect an estimated 400 million school-aged children in the developing world. Chronic hookworm infestations are associated with reduced physical growth and impaired intellectual

---

[9] WHO AND UNICEF Joint Monitoring Programme for Water Supply and Sanitation, (2008). "*Progress on Drinking Water and Sanitation*" UNICEF, New York and WHO, Geneva.

[10] IRC, "*School Sanitation and Hygiene Education Thematic Overview Paper".*

[11] UNICEF *See: http://www.unicef.org/media/media_45481.html*

development, and children enduring intense infestations with whipworm miss twice as many school days as their infestation-free peers.

The average intelligent quotient (IQ) loss per worm infestation is 3.75 points, representing 633 million IQ points lost for the people who live in the world's low-income countries. The study also reveals the dimension impacts of poor access to water and sanitation services. Girls who have reached puberty and female school staff who are menstruating need gender-related privacy. If no privacy is provided, students may not use the facilities at schools, resulting in absenteeism rates that can reach 10–20 per cent of school time.

Another UNICEF survey[12] conducted in South Africa reveals that more than 30 per cent of the girls attending school had been raped at school. Many of the rapes occurred in school toilets, particularly those that are isolated from the protective environment of the school. Coming to Nigeria, the statistics are not different; the country has a high infant mortality rate of 86 per 1, 000 live births, and an under-five mortality rate of 191 per 1, 000 live births. (UNICEF 2010).

3. Access to Water Supply in Nigeria

Water for drinking in Nigeria comes from three major sources, generally: atmospheric water in form of rain, and ultimately the source of drinking water in most rural areas; surface water classified as rivers, streams, lakes or reservoirs and ponds; and ground water obtained from boreholes sunk into

[12] UNICEF, *See: http://www.unicef.org/media/media_45481.html*

water-bearing rocks or aquifers, or water that gushes out from rocks such as in springs[i]

Under the 1999 Constitution of the Federal Republic of Nigeria, urban and rural water supply and sanitation is shared between state and local governments. Aged equipments, inadequate funding, corrupt practices, weak institutional framework, weak human capacity, unreliable power supply, political interference amongst others have hindered state and rural water supply and sanitation utilities from delivery services efficiently and sustainably.

Survey	Year	Access to improved drinking water source			Access to improved sanitation		
		Total	Urban	Rural	Total	Urban	Rural
NDHS*	1990	45.0	78.0	33.0	37.0	50.0	33.3
JMP****	1990	50.0	80.0	34.0	26.0	33.0	22.0
MICS1*	1995	51.0	80.0	39.0	57.0	82.0	48.0
NDHS**	1999	53.1	80.2	41.4	41.0	53.0	36.0
MICS2**	1999	54.2	70.6	48.2	56.0	75.4	44.0
NDHS**	2003	42.3	64.6	29.8	41.4	53.0	35.0
JMP****	2006	47.0	65.0	30.0	30.0	35.0	25.0
CWIQS***	2006	51.4	73.4	40.0	57.6	77.0	47.6

Table 1: Access to Water and Sanitation in Nigeria
Sources:

- The Nigeria Demographic & Health Survey (NDHS) by NPopC (supported by MACRO, UNFPA & USAID)
- National Census- by NPopC
- The UN Joint Monitoring Programme of 2004, 2006 & 2008
- Multiple Indicator Cluster Survey (MICS)-supported by UNICEF, UNDP, WHO and other Intl organizations
- Core Welfare Indicator Questionnaire Survey (CWIQS) by NBS

Access to improved water and sanitation is generally a major challenge in Nigeria. Water and Sanitation coverage in Nigeria are amongst the lowest in the world. According to the 2008 report of the WHO/UNICEF JMP Joint Monitoring

Programme, Nigeria is in the bottom 25 countries worldwide in terms of water and sanitation coverage.

Nigeria, like several other sub Saharan African countries is not on track to reach the MDG targets of 75% coverage for improved drinking water and 63% coverage for improved sanitation by the year 2015. National figures on access to safe water supply and sanitation services are not also cheering. The Joint Monitoring Platform in 2006 estimates that access to improved water supply and safe sanitation in Nigeria is 47% and 30% respectively.

If the present pattern of water coverage continues only 74.8 m out of the estimated 170m will be using water from improved sources in 2015. This figure represents 52.7m people short of the MDG target. For sanitation, if Nigeria continues at the current rate, only 57.8 million out of the estimated 170m people will have access to improved sanitation facilities in 2015, which represents 61.2 million people short of the MDG target for improved sanitation.

4. Access to Water Supply and Sanitation in Nigeria

According to WHO's global progress on drinking water and sanitation released by GLAAS 2012 Report '34 million Nigerians - more than the size of any of the nation's six geopolitical zones - are without toilets, and still practice "open defecation". Nigeria holds the fifth position behind India, Indonesia, Pakistan, and Ethiopia. In several categories evaluated by the study with last updates in 2010, Nigeria falls amongst the worst performing nations with millions of its population without access to basic sanitation and drinking water.

With 66 million without good drinking water (the worst even in Africa), Nigeria contributes to two-thirds of the world's population in that category, and 109 million of its population have no access to improved sanitation, the report says.

The Water supply and Monitoring Platform fact sheet 2009 shows that lack of access to basic sanitation facilities coupled with poor hygiene practices causes diarrhoea which is the 2nd largest direct cause of childhood mortality in Nigeria. Lack of safe, private toilets and hand washing facilities in schools affects educational enrolment and performance. UNICEF state of the World's Children 2007 report estimates that poor sanitation is a contributing factor n Nigeria's low girl enrolment rates-7% points behind boys. On economic development, it is also estimated that 10 million productive days would be gained if access to both water and sanitation rose to 100% (WaterAid calculations for Nigeria using methodology from Evaluation of the costs and Benefits of Water and Sanitation Improvements, WHO 2004)

A report on the economic impacts of inadequate sanitation, released last year by the World Bank's Water and Sanitation Program (WSP), indicates that the Nigeria and 17 other African countries are losing around US$5.5 Billion annually to inadequate sanitation; and unless the affected countries address this cost which represents between 1%-2.5% of their Gross Domestic Product, they will not be able to develop sustainably.

The issue of urban water supply and sanitation will become very critical in the coming years given the rapid rate of urbanisation in Nigeria. The proportion of the urban population with access to improved sources of drinking water in Nigeria decreased by 15% from 80% (5million) in 1990 to 65% (24 million) in 2006. The decrease by 15% in 16 years is very significant at a time that the proportion of the population living in urban areas increased from 30% in 1990 to 49% in 2006. The

number of people without access to improved sanitation in urban centres increased from 17 million in 1990 to 45 million in 2006. 24 million people in urban areas remain without access to improved sources of drinking water in 2006 and 54m people in urban areas have not access to improved sanitation facilities in 2006. Water supply and sanitation has not kept space with rapid rate of population increase.

Survey	Year	Access to improved drinking water source			Access to improved sanitation		
		Total	Urban	Rural	Total	Urban	Rural
NDHS	1990	45.0	78.0	33.0	37.0	50.0	33.3
JMP	1990	50.0	80.0	34.0	26.0	33.0	22.0
MICS1	1995	51.0	80.0	39.0	57.0	82.0	48.0
NDHS	1999	53.1	80.2	41.4	41.0	53.0	36.0
MICS2	1999	54.2	70.6	48.2	56.0	75.4	44.0
NDHS	2003	42.3	64.6	29.8	41.4	53.0	35.0
JMP	2006	47.0	65.0	30.0	30.0	35.0	25.0
CWIQS	2006	51.4	73.4	40.0	57.6	77.0	47.6

Table 2: Nigeria's Water and Sanitation profile

Unless major strides are made, tens of millions of Nigerians in urban areas will continue to drink water from unimproved sources with its attendant health implications and practice open defecation. Lack of access is most prevalent among low income earners living in the peripheral of areas- slums, squatters and outskirts. These areas, though densely populated in most cases are not covered by conventional WASH systems, and are often forgotten in all levels of sectoral planning as most government and External support agencies WSSH projects are focussed on residents of main urban areas, small towns and rural areas . The urban are neglected, forgotten and exploited by informal providers.

5. Potential effects of Climate Change on Water Supply and Sanitation

5.1. Water quality

a. Water quality will be affected by flooding, through erosion and consequent higher turbidity, increases in non-point pollution, but also through damage to wastewater treatment plants and consequent bacterial contamination of water.

Almost 90 % of the burden of diarrhoeal disease is attributable to lack of access to safe water and sanitation (WHO, 2009).

Reductions in the availability and reliability of freshwater supplies caused by climate change are expected to increase this hazard.

b. Increased temperatures, affect the chemical and biological characteristics of water bodies, and by decreased precipitation which concentrates pollution. According to Vadillo (2005), climate change may alter the water quality by four ways:

- Increasing air temperature.
- Alteration of rainfall regime, with its changes in volume and velocity of flows to the aquifers.
- Atmospheric deposition of acid substances with ananthropic origin.
- Increase of CO2 concentration of the air.

Each one of these factors, and their interrelation, could vary in a drastic way the quantity and quality of the water resources. The increase of temperature of the air, even without changes of the rainfall, may increase the temperature of the water, and hence, a decrease in the concentration of dissolved O2 and CO2N(Gleick, 1987) hydrogen ions concentration (pH) in soil and water.

Changes in volume and velocity of flows to the aquifers also have consequences in the quality of the water (Panagoulia and Dimou, 1996).

c. Climate change can also reduce the functionality of drinking water treatment, by for example lessening the effectiveness of treatment processes such as chlorination or causing overly high disinfection by-product levels in distribution systems.

d. Consequences for certain water sources will have knock-on effects on others: precipitation decrease and its impact on surface water will result in increased water abstraction from groundwater and from sources with lower water quality. (Bates, Kundzewicz, Wu & Palutikof, 2008)

5.2. Water Pollution

a. There is increasing evidence of the impact that climate-related disasters have on mental health. For example, flooded communities experience a higher incidence of depression.(Racher et al., 2004).

b. Climate variability can also create more favourable conditions for a number of pathogens, increasing their survival and therefore the risk of several infections.

c. Rainfall induced runoff has been identified as one of causes of faecal contamination in slum areas in Nigeria.

d. Higher temperature may lead to increased thermal stability and stratification in lakes.

e. The lack of movement in surface waters leads to the development of blooms, and can lead to severe oxygen depletion and increased decomposition in deeper waters. This anoxia will provide ideal

circumstances for some groups of pathogens(Roijackers and Lurling, 2007).

f. Waterborne sanitation will be adversely affected by the increased scarcity of water. Pit latrines will often have superior resilience to climate change in view of their flexible design. However where groundwater levels rise, major challenges may exist in preventing the latrines becoming a large pollution risk to groundwater resources used for drinking-water supply.

5.3. Case studies

Case study 1: Water scarcity and water related diseases in Maiduguri

- *There has been a continuous increase in the maximum temperature over the years and this is likely to continue. The average annual maximum temperature in Maiduguri hovered around 35^0c.*
- *There is significant reduction in rainfall received over the 60 years (Fasona and Omojola 2005), and this is also marked by short duration of rainfall.*

Impacts on Water Supply and Sanitation

- *Major towns, such as Maiduguri have been experiencing high water deficit leading to more exploitation of the ground water. Currently, the extraction of groundwater through boreholes and hand-dug wells is tapping one or more of the aquifers underlie the area. Continuous over-pumping of ground water will definitely lead to continuous depletion on the water table as observed by Carmalt and Tibbisalts (1969) who recorded a decline of 6.5m, in the mean ground water level around Maiduguri axis between 1963 and 1972.*
- *The incidences of malaria has been increasing between 1976-2005 except for the period 2000 and 2004 where an inverse relationship holds.*

Source of Information:
Akpodiogaga-A & Odjugo, 2010; Spore 2008; IPCC, 2007

Case study 2: Onchocerciasis in Dadin Kowa Dam and Upper Imo River Basin

- Onchocerciasis, or River Blindness, is a Neglected Tropical Disease (NTD) caused by the parasitic worm *Onchocerca volvulus*. It is transmitted through repeated bites by blackflies of the genus *Simulium*. The blackfly that transmits the infection lives and breeds near fast-flowing streams and rivers and the infection can result in blindness.
- The Dadin Kowa Dam is in Yamaltu local government area of Gombe State in the north east of Nigeria. The dam is located about 35 kilometers to the east of Gombe town, and provides drinking water for the town. Dadin-Kowa dam is suspected to be a major breeding site for black flies that cause river blindness
- The Upper Imo River Basin is also traversed by rivers and several streams, and conditions are favourable for transmission of onchocerciasis.
- The Oji, Ajali, Mamu, Adada, and Imo rivers in the hilly and undulating Udi-Enugu-Okigwe axis support the breeding of the black fly. This area should probably be regarded as the most severe onchocerciasis focus in the eastern part of Nigeria, forming a continuum of high onchocerciasis Endemicity with the Udi Hill range, Oji River Basin and the Anambra River Basin.
- A survey of 91.8% of the population in 2005 in two neighboring high altitude communities of Umuowaibu 1 and Ndiorji, in Okigwe Local Government area of Imo State, Nigeria shows that 37% of those examined were positive for *Onchocerca volvulus* microfilariae (39.2% of males and 34.9% of females).

Impacts on Water Supply and Sanitation

- The incidences of Onchocerciasis is a public health concern, and is likely to increase with increase frequency and intensity of rains caused by climate change, but this need to be investigated further.

Source of Information:

1. EC Uttah, Onchocerciasis in the Upper Imo River Basin, Nigeria: Prevalence and Comparative Study of Waist and Shoulder Snips from Mesoendemic Communities
2. Wikipedia, the free encyclopedia

6. **Climate Change Adaptation and Mitigation Strategies for Water Supply and Sanitation in Nigeria**[13]

Nigeria's Health Agencies should :

a. Create of awareness and public understanding of the global and locally relevant health consequences of climate change.

b. Embark on education and mass media campaigns to spark commitment and action among governments, international organizations, donors, civil society, business and communities, especially among the young people to anchor health at the heart of the climate change agenda.

c. Advocate for interdisciplinary and inter sectoral partnerships from the local to national level that seek to improve health through rapid deployment of mitigation strategies to stabilize climate change and development of proactive adaptation programmes to minimize health impact.

d. Carry out research on the ecology and epidemiology of infectious diseases that will probably be affected by climate change.

e. Carry out research into early warning system to help populations prepare for impending epidemics.

f. Encourage and follow up immunization for preventing human suffering that could otherwise occur as a result of climate change.

g. Train and Retrain health personnel on climate change mitigation and adaptation.

h. Increase investment in Onchocercisis prevention, control, and treatment.

[13] Adopted from the Africa Adaptation Programme, (2012) "Impacts of Climate Change on Water Supply and Sanitation in Nigeria"

i. Lead public education on preventive programmes: e.g. vaccines, mosquito control, food hygiene and inspection, and nutritional supplementation.

j. Support provision of health care (especially mental health promotion and primary care) for communities affected by environmental adversity, for example drying conditions in rural communities.

k. Embark on surveillance of disease, especially infectious disease and its key environmental, social and biological risk factors for that disease.

Nigeria's Water Agencies should :

a. Undertake vulnerability studies of existing water supply and sanitation system and ensuring that new systems are built to reduce vulnerability.

b. Conduct baseline studies to generate data and information on status of water supply and sanitation sector to serve as a basis for measuring/determining climate change impacts; and as part of these map WSS systems in Global Information System GIS format.

c. Include climate change planning in their annual work plans.

d. Optimise existing water and sanitation policy papers/regulation so water can be allocated to the most efficient and highest value uses and to defined priorities.

e. Modifying existing infrastructure and operations to cope safely with and perform in more variable and extreme conditions.

f. Introduce demand management techniques such as efficiency increases, active leakage management, behavior change or pricing policies, use of water-saving technologies, and universal metering.

g. Reduce physical water losses through both the repair of leaking pipes and the introduction of a water pressure management of water pipe networks.
h. Maintain accurate record of water flow fluctuation in intakes including streams, rivers, and dams to enable them predict climate variability.
i. Maintain the system and its important nodes periodically (clean and wash pipelines and tanks to prevent aggregation of sediments, perform regular maintenance of machines, pumping stations and their electric parts).
j. Incorporating climate change effects into the design considerations for major infrastructure.
k. Develop water safety plans to respond/prevent to possible contamination.
l. Establish water quality testing laboratories to ensure control and monitor water quality.
m. Set up Hydrological units monitoring stations to provide reliable forecast on meteorological and hydrological conditions as well as information on current weather condition.
n. Strengthen communication with meteorological forecasting offices.
o. Promote the use of simulated hydrological models of water runoff based on precise measurements and calibration to increase knowledge of vulnerability of the system related to changes in the surrounding hydrological conditions.
p. Support a pro-poor approach to water resources management that encompasses communities that are particularly vulnerable to climate change and variability.
q. Strengthen adaptive capacity at the local level by supporting localized water resources approaches that are adapting to climate variability.

r. Increase stakeholder's education on the potential impacts of climate change on service providers and users.

s. Implement pro-active measures to identify changes in quantity and quality of raw water.

t. Reinforce and/or (re)introduce flood and drought preparedness programmes. Ensure staffs are properly trained and adequately skilled to recognize the danger, analyze the risk and respond properly.

u. Implement the following measures to increase water availability:

    a. *Encourage drilling of communal boreholes particularly in estates to reduce proliferation of boreholes and over abstraction of groundwater; ensuring* geophysical analysis are completed prior to the drilling of boreholes.

    b. *Construction of small dams.*

    c. *Development and protection of springs and ponds.*

    d. *Promote appropriate WSS technologies that at climate resilient e.g. household water treatment, rain harvesting, and provision of community water storage tank for rain harvesting.*

    e. *Supply of water through tankers.*

    f. *Aquifer storage and recovery.*

    g. *Installation of water collection and storage units (cisterns and underground reservoirs) providing water for drought periods.*

    h. *Monitoring the ability of wells to cope with current droughts.*

    i. *Implementation of water efficiency plans for Car WASH users and managers.*

v. Organize forums at grassroots to inform and educate people on climate variability and its impacts on water supply and sanitation, sensitizing water consumers on the potential impacts of climate change, and informing them on future precipitation changes as noticed by Nigeria Meteorological Agency (NIMET).

w. Adopt/develop technologies for treating/desalinisation of the abundant sea water for future domestic consumption.

x. Reinforce or (re)introduce watershed management measures to regulate extreme event runoff, erosion, and sedimentation originating from higher intensity rainfall.

y. Investigate the impact of increased water temperature/changed pH on effectiveness of disinfection to determine how flow changes affect the effective Ct of disinfection stages.

z. Ensure enhanced monitoring of the following in reservoirs:

    a. *Turbidity/physical quality.*
    b. *Indicator organisms (pathogen loading).*
    c. *Algal species and counts*
    d. *Emerging contaminants.*
    e. *Limnology – risks of low draw-down, storage reservoir inversion (use of bubblers, forced currents etc.)*
    f. *Vector-borne diseases.*

aa. Work with environmental protection agencies to identify flood risk areas and estimate the extent and depth of flooding that could be expected in a variety of scenarios.

Nigeria's Sanitation Agencies should :

a. Undertake vulnerability studies of existing water supply and sanitation system and ensuring that new systems are built to reduce vulnerability.
b. Promote the use of mathematical models to illustrate the hydraulic characteristics of the sanitation system to identify its most critical points.
c. Improve urban sanitation infrastructure.
d. Use appropriate reuse-oriented sanitation systems with energy, nutrient or wastewater recovery and reuse in order to reduce anthropogenic greenhouse gas emission as well as increase people's capacity to cope with climate change impacts.
e. Avoid the use of energy intensive aerobic treatment systems, and ensure sanitation systems produce renewable energy in the forms of either biogas or biomass to reduce the primary energy consumption.
f. Explore on site unconventional or modified climate resilient sanitation technologies which offer alternatives to water-borne sanitation, particularly in rocky areas or areas where there is too little water for waterborne sanitation systems.
g. Promote the use of dry toilets system (especially in water scarce areas or areas with high water table) for substituting waterborne sanitation systems. Toilets which don't require water for flushing, but can nevertheless be indoors (e.g. UDDTs, composting toilets) may save about 40L/(cap.d) compared to conventional flush

References

1. Africa Adaptation Programme, (2012) "Impacts of Climate Change on Water Supply and Sanitation in Nigeria"
2. WHO/UNICEF JMP Joint Monitoring Programme report, 2008
3. Water supply and Monitoring Platform fact sheet, 2009
4. UNICEF state of the World's Children, 2007
5. Evaluation of the costs and Benefits of Water and Sanitation Improvements, WHO 2004)
6. Economic impacts of inadequate sanitation, World Bank's Water and Sanitation Program (WSP) 2011
7. WHO's Global progress on drinking water and sanitation, GLAAS 2012 Report
8. Platform John Gambo Laah,Water and Sanitation Summary sheet, Water and Sanitation Monitoring Platform (WSMP), Nigeria