# UNIVERSITY OF KUOPIO

# ADVANCED STUDIES IN ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

## Millennium developing goals are aimed also for Africa

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## Millennium developing goals are aimed also for Africa

United Nations and its member states have launched Millennium Developing Goals (MDGs) globally to reduce extreme poverty and thus to make human life safer and to give for all a better education and a better health. Water hygiene and especially sanitation are two necessary services, which are often lacking. Real efforts to get sanitation or improved sanitation have often neglected. Thus still some two-three billion poor people are waiting for safe sanitation and clean water. The development seems now to be most slow in African continent and we must be afraid that many African states will not reach MDGs in spite of promises given by their political leaders. As one symptom of extreme shortages in sanitation and water hygiene is the cholera epidemics which started in 2008 in Zimbabwe and is spreading to its neighbour countries. Generally cholera is today most common in African continent.

There are also serious shortages of food, which might mean political problems in future. It is evident that African states should get extra monetary aid from industrial countries in order to reach MDGs. Besides the money African states and the African people must also do much themselves since money alone is not the way to reach really MGDs.

Ordinary people without any support from political leaders could also do much in order to make their own environment safer and to avoiding to risk their own food and water hygiene. They of course need knowledge to understand better the real risks and the real possibilities. In many cases they could make efforts without any money or with very low amount of money. People could also get financial benefits from eco-sanitation if they dare to think about, since human excreta and domestic wastewaters can be used as fertilizer or/irrigation water and increase thus plant production for edible or non-edible plants.

The situation in Africa – mainly in West Africa - can be seen in some of the papers presented here. The papers deal also with the possibilities. The improving would be possible in African villages and peri-urban areas – with very moderate price.

These works have been produced by students participated in the course Advanced Studies in Environmental Microbiology and Biotechnology held in spring 2009 at the Department of Environmental Science, University of Kuopio. Besides these papers there is one extra paper about the possibilities to cultivate non-edible plant with human urine.

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# Contents

# HUMAN EXCRETA FOR FERTILIZATION OF NON-EDIBLE TROPICAL PLANTS

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**Abstract**

Open defecation, untreated sanitary and washing wastewaters are a serious problem in many poor areas. If the nutrients of human excreta would be seen as economical resource there would be reasons to build separating dry toilets and use valuable urine and washing waters for plant fertilizer and irrigation. This paper describes plants that could be cultivated in tropical areas utilizing wastewaters. The plants presented are mainly non-edible, since many people are not willing to use consciously human excreta for fertilization in food production. The survival abilities of these plants under water-logging or salt stress are considered. Plant species which could be used as fibers, light construction, fuel, fodder or timber, are presented. The regulations related to CITES-lists are presented. Since human urine can contain schistosomiasis spreading eggs, some plants known to have toxic effect on host snails of schistosomiasis spreading eggs are included. The better, safe latrine coverage would benefit especially women, but it would improve food and water hygiene.

*Key words*: millennium goals; schistosomiasis; timber; urine; wastewater; women

## 1. Introduction

Open defecation of urination is often practiced in developing countries, because still 2.6 billion people do not have any access to latrines according to United Nations http://www.un.org/waterforlifedecade/factsheet.html . The ability to use toilet has been counted as a human right in Bangladesh (National Sanitation Strategy, 2005). Many more people (children, people working outdoors or travelling etc.) urinate or defecate outside occasionally when latrines are too distant. Soil microorganisms degrade human excreta to chemical components, which vegetation can totally utilize. If the amounts of human and animal excreta are moderate per area and there are no generally known serious phototoxic symptoms caused by this excreta. The vegetation area needed for degradation of all excreta produced by one person is theoretically equal to the land area needed for food production of the same person. This area is highly dependent on climate but it can roughly be calculated to be 100-500 $m^2$, though this area can be as small as under 50 $m^2$ in tropics where different plants in different growth stages can grow all the year in different layers i. g. from high trees or climbing plants to small grasses and the photosynthesis area of roads, roofs or ponds can be efficiently utilized.

Human feces lead directly to waters pose a hazard to water and food hygiene and therefore good hygienisation of feces would be most essential. Plain pure urine on the contrary is usually microbiologically acceptable. Because it contains an abundance of nutrients its spreading into the soil without vegetation leads to nitrate contamination of groundwater and eutrophication of surface waters. Anyhow, urine can spread schistosomiasis eggs and this disease is known to spread via snails living in fresh waters as in dams (Ofoezie, 2002). Some plants which can inhibit the host

snails of this pathogen are included. Urine contaminated with feces of course contains enteric microorganisms. It should be emphasized that the normal urine is a powerful fertilizer but it cannot replace irrigation water. Toilet waters are, anyhow, often used after appropriate dilution (and possible hygienisation) as irrigation water and fertilizer with only modest treatments (Quazi, 2005).

The volume of water used during each toilet visit depends on the availability of water. If there is tap water, more than 10 liters of water/per visit can be used only for transporting toilet wastewater away. In addition, anal cleaning requires more water, thus the water consumption and electricity needed for pumps is remarkable. On the other hand, if women or other people must carry water into the latrine, the water consumption is less (maybe typically 1-3 liters) per a flush and possibly during the dry season there may be no flushing water.

In the ideal world it would be possible to build for all people water pipes with safe drinking water and a wastewater pipe with effective wastewater treatment. However, this would be expensive and will only come to fruition in the distant future. If a latrine could be seen as an investment and not only as a cost, more families could build an own family latrine. This aim of this paper is to show that a latrine can also give income so that more latrines would be built and used so that millennium goals could be reached. The paper is aimed to serve social workers, engineers and other non-agronomist officers who help households, schools and other organs for sustainable development.

## 2. **Improvements to environment are now possible with low costs**

The risks of contaminating water and food chains could be already now reduced if we could reduce radically the volumes of enteric wastewater gaining access to drinking and irrigation water. Dry toilets are one possibility but they are not easily accepted in cultures where anal cleaning is traditionally done by washing. A separating toilet with urine utilization could represent another possibility, if urine would be accepted for fertilization, since pure urine is recognized as being a useful fertilizer also for edible plants (Richert Stintzing *et al.,* 2005; Heinonen-Tanski *et al.,* 2007; Pradhan *et al.,* 2007).

Human urine is rich in nutrients but dependent on diet. For example the human excreta formed by Thai rural people contains approximately half the nitrogen content of excreta from Western countries, since the Thai diet contains less protein than the Western diet (Schouw *et al.,* 2002) and people living in tropical climate excrete a relatively higher percentage of nitrogen in sweat and less in urine than people in temperate climate (Huang *et al.,* 1975; Huang *et al.,* 2002). Therefore Western calculations about urine volume and nitrogen content can be assumed to represent overestimations. Furthermore in climates, where there are seasonal heavy rains, the soil will regularly be cleaned of water soluble nitrogen and thus the risks of over fertilization with nitrogen are smaller than is the case in Western countries. If people eat mainly vegetarian food their excreta may contain similar ratios of nitrogen and phosphorus as taken up by plants and this ratio is 10:1 for most plants (Knecht and Göransson, 2004). Thus there are no specific risks for unbalancing plant nutrients if human excreta are used as plant fertilizers (Pfister and Baccini, 2005).

Tropical vegetation usually has high water requirements. Mean evapotranspirations have been estimated to be some 3-5 mm/day in Philippine (Stöckle *et al.,* 2004) or in India (Amin *et al.,* 1997) and thus annually 1400-1500 mm of water can be released by vegetation. Thus a single medium size tree with crown area of 25 m$^2$ could evaporate approximately 100 l water each day corresponding to the wastewater volume from one family latrine. Thus the trees growing with the latrine wastewater can play an important role when controlling floods and bounding nutrients, and thus also the risk of flooding and consequent pollution of water can be reduced. If the latrine wastewater is dried efficiently by vegetation, then bad odors are reduced and mosquito larva would

have fewer niches to spread malaria, dengue or other diseases and also schistosomiasis could be partly controlled.

Vegetation could be planted near to discharge pipes of latrine so that the pipes could not be seen and the landscape could be more scenic. The plants selected in this report can be grown in tropical home plots, schools or common areas. Some of the plant species presented are resistant to permanent water logging and salt stress, which are problems in coastal areas. If the male trees of nutmeg, rambutan etc. were included, there would be many more species that could be cultivated with human excreta.

The plant residual leaves and branches can be used as bedding materials in composts or as fuel, so that women could get more easily firewood which in addition, would mean that more natural forests could be protected. The firewood is economically important for poor people who often must use even half of their income for firewood (Quazi, 2005).

Since the scientific literature released to the fertilization of tropical plants is limited, the fertilizer needs of different plants have been estimated from the knowledge of the energy or protein content in their leaves, fruits or other parts as well as from the growth rate.

### 2. 1. Many potential plant species
### 2. 1.1. Plants having potential to destroy host snails of schistosomiasis

**Foxtail agave** (*Agave attenuate*) originates from Mexico but it is widely cultivated as an ornamental and it can be propagated vegetatively. Its dry leaves contain compounds known to destroy efficiently *Bulinus africanus* (causing schistosomiasis) and *Anopheles arabiensis* (spreading malaria) but less *Daphnia pulex* (Brackenbury and Appleton, 1997). The same research workers reported that the toxicity of leaves against fish, rabbit skin or cornea was very low and the germination of cereals was inhibited only at much higher concentration than that needed for *B. africanus* and *A. arabiensis*.

Clark and Appleton (1997) found that also *Gardenia thunbergia* leaf power in water had a high toxicity against *B. africanus* and in addition they recommended that the leaves of *Apodytes dimidiata* and possible *Warburgia saluris* had so much mollucicidal activity that they could be used against snails. **Gardenia** is a small South-African tree used as ornamental due its white big flowers. **Apodytes** (in Swahili **mlambuzi)** with its edible red or black fruits can reach 25 m height and grow in dry areas of Sub-Saharan Africa (Lovett *et al.,* 2006).

If wastewater tends to form ponds these plants and especially gardenia and apodytes could be useful so that their leaves could be used against snails cultivated both of them so far of ponds that their roots are not water-logged.

### 2. 1.2. Fiber plants

**Cotton** (*Gossypium spp)* is an annual plant and one of the most important plants in tropical and semitropical areas. Cotton seed boll pods can be harvested some six months after seeding and seeding can be done in the tropics at any time. Due to its rapid growth and harvesting of nutrient-rich seed bolls, cotton needs an abundant supply of fertilizers (Sawan *et al.,* 1998, Blaise *et al.,* 2005) and thus the cultivation of cotton would fit well near latrine outlet areas rich in nutrients. Cotton seeds can first be grown in small pots and the young seedlings can then be planted near latrine outlets meaning that the small scale cultivation is not expensive. Since the yield must be collected during many different days, it is convenient to cultivate this plant in home plots and use

seed boll fiber could in women handicrafts and, health care. Animals can feed on cotton seed residues. Cotton with its red beautiful flowers and seed boll pods has also decorative value. Cotton is, however, known to be sensitive to insects and phytopathogenic micro-organisms (Rothrock *et al.,* 2004) so it may be difficult to cultivate it in the same plot permanently without the use of pesticides.

**Ramie** (*Boehmeria nivea*), **jute** (*Corchorus* sp.) and **fiber hemp** (*Cannabis sativa*) are widely cultivated industrial plants. Their fertilizer needs are not well documented, but generally the yield has improved by fertilization (Scheer-Triebel and Leon, 2000; Banik *et al.,* 2003; Patel and Thakur, 2003) and especially by split fertilization (Bhattacharjee *et al.,* 2000). Considering the annual yields and fertilizers used for these plants it seems that too low fertilizer level might often limit the yields. If there is a need to cultivate these plants and shortage of space and fertilizers, it could be beneficial to cultivate ramie near to latrine pipes.

**Textile hemp** (*Musa textilis*) grows, as do other bananas, in less than one year and it has smaller size than edible banana. All bananas tend to benefit from good fertilizer status in soil and thus their cultivation could be an interesting possibility, if their leaf stalks can be used making for ropes, nets, hammocks, hats, mats or other purposes (Jensen, 2001).

**Kapok, white silk-cotton tree** (*Ceiba pentandra*) can reach up to 30 m in height (Jensen, 2001) and it grows rapidly. It can grow also in poor soils but growth is better if urea and phosphate fertilizations are used (Gupta and Mohan, 1991). Kapok is used as stuffing material in building materials, toys, cloths, textile bags, furniture pillows and other handicrafts. Its seeds are rich in nutrients so they fit for poultry feed (Narahari and Asha Rajini, 2003). As a rapidly growing tree and with an ability to benefit from high amounts of nutrients and water kapok tree would be expected to grow well adjacent to latrine outlet sites.

**Silk cotton tree, red cotton tree** (*Bombax ceiba* or B. *malabaricum*) is even larger (up to 40 m) than the kapok tree (Jensen, 2001) and its red flowers are decorative. The bark has been used for rope making. In addition, its timber wood is valuable, i. e. this tree is multipurpose.

**Mulberry tree** (*Morus alba*) leaves are used for silk fiber production by silk worms. These trees are usually pruned as small trees or shrubs so they fit to small sites. If the leaves are regularly eaten by silk-worms, which make from leaf protein silk fiber protein, the plant must have a high protein synthesis capacity and a high need of nitrogen. Abbasov and Ataev (1970) have shown that mulberry trees grow better than the non-fertilized controls if 90 or 180kg/ha/a nitrogen was used. Therefore the mulberry tree would be expected to thrive in the vicinity of latrine discharge pipes. Mulberry tree can't survive if the soil is too alkaline (Gill *et al.,* 1987) thus latrine should not be washed with sodium hydroxide or lime. Not only silk worms eat the leaves, they can be fed to cattle or rabbits so this tree could be converted into animal protein. The wood can also be utilized for fuel or sport goods (Jensen, 2001). Humans could also eat mulberry berries.

### 2.1.3. Light construction material plants

**Rattans (canes)** are the names given to many different climbing palms - lianoids (Jensen, 2001). These plants usually need a trunk on which they can climb. Rattans grow rapidly and thus they would benefit from the rich nutritional status of latrine pipe discharge sites. Rattan products are popular for making light furniture, baskets, toys or sport items (Chan, 2000) sold also in Western countries.

**Bamboos** (*Bambusa vulgaris* and many more species from different genera) are rapidly growing grasses (Chan, 2000) and some of them can grow to over 30 m (Jensen, 2001). Different bamboos are used for the construction of houses, fences, supporting poles for climbing plants, furniture, baskets, musical instruments, and sport goods. They can even be used for plywood or paper making. Transportation of bamboos on bikes or rickshaws is a very common sight in South Asia. The very rapid growth of bamboos means a high nutrient need. Bamboos are often seen in tomb sites and close to water bodies, where they might benefit from soil or sediment nutrients, as near public latrine in Peradeniya Botanical Garden. Private farmers have cultivated bamboo using human excreta and earned well money from this production (Quasi, 2005).

**Oil palm** (*Elaeis guineensis*) is a common 20-30 m tall tree in many tropical areas. It is an important industrial plant since its seed oil is used for food processing and making soap (Jensen, 2001). In addition it is cultivated in big farms to make biofuel for car gasoline. Palm leaves are very often used for roofing, walls or fences. The young leaves and press cake fiber can be given to animals and on the other hand urine and feces from grazing cows and goats has found to be a good fertilizer for oil palm and these excreta improved soil structure (Devendra, 2004). Since urine and feces of ruminants are beneficial to the yield of oil palm, also human fecal matter must be a beneficial fertilizer so that oil palm can produce its fruits with high energy content.

### 2.1.4. Timber trees are beneficial but the restrictions imposed by CITES-lists need to be respected

Several timber trees have also many other uses. They or their leaves can be used as firewood or fodder, and the bark can be used as medicines or for tanning. In some cases there are also fruits or seeds, which are utilized by people or animals. Trees give shadow and act as windbreaks. They are important in creating a more attractive landscape. The cultivation of tall trees can also protect the natural coastal mangrove forests, which are extremely important for controlling against major storms and flooding as well as reducing the effect of high waves or tsunamis as occurred 26 December, 2004 and reported by FAO (2005).

The trees are useful for improving the soil properties. The root activity and the falling leaves increase soil organic matter content as has been reported by Osman *et al.* ( 2001) and roots can bind soil and make it less erosion-sensitive. Thus the serious water erosion can be controlled by trees.

Before cultivating tropical trees, it is essential to consider the **CITES-list** (Convention on International Trade in Endangered Species of Wild Fauna and Flora), which is an agreement between governments supervised by the United Nations Environmental Programme. This agreement is aimed at preserving the environment so that rare and vulnerable animals or plants are protected. Many valuable tropical timber tree species have been placed on this list in order to save the natural forest from illegal felling. Often industrial countries demand a certificate to show that a plant on the CITES-list has been cultivated in a way which is ecologically and environmentally acceptable. Therefore, if a tree species is placed on the CITES-list, it requires a certificate on its cultivation origin. The governmental authorities must give guidance on how this certificate can be obtained. The CITES-lists are different in different areas so that natural plant species are protected in the areas where they naturally grow. The web site http://www.cites.org/index.html provides more knowledge about species on this list. Some very vulnerable plant species are placed on the red list (see www.wcmc.org.uk/species/plants/red_list.html ). One certification system is supervised by FSC (Forest Stewardship Council) and this certification system is accepted by European furniture

makers.

**Roseapple** (*Syzygium jambos*) is an ornamental fruit tree but its fruits are not considered to be tasty and they are used as raw material for rosewater and leaf oils can serve perfume industry. This tree is some 10 m high so that it can be cultivated in small yards. The heartwood serves as good timber (Jensen, 2001). This tree thrives in wet conditions and it tolerates also waterlogged areas and thus it could be cultivated in the lower parts of banks receiving latrine pipe effluents. Its botanical relative, *S. aromaticus,* produces clove and this tree is known to favor from nitrogen fertilization (Martin and Dabek, 1988).

**Indian jujube** (*Ziziphus mauritiana)* is a small tree (15 m high). It can grow in different soils including the occasionally waterlogged or arid conditions. The reddish timber is used for turnery products. This tree can be cultivated to feed lac insects (*Coccus lacca*) in order to produce shellac (Jensen, 2001).

**Sapodilla, lamut or noseberry** (*Manilkara zapota*) is a fruit tree and a furniture timber tree usually grown to about 20 m high. This tree is rich in white latex, which has been used for chewing gum and different industrial applications. It tolerates strong winds and salt, which makes it interesting on coastal areas (Jensen, 2001). It can also grow in relatively poor soils but good fertilization increases growth rate (Zech *et al.,* 1991). However, this tree cannot grow in permanently water-logged sites and thus it should be planted on the upper part of bank areas.

**Cempedak** *(Artocarpus integer*) is a fruit tree (typically less than 20 m high), but its wood is valuable and durable as timber and its latex can also be used. Thus it is similar to its botanical relative jackfruit tree *(Artocarpus heterophyllus*), which is well-known as a medium sized (20-30 m high) fruit tree. In addition, cempedak leaves can serve as animal feed and its bark as tannin for leather. The timber is known to be termite resistant and a medium hardwood. Both *Artocarpus* species are used in making furniture, boats and for house construction.

**Neem tree** (*Azadirachta indica* or *Melia indica*) grows in many places including wastelands and even highly alkaline soils fertilized with urea (Gill *et al.,* 1987). The tree is usually less than 20 m high but the trunk can be as wide as 1 m in diameter (Jensen, 2001) and since the wood is said to be insect repellent it is very valuable for construction. Furthermore, its seeds and leaves can be used as an insecticide (Rao *et al.,* 1992) and the leaves are used as animal fodder. The plant has also medical and cosmetic value. A high lime content of the soil can cause chlorosis in the neem tree (van den Burg and Kopinga, 1983) but latrine waste is unlikely to contain lime if ash possible used for hand washing is not lead to latrine pit. Neem trees are growing well utilizing urinal wastewaters in a Bangladesh girl school (Heinonen-Tanski, 2006).

**Indian almond** (*Terminalia catappa*) is often cultivated along streets or home plots as an ornamental tree in the subtropics and tropics (Mattila and Virolainen, 1995). It is native to the East Indies (Jensen, 2001) but it is popular also in the Caribbean, where it has been described to be fast-growing and tolerant to marine wind or salt spray and to be a good provider to shade (Morton, 1985). It grows to approximately 25 m in height. The timber is multipurpose for building or firewood. The leaves can be given to cattle or silkworms. It is a pioneer species growing on disturbed soils and in beach forests. Its kernels are rich in fat (>50%) and protein (>25%). The kernel oil can be used as raw material for medicines or soap and also as animal fodder and human food.

**Teak** *(Tectona theka or T. grandis)* is very well-known timber wood having high market value cultivated in many countries. The trunk grows straight up to 25-30 m high and 1-2.5 m with diameter.  This tree with its big leaves is often cultivated along streets and yards. The wood is used for furniture, house frames, boats, bridges, rails and floodgates. Jensen (2001) recommends that this tree should be cultivated together with Borneo teak or bamboos. It grows well and rapidly with sufficient fertilization (Bhumibhamon *et al.,* 1981). Shortages of nutrients reduce the growth rate and this is reflected in chlorosis and other symptoms (Zech *et al.,* 1991). This tree is on the CITES list. In some countries it is forbidden to export raw teak, since wood-processing provides work and income for local people.

**Red sandalwood, rosewood** *(Pterocarpus indicus)* is usual in Southeast Asia growing adjacent to mangrove swamps or along streams. The tree can grow to a height in excess of 35 m high and its trunk can be 2 m in diameter (Jensen, 2001). This valuable tree is on the CITES-list. It is used for making furniture and cosmetic products. The wood gives off a camphor or cedar smell and the bark has a red color. The timber quality is reduced in dry season (Jensen, 2001), but should it be cultivated near to latrine pipe outlets, the unfavorable impact of the dry season could be reduced and the timber quality thus improved. It could also grow well near latrine pipes which have earlier got abundantly nutrients but recently there is only water, since phosphorus precipitated can be taken by sandalwood and this tree belongs to the *Leguminosae* family having an ability to get nitrogen from air in symbiosis with nitrogen fixing bacteria. The crown with beautiful yellow flowers can be extensive so this tree provides shade for roads, houses, yards and other vegetation.

**Yemane** *(Gmelina arborea)* prefers a fertile soil and therefore it could be expected to grow near to latrine outlet pipes. The trunk can be wide and the height can be up to 40 m (Jensen, 2001). The wood can be used for many purposes but also as fuel wood. Its flowers are beautiful. The leaves can be used as fodder for ruminants and the tree has also medicinal value. Improving growth was reported in a fertilization test (Otsamo *et al.,* 1995), even though it can also grow in poor natural soils (Zech *et al.,* 1991).  This species is on the CITES list in some countries.

**Borneo teak** or **Malaccan ironwood** *(Intsia bijuga)* is a large tree (up to 45 m) with the diameter of up 2 m. It requires a good water supply so it grows often on river banks, seashores and swamps. This wood is viewed as a "premium" tree for flooring, stairs, windows or door frames etc. (Jensen, 2001). Furniture made from this tree is sold under the name merbau. This plant belongs to *Leguminosae* so it lives in symbiosis with rhizobia bacteria, which have an ability to fix nitrogen. This tree could grow adjacent to latrine pipes utilizing the phosphorus from latrine residues and providing nitrogen to the other plant species growing adjacent to the trees. The leaves and seeds of all leguminous plants are rich in protein. This species is also on the CITES list.

**Big-leafing mahogany (Honduras mahogany or true mahogany)** *(Swietenia macrophylla)* is a source of extremely valuable timber used in the fine furniture and musical instruments, boats etc. The bark tannin is used for leather tanning. The tree can grow up to 40-60 m high with a branchless trunk to 18-25 m and 2 m diameter with buttresses to 5 m (Jensen, 2001), and thus it needs plenty of space. This tree originated from Central America and the wild tree has been set on the CITES-list to protect it from illegal felling. There is a special mahogany program in the CITES programme, i. e. in this case a certificate is mandatory. The cultivation of mahogany seedlings has been shown to succeed better if they receive at least some nitrogen (Yao, 1981), potassium, water and light (Dünisch *et al.,* 2002) but its growth is not rapid (Otsamo *et al.,* 1995). It can suffer heavily from nutrient deficiency in calcareous soils (Zech *et al.,* 1991) and too low levels of nitrogen, phosphorus and magnesium could disturb its growth. Wood ash tends to contain too large amount of calcium,

and therefore ash must be avoided. Since there are many nutrients which limit its growth, latrine wastewater with its special mix of nutrients may provide exactly the nutrients needed.

**Small-leafing mahogany** (*Swietenia mahagoni*) is clearly smaller than the big-leafing mahogany (only 30 m high) but it is as valuable as big-leafing mahogany and in practice the timbers from these tree species are not always separated from each other. Since it has more branches the timber of small-leafing mahogany is more interesting than that of big-leafing mahogany but also more difficult to work with. Also this tree can be cultivated legally but there has to be a CITES-certificate if it is to be sold on the Western market. Due to its smaller size, this tree could possibly be cultivated in a smaller space.

### 3. Discussion

As presented there are many different plants which could grow near to latrine outlets. Thus one can do a question: which plant should be chosen?

The selection can be done first by considering if the main reason is to get a new, economic resource from fertilizers for poor people or if the main reason is to reduce contamination of waters considering eutrophication, enteric diseases, schistosomiasis and malaria. Fiber plants and light construction plants may be a good selection giving yield soon and giving handicraft work for women with low capital. Big trees can be a better selection if the protection of groundwater is seen as the major reason. Big trees needing a long growing period may also fit for public places where they need plenty of place but where they are important for landscape.

The selection of a suitable plant could be based secondly on the size of available site. If there is a sunny open space in the vicinity of roads, ponds or rivers, even the very large trees may be suitable bearing in mind that the cutting of a large tree needs more space and its growth time can take decades. The large trees can of course be cut before they have reached the full size; should the space be needed for some other purposes. It is also possible to prune only one or a few branches to get some money.

Furthermore, the selection of the plant to be cultivated near to latrine outlet pipe should take into consideration the possibility to obtain seeds or seedlings. Some of these plants are available in each area. Some are freely available or at low price. If local seeds or seedlings of good quality and good health are available, they are often adapted to the local climate thus they represent a good choice. There are also seed vendors who can have extensive lists of seeds available and novel plants which can be tried.

In many cases it is better to reduce the final growth time in the final site near to the latrine by sowing seeds first into small pots and later to plant the best seedlings into larger pots and then finally to plant the best seedling near to the latrine site. This can guarantee that there is a living plant competing for resources with weeds.

It is also important to consider whether there will be water-saturated conditions or if there will be dry seasons, which the plant must tolerate. The possible salt tolerance should also be estimated. There may be also a need to re-evaluate the washing detergents so that strong mineral acids or bases (leading also to the smell of ammonia) should not be used.

### 4. Versatility of plants for future

In many cases it would be useful to cultivate many different plant species together near to the latrine site i. e. two or three herbs and one or maybe two tree species possibly at different growth

phases so that harvesting could be done at different times. Small herbal species can often be harvested already after a few months, providing work for women and other family members. On the other hand, the circulation times of many timber species can be 10-20 years, and in extreme cases, even 60 – 150 years.

Over that kind of time scale habits and attitudes may change so that it may be that the use of human excreta for edible plants may no more be a taboo. It is also possible that sanitation may be improved so that it will no more require such amounts of water as used today and then it would not be necessary to drain latrine wastewaters directly into fields or streams. True sustainability in sanitation and plant production may be then accepted in developing and industrial countries.

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# ASSESSMENT OF SANITATION AND ENVIRONMENTAL CHANGES TOWARDS THE ATTAINMENT OF THE MDG IN AFRICA

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**Abstract**

In order to have a world-wide, all-round human development, Millennium Development Goals (MDG) were set in the year 2000 and adopted by member states of the United Nations. Majority of these goals which are majorly targeted at the poor and those in the rural areas, have bearings with sanitation and environmental changes. If these goals will be achieved at the set time, the year 2015, more effort must be made to address these two issues. Since 70% of the target groups live in Africa and Asia, these two continents must be in the fore front of this crusade. Unfortunately, despite the huge effort and investment that is put into Africa, most African counties are not currently on track to achieve any of the goals. Principal among arguable reasons for this paradox include the defective institutional structure set in place to achieve the MDGs. It was assumed that the individual state is willing and able to set up an effective development policy aimed at achieving the MDGs while ignoring local or regional initiatives, such as those of the African Union and NEPAD. Some argue that globalization exposes African countries to risks from external shocks and instability while others feel that the targets are overly ambitious and unattainable for the least developed countries. Having said this, it has been recognized that success in rural development will require agreement among, and active support by, governments, civil society, and the private sector in both developed and developing countries. The process should be adjusted to integrate development and environmental sustainability into core development work to maximize synergies for adaptation to climate changes. Resource management for growth and technology transfer from developed countries should be started.

## INTRODUCTION

In the year 2000, Eight Millennium Development Goals (MDGs) with quantifiable targets were set and adopted by member states of the United Nations to help improve the standard of human development all over the world. The goals which in broad sense, included eradication of extreme poverty and hunger, achievement of universal primary education to promote gender equality and empower women, reduction in child mortality, improvement in maternal health, to combat human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), malaria and other diseases,-to ensure environmental sustainability and development of a global partnership for development, became important in the focusing of governments and NGOs on key developmental issues (Greaves and Webster, 2007).

The structure was based on the assumption that the individual states are willing and able to set up an effective development policy aimed at achieving the MDGs.  The MDGs was embraced by many and become an important instrument for advocacy and for focusing developmental aids. Five out of

the eight MDGs, precisely MDG Nos 1, 4, 5, 6, and 7, have direct and indirect links with sanitation and environmental changes. Safe drinking water, sanitation and good hygiene are fundamental to health, survival, growth and development (WHO/UNICEF, 2004), but unfortunately, are still luxury for many poor of the world today. Every year, unsafe water coupled with lack of basic sanitation kills at least 1.6 million children under the age of five years (WHO/UNICEF, 2006).

Sanitation, which is the safe management of human waste is not only critical to the health of communities but good sanitation can help to control infectious conditions, such as diarrhea and dysentery while improved sanitation and hygiene have a direct impact on child health in particular (Greaves and Webster, 2007). Safe water and sanitation are fundamental to human development (World Bank 2002). In 2005, the report of a roundtable discussion organized jointly by the UNICEF and the Water Supply and Sanitation Collaborative Council (WSSCC) during the 2005 World Summit at the United Nations in New York,   pointed out that lack of safe water, sanitation and hygiene awareness remains one of the world's most urgent health issues. Water is a precious natural resource and its sustainable management is essential to protect the water environment and to meet current and future demand.

According to Department For International Development (DFID, 2007), ignoring water resources management or poor water resources management will add conflicts, and has been a contributing factor in Darfur. Factors such as climate change, population, household size and affluence will put water supplies under greater pressure in the future. It is therefore important that we adopt more efficient water use patterns. Water resources management is considered critical in coping with climate change - both in terms of adaptation and mitigation, which also offers means of reducing conflict. According to Gorre-Dale (2005), unsafe water, inadequate sanitation and poor hygiene habits play a major role in Africa's high child mortality rate. Diarrhea is the third-biggest child killer in Africa after pneumonia and malaria, accounting for 701,000 child deaths out of 4.4 million on the continent every year. It also leaves millions of children with chronic malnutrition, the underlying cause of over half of all child mortality. The consequences are particularly severe for African women and children. This is because according to UN Millennium development Goals report (2005),  over 60% urban population in sub-Saharan Africa lived in slum conditions and more than half of the slum households suffered from two or more shelter deprivations, lacking a combination of access to improved water, improved sanitation, durable housing or sufficient living area. Also, migration from rural to urban areas poses a major challenge for city planners; extending basic drinking water and sanitation services to slum areas (WHO/UNICEF, 2006).

 According to International Bank for Reconstruction and Development/World Bank (2003) report, three out of every four of the world's poor live in rural areas and there will be no success in the war against poverty and achievement of the MDGs unless the fight is taken to where these people live. The same group in 2004 also reported that estimated 70% of the MDGs' target groups live in rural areas, particularly in Asia and Africa. In these areas and to a significant extent, these countries are living 'off' their natural capital but counting resource depletion as income; leading to serious environmental changes.

For instance, many countries have cut rainforests to make space for new farmland and to provide fuel, wood and timber while farmers have been depleting the soils of nutrients by growing crops without fertilizers. These countries at the same time are depleting their mineral reserves, counting them as earning income rather than converting one form of capital (mineral deposits) to another (financial assets).  According to World Bank (2002), 70% of Africans rely directly on natural resources for a part or all of their incomes). Whether the world (in particular Africa) continues to be

able to feed itself depends in large part on the condition of the world's natural resource base in the future, and this depends, in part, on whether poverty will be greatly reduced. Poor people live at the margin of subsistence and are more vulnerable to adverse events than others. Concern by policy makers over environmental degradation is driven by growing scarcity and continued degradation, in both developed and developing countries. (World Bank, 2003). Clearly therefore, the concerns over environmental degradation and global climate change and their links with rural poverty and agricultural development are well placed. Improved natural resource management, however, can lead to higher incomes and reduce risk (World Bank, 2002).

Africa is ecologically, socially and politically very diverse and countries are using variety of approaches to improve management of forests, biodiversity, soils and water resources (World Bank 2002). Important among these are efforts include;

- To avoid harm, through prior screening and use of environmental assessments
- To mitigate adverse impacts identified in the environmental assessments through environmental management plans and other measures
- To empower communities and individuals to take full responsibility for managing natural resources and contributing to their sustainable livelihood
- To include mainstream environmental issues into broader development programs through environmental support programs and other capacity building efforts
- To address past damages and assist communities to improve their management of natural resources through focused investments
- To improve incentives for long-term environmental stewardship rather than short-term exploitation, such as through introducing predictable natural resource charges or taxes, transparent systems of forestry concessions, sustainable management plans, etc.
- To establish regulations and laws to protect the environment and build capacity to enforce them.

## PROGRESS REPORTS

According to the UNU and Cornell University (2008), even though the MDGs are the top priority of the United Nations, especially with the establishment of MDGs Africa Steering Group by the Secretary General in September 2007, Africa as a whole is lagging behind in achieving the Millennium Development Goals (MDGs). At the midway point between their adoption in 2000 and the 2015 target date for achieving the MDGs, most African countries are not on track to achieve any of the goals. Africa has the lowest income per capita and the lowest life expectancy among developing countries. Africa is lagging behind with regards to gender equality, child mortality, maternal health, AIDS and other diseases and environmental stability. Less than half the people in Africa have access to safe drinking water.

Only about 5 percent of Africa's rural residents have access to modern electricity; the remainder depends on traditional fuels, mainly wood and cow dung, for cooking, heating and light (World Bank, 2002). Africa leads the world in the burden of disease arising from unclean water and poor sanitation, malaria, and (together with India) indoor air pollution (World Bank, 2002). WHO/UNICEF (2004) and (2005) reported that although about 1.1 billion people worldwide still lack safe water while 2.6 billion have no basic sanitation facilities that the Sub-Saharan Africa is the only region likely to miss Millennium Development Goal (MDG) (No 7) targets on both safe water and basic sanitation, unless the world acts quickly to turn this around. Although African continent is one in which the international development community is most heavily engaged, paradoxically, Africa is lagging behind partly because there is a governance failure (UN, 2005).

Although all these reports sparked off action in an attempt to address these problems highlighted, managing water resources, sanitation and environmental changes in Africa effectively is a crucial development challenge made more difficult by urbanization and rising populations. These developments directly affect efforts to reduce poverty. The economic slowdown will diminish the incomes of the poor and the food crisis will raise the number of hungry people in Africa. It will push millions more into poverty while climate change will have a disproportionate impact on the poor who are supposed to be the target of these policies (United Nations, 2008a). For instance, many coastal, marine and freshwater fisheries which provide protein for a large part of the population are threatened by over-fishing and by reduced surface water flows and pollution. Rapid and widely shared growth has benefited rural people elsewhere in the world in recent decades, notably in India and China, but has thus far eluded much of Africa. (World Bank, 2002)

Although the performance of African agriculture in the 1990s improved, compared to the 1980s, the improvement was not great enough or shared widely enough to meet the demanding goals for poverty reduction in the coming decades. African leaders will pursue more intensive efforts in the years ahead (World Bank, 2002).

On current trends, however, most human development MDGs are unlikely to be met at the global level. Sub-Saharan Africa and, in some cases, South Asia are likely to fall short most, especially in the areas of child and maternal mortality, access to basic sanitation, and reducing child malnutrition (IMF, 2008). UN (2008b) in their Department of Public Information reported that at the mid-point in the global effort to achieve the Millennium Development Goals (MDGs) by 2015, progress in many African countries is not on track. DFID (2008) reported that almost 900 million people still lack access to safe drinking water and 2.5 billion people still lack access to basic sanitation and that at current rates of progress, the water target will not be achieved in Sub-Saharan Africa while the sanitation target will be missed in both Africa and Asia by almost one billion people; meaning that Sub-Saharan Africa is off-target for both sanitation and safe drinking water target (DFID 2007).

Sub-Saharan Africa remains the area of greatest concern. It is a region of the world where, over the period of 1990 to 2004, the number of people without access to drinking water increased by 23% and the number of people without sanitation increased by over 30%. More intensive, effective and concerted action by all stakeholders is needed if the MDG drinking water and sanitation target is to be met in this region (WHO/UNICEF, 2006).

Table 1: Millennium Development Goal targets in Africa

| Access to improved | Areas | Estimated average for | | |
|---|---|---|---|---|
| | | 1990 (%) | 2002 (%) | 2004 (%) |
| Drinking water resources | Rural | 33 | 49 | 31 |
| | Urban | 80 | 72 | 67 |
| | **Total** | **49** | **60** | **48** |
| Sanitation coverage | Rural | 33 | 30 | 36 |
| | Urban | 51 | 48 | 53 |
| | **Total** | **39** | **38** | **44** |

Source: WHO/UNICEF (2004) Joint Monitoring Programme (JMP) for water supply and sanitation

**IDENTIFIED REASONS**

The MDG structure is based on the assumption that each individual state is willing and able to set up an effective development policy aimed at achieving the MDGs. This might not always be the case as some states are corrupted while others are weak. The political situation in Africa is the most obvious symptom of the defective institutional structure set in place to achieve the MDGs. There is a strong correlation between effective political institutions and the level of development. Where the state is weak and not performing well her key functions, the level of development lags behind (UN Millennium Project, 2005). Although African continent is one in which the international development community is most heavily engaged (UNU and Cornell University, 2008), paradoxically, partly because there is a governance failure, poverty trap, pockets of poverty and areas of specific policy neglect, there is lack of progress of the MDGs in Africa (UN Millennium Project, 2005). According to the UNU and Cornell University (2008), lack of progress of the MDGs in Africa clearly highlights the limitations of African states in formulating and implementing a development policy, i.e. its governance failure. The United Nations and other international institutions tend to ignore local or regional initiatives, such as those of the African Union and NEPAD. The situation in Africa is the most obvious symptom of the defective institutional structure set in place to achieve the MDGs (DFID, 2007).

Also, globalization exposes African countries to risks from external shocks and instability mainly because African countries have a long legacy of governments and donors influencing supply (World Bank 2002). The natural resource base on which most of Africa's rural poor depend is under pressure from poverty and population growth. Soils are degrading from poor cropping practices and increased exposure to wind and water. Neglect by national governments and the international community under the present circumstances are neither benign nor conscionable (World Bank 2002). There is a decline in attention to rural issues and a reduction in support to agriculture during the 1990s, (World Bank 2002). For instance, this last decade of the twentieth century could be broadly characterized as a period during which African governments and their development partners withdrew from many of the expensive and ineffective agricultural interventions pursued under earlier models of development, and turned attention to better macroeconomic management and investment in human resources. According to World Bank President James D.Wolfensohn "poverty challenge is getting bigger and harder, many of the benefits of an increasingly interconnected and interdependent global economy have bypassed the least developed countries, while some of the risks—of financial instability, communicable disease, and environmental degradation—have extracted a great price".

Other analysts and researchers feel that the targets are overly ambitious and unattainable for the least developed countries, especially in sub Saharan Africa, arguing that starting from a low development baseline, the progress cannot be faster. According to Easterly (2008), MDGs were designed as global targets and should not be applied to regions and countries. He also pointed out that MDG targets were biased against Africa in the following ways:
  i.  Choosing 1990 as a benchmark year when Africa's economies were in a slump instead of 2000, the year when MDGs were adopted.
  ii. Applying linear relationships to time or per capita income when nonlinear relationships may be more appropriate.
  iii. Opting for percent changes that hide considerable progress when measured in absolute numbers.

iv.    Setting level targets like universal primary school enrollment that penalize Africa, because it starts from relatively low levels compared to other regions. Change targets can reduce this bias.

v.    Expressing water and sanitation coverage in negative terms, which increases the gap between Africa and other regions, rather than using a positive indicator that would show the gap narrowing.

These countries save too little to achieve economic growth, and aid is too low to compensate for the low domestic saving rates. The institutional structures, characteristic of many government administrative systems are often too centralized which sap the effectiveness of development investments and policies.

## POSSIBLE SOLUTIONS

In every country, for the achievement of the MDGs, the starting assumption should be that they are feasible unless technically proven otherwise. On the basis of this, and according to Ndegwa (2002), some key issues needs to be addressed, such as can the developing state, and in this specific case, African state implement the MDGs? Does it have the legitimacy and the capability to do so? Is decentralization a plausible solution as a way to strengthen and make the African state more accountable politically, administratively and fiscally? With these issues addressed, it will be recognize that success in rural development will require agreement among governments, civil society, and the private sector in both developed and developing countries. African governments in particular need to seek a more proactive program of public and private investment to facilitate rural growth programs financing systems to support development (World Bank 2002). There should be increased public and private partnership to secure the roads, bridges, power, and communications to underpin success (World Bank 2002). The various Governments should be decentralized, by passing responsibilities and resources down to provincial and local governments that are better suited to identify priorities for construction and maintenance of infrastructure.

Regional institutions in Africa such as the African Union Commission, the New Partnership for African Development (NEPAD) Secretariat and the African Peer Review Mechanism (APRM) Secretariat with their specific institutional roles can have a positive impact for peace and security as a prerequisite to the MDGs. This progress needs, anyhow, a proper coordination with the domestic agenda of the African state, the United Nations and the international community. Several statistical studies have established strong reciprocal causal links between low incomes, low growth and the occurrence of violent conflict. There is therefore need for peace and security as a prerequisite to the achievement of these goals (Collier and Hoeffler, 2002).

Furthermore, there is need for policy change within the developed world. The livelihood of most rural inhabitants in these countries is connected to agriculture and protection of the agricultural sector in OECD countries for example creates significant barriers to agricultural exports from these countries, and hampers their ability to grow their way out of poverty through increased agricultural production (World Bank, 2002). Equally important, is to improve regional governance and building regional capacity for water management of waters, shared between countries, e.g. the Nile Basin Initiative, which supports countries bordering on the River Nile to work together to better manage their water resources (United Nations, 2008c).

Practically, the process should integrate development and environmental sustainability into core development work to maximize synergies, have sound resource management critical for growth,

plan for technology transfer from developed countries and put in place measures to adapt to climate changes (IMF, 2008). This implies that governments, and institutions work better for the poor, promote widely-shared growth, enhance management of natural resources, and reduce the risk and vulnerability of people. Moreover, the strategy emphasizes community participation, strengthening of voluntary producer organizations, primacy of the private sector in production and trade, a stronger role for markets, enhanced activity of local governments and private firms in the provision of public services, and transparency in the use of public funds (World Bank, 2002). Setting out current levels of access and identifying the investment and human resources to meet needs, bringing together government, civil society and donor groups to identify the blockages and agree on their activities and roles (DFID, 2007). All the challenges can be addressed using resources, skills and technologies that the international community has at its disposal, based on the commitments made by African Governments and the donor community alike. Although money will not solve everything, yet the lack of finance in Africa today clearly contributes to a situation in which the number of countries on track to achieving the MDGs is zero today (United Nations, 2008a).

In conclusion, country-driven, result-orientated, comprehensive, partnership-oriented and long-term perspective principles should for the bedrock of the strategies (IMF, 2008). That is, better government planning in developing countries, striking the right balance between the demands of economic growth, livelihoods and sustainability (United Nations, 2008c) as well as rural development challenge could be met only if international and domestic policies, institutional frameworks, and public expenditure patterns were conducive to sustainable rural development. An appropriate macroeconomic policy environment and a supportive institutional framework are essential to growth and poverty reduction while economic growth, better quality aid, and trade reforms, as well as governance are essential elements to achieve the Millennium Development Goals (World Bank and IMF, 2006). Rapid progress is possible across Africa when sound national programmes are matched with adequate development assistance and full support from the international system (United Nations, 2008b).

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# PROSPECTS AND CHALLENGES OF ATTAINING MILLENNIUM DEVELOPMENT GOAL IN ENVIRONMENTAL SUSTAINABILITY IN NIGERIA

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## ABSTRACT

Severe environmental degradation threatens the long-term development prospects of developing countries such as Nigeria. Studies on the linkages between poverty and environmental degradation has pointed out that the poor are both victims and agents of environmental degradation. The immediate struggle for basic survival by the poor in various countries undermines the legitimate concerns of environmental protection. In order to address the problem of poverty and promote sustainable development, the United Nations Millennium Declaration was adopted in September 2000 in an assembly of 189 world leaders. Whether they are achievable or not within the time frame, the MDGs indicators illustrate the interaction between environment and development and they have become important tools of monitoring human progress across nations.

This paper evaluates the progress, prospects and challenges facing Nigeria in attaining environmental sustainability of the MDGs by 2015. The paper further highlights the profile and current status of Nigeria's environmental sustainability.

**Keywords:** Degradation, Millennium Development Goals, Nigeria Environment, Sustainability

## PROSPECTS AND CHALLENGES OF ATTAINING MDG IN ENVIRONMENTAL SUSTAINABILITY IN NIGERIA

### OVERVIEW

Sustainable development is a global challenge. Severe environmental degradation threatens the long-term development prospects of developing countries such as Nigeria arising from reliance on the use of natural resources in their growth and development process.

Environmental degradation and poverty are inextricably intertwined. Studies on the linkages between poverty and environmental degradation have pointed out that the poor are both victims and agents of environmental degradation: victims in that they are more likely to live in ecologically vulnerable areas, agents in that they may have no option but deplete environmental resources thus contributing to environmental degradation (Leach and Mearns 1991; UNEP 1995; Sida 1996).

A world in which poverty and inequity are endemic will always be prone to ecological and other crises. In an attempt to survive, impoverish populations often descend on massively on excessive exploitation of natural resources. The immediate struggle for basic survival by the poor in various countries undermines the legitimate concerns of environmental protection and leads to consequent pressure on the environment, with attendant pervasive degradations (Hisham, 1993).

Exploitation of natural resources such as forests, land, water, and fisheries have caused alarming changes in our natural world in recent decades, often harming the most vulnerable people in the world who depend solely on natural resources close to their homes for their livelihood. Environmental sustainability is therefore very essential for helping poor people. The sustainable use of natural resources can improve the lives of the poor in many ways, including reducing vulnerability, increasing income, and improving health.

In order to address the problem of poverty and promote sustainable development, the United Nations Millennium Declaration was adopted in September 2000 in an assembly of 189 heads of government. The Millennium Declaration contains eight time-bound Millennium Development Goals (MDGs), 18 numerical and time-bound targets and 48 indicators intended to improve living conditions and remedy major global imbalances by 2015. Whether they are achievable or not within the time frame, the MDGs indicators illustrate the interaction between environment and development and they have become important tools of monitoring human progress across nations.

The eight Millennium Development Goals are:

Goal 1. Eradicate extreme poverty and hunger

Goal 2. Achieve universal primary education

Goal 3. Promote gender equality and empower women

Goal 4. Reduce child mortality

Goal 5. Improve maternal health

Goal 6. Combat HIV/AIDS, malaria and other diseases

Goal 7. Ensure environmental sustainability

Goal 8. Develop a global partnership for development

For the purpose of this paper, Goals 1 and 7 that focus specifically on poverty eradication and environmental sustainability will be analyzed.

**SUSTAINABLE DEVELOPMENT AND SUSTAINABLE ENVIRONMENT**

Sustainable development has been given several definitions. According to the World Commission on Environment and Development (WCED, 1987), "Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs". Sustainable development is multi-dimensional and implying different types of basic needs: economic, social, political and ecological and is, therefore, not just about the environment, but about the economy and our society as well.

Environmental sustainability on the other hand refers to the maintenance of the ecosystem and the natural resource base and the failure in this regard is signified by Environmental degradation (Masika and Joekes, 1997).

TABLE 1: MILLENNIUM DEVELOPMENT GOALS 1 AND 7 (GOALS, TARGETS AND INDICATORS)

| GOAL | TARGET | INDICATOR |
|---|---|---|
| *GOAL 1* **ERADICATE EXTREME POVERTY AND HUNGER** | **1. Halve between 1990 and 2015 the proportion of people whose income is less than US$1 a day** | -Proportion of Population below US$1 per day<br><br>-Poverty Gap Ratio<br><br>-Share of poorest Quintile in National Consumption |
| | **2. Halve between 1990 and 2015 the proportion of people who suffer from hunger** | -Prevalence of Underweight children under five years of age<br><br>-Proportion of Population below minimum level of dietary energy consumption |
| *GOAL 7* **ENSURE ENVIRONMENTAL SUSTAIBABILITY** | **9. Integrate the principles of sustainable development into countries policies and programmes and reverse the loss of environmental resources**<br><br>**b. Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss** | -Proportion of land area covered by forest<br><br>-Ratio of area protected to maintain biological diversity to surface area<br><br>-Energy Usage (kg oil equivalent) per US$1 GDP (PPP)<br><br>-Carbon Dioxide Emissions per capita, and consumption of ozone depleting CFCs<br><br>-Proportion of population using solid fuels |
| | **10. Halve by 2015, the proportion of people without sustainable access to safe drinking water and sanitation** | -Proportion of population with sustainable access to an improved water source, urban and regional<br><br>-Proportion of population with access to improved sanitation, urban and rural |
| | **11. By 2020, Achieve Significant Improvement in the lives of at least 100 million slum dwellers** | - Proportion of households with access to secure tenure |

Source: United Nations Development Programme (2001) **The Millennium Development Goals** www.undp.org/mdg;

 The concern for the environment was further re-echoed at the World Earth Summit in Johannesburg, South Africa in August, 2002 culminating in the adoption of the "Johannesburg Plan of Action" blue-print. The document prescribed actions for tackling identified social, economic, political and environmental problems (Adenuga et al, 2003).

This paper examines the progress made by Nigeria towards achieving MDGs with particular focus on prospects and challenges facing Nigeria in attaining Environmental sustainability (goal 7) by 2015.

**NIGERIA'S PROFILE**

With an area of approximately 923,768 sq km and a population of about 150 million (2006 Census), Nigeria is the tenth largest country and the most populous country in Africa respectively. Nigeria lies on Africa's west coast bordering Niger, Chad, Cameroon and Benin. The country is made up of 36 states and the Federal Capital Territory. These are further divided into 774 local government areas. For more than thirty years after achieving independence in 1960, the military ruled the country. Civil rule resumed only in 1999 and, since then, the Government has been implementing a reform programme.

Owing to a wide range of climatic, vegetational and soil conditions, the country is greatly endowed with minerals, forest, water resources and a rich biodiversity of flora and fauna. Climate varies from equatorial in south, tropical in centre, arid in north. Rainfall ranges between 500 - 1800mm while temperature averages $20^0C$ - $32^0C$ minimum and maximum respectively depending on the season. In general, the environment provides all life support systems in the air, on water and on land as well as the materials for fulfilling all developmental aspirations.

Sadly, despite the vast human and natural resource endowment, Nigeria, has consistently retrogressed from being one of the richest 50 countries in the early 1970s, to become one of the 25 poorest countries at the threshold of the twenty first century. With a Gini index of 50.6, Nigeria is among the 20 countries in the world with the widest gap between the rich and the poor. According to the 2004 report by the National Planning Commission poverty has decreased from 69.2 in 1997 to 54.4 percent which is still relatively high by the standard of the MDG (Igbuzor, 2006).

**STATUS OF NIGERIA'S ENVIRONMENTAL SUSTAINABILITY**

The Nigerian environment today is faced with many problems, arising from the impacts of human activities and natural phenomena. Nigeria's rich environmental resource base is being undermined by deforestation (3.5% per annum), erosion, desertification, gas flare and oil pollution. Nigerian ecosystem has been degraded by oil spills, gas flaring and sundry activities deriving from oil exploration, production and processing as experienced in the Niger Delta area of Nigeria. Oil spillage on land and in water has destroyed farm crops and farmlands, aquatic life as well as the flora and fauna of the entire region, thereby depriving the local population off their primary sources of livelihood in such affected region. In addition to their crippled economic mainstay, polluted food and domestic water sources also posses' serious health hazards.

Gas flaring results in huge economic losses with concomitant health hazards arising from reduction in air quality, and contribution to global warming through the release of greenhouse gases. The annual financial loss to Nigeria from gas flared has been put at about US $2.5 billion (UNDP/EMAP, 2004). According to the Nigerian National Petroleum Corporation (NNPC, 2003), "a greater proportion of the gas produced in Nigeria is flared". Despite the deadline set by the government to stop gas flaring, by 2002 and 2003, gas flared remained as high as 45.4% and 42.7% while gas utilized was 54.6% and 57.3%, respectively (Adenuga et al, 2003). There has been a decrease in the proportion of the gas flared in the last two years. According to the Nigerian National Petroleum Corporation (NNPC, 2007) report; a total of 789.55 Billion Standard Cubic Feet (BSCF) (32.68%) of the natural gas produced was flared, while 1,626.10 BSCF (67.32%) was utilized (figure 1). The Nigerian National Petroleum Corporation (NNPC, (2008) report indicates that a total of 631.19 BSCF (27.65%) of the natural gas produced was flared, while 1,651.25 BSCF (72.35%) was utilized as shown in figure 2 below.
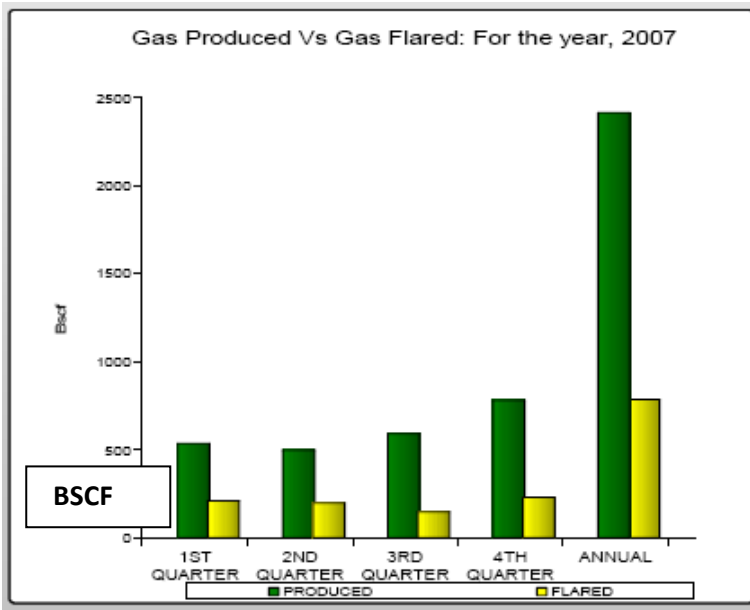
Fig. 1. Proportion of gas produced and flared (Source: NNPC, 2007).

*BSCF (Billion Standard Cubic Feet)*
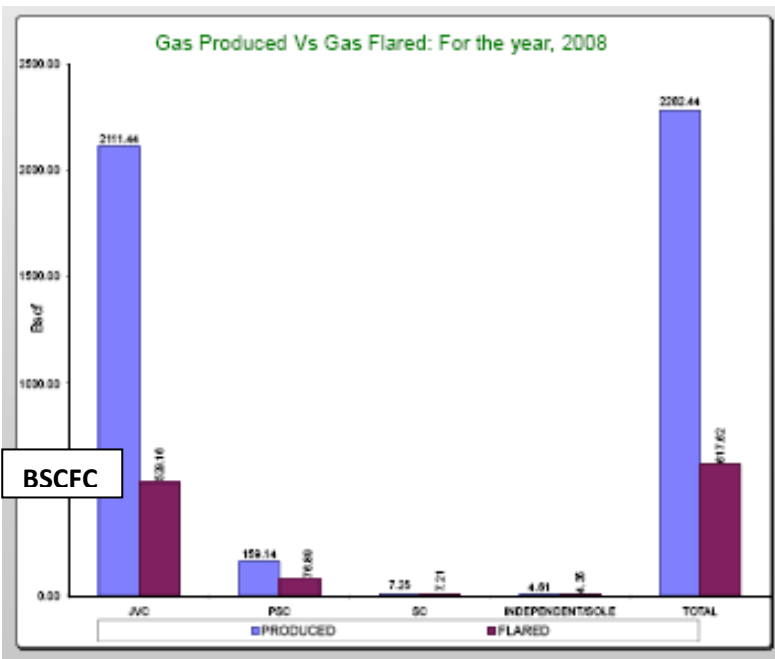


Fig. 2. Proportion of gas produced and flared (Source: NNPC, 2008).

*BSCF (Billion Standard Cubic Feet)*

Uncontrolled logging and tree felling accentuated by lack of re-stocking has resulted in massive depletion of the rich tropical rainforest. Deforestation (3.5% per annum) has accelerated the rate of desert encroachment and desertification particularly in the northern fringes of the country. These two outcomes of unsustainable environment processes have been exacerbated by a growing population that is heavily dependent on fuel wood as their energy source.

Fig. 3.  Gas flaring in the Niger Delta region. (Nigeria MDGs, 2006 Report).

Unsustainable land use and rampant bush burning is threatening the growth of trees and wildlife species leading to loss of precious biological diversity due to habitat destruction. Rapid and uncontrolled urbanization has contributed its quota to the deteriorating state of the Nigeria's environment with its attendant problem of population pressure and waste generation and management. For instance urbanization pressures have systematically converted areas originally earmarked as green belts and recreational areas into building sites and markets. Due to the absence of development in rural communities, there has been a high rate of rural-urban migration which has led to the expansion of urban slums.

Though erosion is a natural phenomenon, the problem has been aggravated by sand and gravel mining for construction and other activities that exposes the land to the direct impact of the agents of denudation. This is of particular concern in the south eastern part of the country with undulating topography.

**PROSPECTS**

Despite the plethora of environmental problems Nigeria has consistently shown some prospects of meeting some of the MDGs  Evidence from the 2006 MDGR shows a likelihood of achieving three of the eight goals in Nigeria; universal basic education; ensuring environmental sustainability; and developing global partnership for development. The recognition of the critical linkage between the environment and national development led to the transformation of Federal Environmental Protection Agency (FEPA) into a full-fledged Ministry of Environment in 1999. Consequently, there has been a growing institutional awareness and concern for environmental sustainability evidenced in the establishment of environmental bodies in all tiers of government

Nigeria is a party to international Conventions on Biodiversity, Climate Change, Desertification, Agenda 21 etc. and has shown commitment in the implementation of the Montreal Protocol.  The rate of gas flaring has

dropped by 24.5% since 2000 as a result of government legislation and intervention to be firm on the 2008 deadline given oil companies to bring a total end to the huge economic waste in gas flaring (MDGR 2006).

There has been a heightened campaign on environmental consciousness aimed at sensitizing the populace on the principles and gains of environmental sustainability

**PROGRESS**

A comparative analysis of available MDGs reports on Nigeria progress in attaining the MDGs reveals some progress in some areas though minimal.

Recent report has indicated that Environmental sustainability is one of the MDGs which Nigeria is likely to achieve by the 2015 deadline (MDGR, 2006). Access to safe drinking water is improving but access to sanitation is still low while housing has reached a crisis point with only 31.0% having secured tenure.

**TABLE 2: MILLENNIUM DEVELOPMENT GOALS PROGRESS REACHED IN NIGERIA. (Source; Nigeria MDG Report, 2004)**

| GOAL | TARGET | PROGRESS AS AT 2004 |
|---|---|---|
| **GOAL 1** Eradicate Extreme Poverty and Hunger | 1. Halve between 1990 and 2015 the proportion of people whose income is less than US$1 a day | NO PROGRESS YET |
| | 2. Halve between 1990 and 2015 the proportion of people who suffer from hunger | REASONABLE PROGRESS MADE |
| **GOAL 7** Ensure Environmental Sustainability | 9. Integrate the principles of sustainable development into countries policies and programmes and reverse the loss of environmental resources | SLOW PROGRESS |
| | 10. Halve by 2015, the proportion of people without sustainable access to safe drinking water and sanitation | REASONABLE PROGRESS |
| | 11.. By 2020, Achieve Significant Improvement in the lives of at least 100million slum dwellers | NO PROGRESS |

Federal Government has addressed the unsustainable oil production practice of gas flaring through the introduction of a 2008 deadline for oil companies to totally eliminate gas flaring. However, compliance by the oil operators is another issue. The use of gas-fired electricity power plants was approved for construction in 2005, to fully utilize the economic potential of the abundant natural gas resources furthering the effort to limit gas flaring. Also according to the MDGR, 2006, about 2000 km of greenbelt has been established in desert-prone region of the country in an attempt to increase the proportion of land area covered by forests.

Recently, the government has intensified effort to upgrade slums. However, affordable housing to the poor still posses a major challenge to the government.

**CHALLENGES**

A critical barrier to planning for achievement of the MDGS is the availability of up to date data on most of the indicators. The scarcity of statistical data on the environment in a common data base is a big problem and

has often resulted in conflicting and misleading progress report. According the recent Nigeria MDGR 2006, data gathering capacity and quality of survey information is weak as shown in the score chart below.

**Table 3; Progress level towards achieving environmental sustainability (MDGR, 2006).**

Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources.

| INDICATOR | 1990 | 2000 | 2004 | 2005 | 2015 Target | Progress Towards Target |
|---|---|---|---|---|---|---|
| Proportion of land area covered by forests | 10.0 | 14.6 | 13.0 | 12.6 | 20 | Worsened in 2005 |
| Proportion of gas flared | 68.0 | 53.8 | 43.0 | 40.0 | 0 | Good |
| Proportion of total population with access to safe drinking water (%) | 54.0 | | 57.0 | 60.0 | 80 | Slow, weak database |
| Proportion of total population with access to basic sanitation (%) | 39.0 | | 38.0 | | 100 | Insufficient data |
| Carbon dioxide emissions (per capita) | | $0.3^{2000}$ | 0.2 | 0.1 | | Insufficient data |
| Proportion of people with access to secure tenure (%) | - | - | 31.0 | | 100 | Insufficient data |
| Residential housing construction index (ACI) (Proxy) | | $45.8^{1999}$ | $50.4^{2003}$ | | | Improving/ Insufficient data |

Sources
  (i)      Federal Ministry of Environment
  (ii)     Federal Ministry of Water Resources
  (iii)    Central Bank of Nigeria          (2005), Annual Report and Statement of Account
  (iv)     NBS (2006) Socio-Economic Fact Sheet.

**Table 4. Tracking progress in ensuring environmental sustainability**.

Tracking progress in ensuring environmental sustainability

| Elements of the Monitoring and Evaluation Environment | Assessment | | |
|---|---|---|---|
| | Strong | Fair | Weak |
| Data gathering capacity | | | ✓ |
| Quality of recent survey information | | | ✓ |
| Statistical tracking capacities | | | ✓ |
| Capacity to incorporate statistical analysis into policy planning and resource allocation mechanisms | | ✓ | |
| Monitoring and evaluation mechanisms | | | ✓ |

Source: MDGR, 2006

Endemic poverty among the population is another major challenge to environmental sustainability in Nigeria. As has been earlier noted poverty and environmental degradation are intertwined and a highly impoverished population impacts negatively on the environment. For instance a growing rural population

heavily dependent on fuel wood for cooking exacerbates deforestation. It therefore follows that tackling environmental sustainability in isolation without poverty reduction is less likely to yield the desired outcome.

Furthermore, population pressures have undermined the genuine effort of government towards attaining the MDGs. Infrastructural decay is rampant especially in urban centres where population is concentrated with a consequent effect on poor sanitation.

Limited funding available for implementation and management of policies is yet another challenge to attaining environmental sustainability. Sound environmental policies often end up on the drawing board due to lack of funds which weakens the capacity for data generation and management. Developing partners can assist by financial and technical assistance. Nigeria is the lowest aid recipient in Sub-Saharan Africa with per capita annual aid flow approximately $4 per capita compared with $28 per capita average for Sub-Saharan Africa.

The lack of continuity of monitoring, accessibility to updated information has also contributed to slowing down or stopping totally the rate of progress towards achieving the MDGs in Nigeria. Often as a result of a change in administration, a time-driven developmental project is discontinued and updated progress report about that programme is not available and accessible for use.

Environmental objectives are not well defined in most cases and this has made it impossible to implement sound environmentally sustainable practices. Environment programmes need to be mainstreamed into development agenda of federal, state and local governments while resources for environmental management should be increased appreciably.

Inadequate complementary efforts from states and local government are also a threat to achieving the MDG in environmental sustainability in Nigeria. A strong commitment from all levels to mainstream environmental concerns into development activities is very vital to sustaining government plan of action.

## CONCLUSION

Undoubtedly, Nigeria has created a strong platform for the achievement of the MDGs of environmental sustainability if the Nigeria MDG report 2006 is anything to go by. Nigeria has adopted the principles of sustainable development and agreed to international accords on protecting the environment.

However, good intentions alone do not produce results. It is, therefore, obvious that more concerted efforts are required from the three tiers of government if Nigeria is to meet the targets that she has committed to and achieve environmental sustainability of MDGs.

Good governance and a strong collaboration among key stakeholders (private sectors) are also needed for achieving the MDGs by 2015.

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# SANITATION IN GHANA: THE PAST, THE PRESENT AND THE FUTURE TOWARDS ATTAINING THE MILLENNIUM DEVELOPMENT GOALS

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ABSTRACT

The Millennium Development Goals (MDG) were adopted by the United Nations (UN) to curb the socio-economic problems facing member countries. MDG aims to bridge the gap in respect of poverty, hunger, disease, lack of adequate shelter while promoting gender equality, health, education and environmental sustainability. They also comprise basic human rights to health, education, shelter and security by 2015. Sanitation is one of the most challenging problems which always worsen the health situation in most developing countries including Ghana. Enteric diseases account for very high percentage in all diseases reported by hospitals and health centers in many countries. This makes the issue of sanitation a very challenging problem to the health care of Ghanaians. Most people in Ghana depend on public sanitary structures as a means of waste disposal. From the results obtained, Ghana is not on tract to meeting the MDG target on sanitation unless much effort is committed to it by individuals in particular and the government in general.

Key words: Millennium Development Goals, sanitation, Ghana

## OVERVIEW

Ghana is a tropical country in Africa which is bounded in the north with Burkina Faso, south with the Atlantic Ocean, the west with Cote D'ivoire and the east with Togo. The country is divided into ten administrative regions and 138 decentralized districts. The population of Ghana is about 23.9 million (UN, 2008) and a life expectancy of 60 years. The population density varies from 31 per $km^2$ in Greater Accra Region, the capital to 897 per $km^2$ in the Northern Region and literacy rate is 57.9%.

It can be seen from the table above that 49% of the diseases reported in Ghana (top 5 diseases) were related to poor sanitation in one way or the other. Poor drainage system create many stagnant conditions which favour the breeding of the malaria vector; mosquitoes. Diarrhoea also occurs as a result of insanitary conditions. The real total number of people who suffered from malaria is likely to be higher than the cases reported by hospitals because many patients do not resort to hospital treatments.

During the 1980s and 1990s there was considerable investment in the provision of sanitation in developing countries. According to WHO (2004), however, still a significant proportion of the world's population remained without access to improved sanitation. Over 2.5 billion people globally suffer from lack of access to improved sanitation and nearly 1.2 billion practise open defecation, the riskiest sanitary practice of all, according to WHO/UNICEF (2008).

Global Annual Assessment of Sanitation and Drinking-Water (2008) revealed that from 1990 to 2006, approximately 1.12 billion people gained access to improved sanitation and despite this considerable progress, the world is not on track to meet the MDG sanitation target by 2015. The

report further presented that only 62% of the world population uses improved sanitation facilities as compared to 54% in 1990 and 16 out of the 54 countries in Africa have sanitation coverage of less than 25% (WHO/UNICEF, 2008) and Ghana is one of those 16 countries. The report goes on further to say that the proportion of the population practising open defecation has dropped from 32% in 1990 to 25% in 2006. Although the MDG campaign has gone a long way to improve the sanitary facilities in the world yet in 2006, WHO/UNICEF (2008), reported that about 2.6 billion people, more than 40% of the world population, do not use a toilet, but defecate in the open or in unsanitary places.

**Table 1**. Top 10 diseases in Ghana (Ghana Health Service, 2002)

| DISEASE | MALE | FEM. | TOTAL | % |
|---|---|---|---|---|
| Malaria | 1,390, 000 | 1,630,000 | 3,020,000 | 43.5 |
| Other Acute Respiratory Infection | 247,000 | 267,000 | 514,000 | 7.4 |
| Skin Diseases and Ulcers | 151,000 | 155,000 | 306,000 | 4.4 |
| Diarrhoeal Diseases | 139,000 | 145,000 | 284,000 | 4.1 |
| Hypertension | 74,000 | 121,000 | 195,000 | 2.8 |
| Acute Eye Infection | 90,000 | 92,000 | 182,000 | 2.6 |
| Pregnancy & Related Complications | - | 177,000 | 177,000 | 2.6 |
| Home/Occupational Accidents | 93,00 | 73,000 | 166,000 | 2.4 |
| Rheumatism & Joint Pains | 67,000 | 77,000 | 144,000 | 2.1 |
| Aneamia | 64,000 | 73,000 | 137,000 | 2.0 |

According to the WHO (2009), sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. Inadequate sanitation is a major cause of disease world-wide and improving sanitation is known to have a significant beneficial impact on health both in households and across communities. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal.

According to WHO (2000) data on investments into the water and sanitation sector shows that external investments exceeded national investments by a two to one ratio. Total external investments averaged US$ 1,513 million per year, while total internal investments were US$ 698 million per year. The report continued that regionally, more investments from both national and external sources were made into the urban sub-sector than into the rural sub-sector.

On the 8th plenary meeting, September 2000, upon a decade of major United Nations conferences and summits, world leaders adopted the eight United Nations Millennium Development Goals, committing respective member states to series of time-bound targets of global partnership which aims to reduce poverty by 2015. Thus the world leaders of the United Nations having seen the important attachment to sanitation in particular, listed it as the third target under the environmental sustainability goal and reads 'to halve, by 2015, the proportion of the population without sustainable access to safe drinking water and **BASIC SANITATION'** with the expected output-to

optimize the health outcomes associated with investments in sanitation services as the overall success at improving sanitation and quality of life is linked to good toilet facilities and clean environment.

**Table 2.**Definition of improved and unimproved sanitation (WHO/UNICEF, 2008)

| IMPROVED | UNIMPROVED |
|---|---|
| • Flush or pour-flush to: | • Flush or pour-flush to elsewhere |
|   • Piped sewer system | • Pit latrine without slab or open |
|   • Septic tank |   pit |
|   • Pit latrine | • Bucket |
| • Ventilated Improved Pit | • Hanging toilet or hanging |
|   latrine |   latrines |
| • Pit latrine with slab | • No facilities or bush or field |
| • Composting toilet | |

The aim of the present work is to assess the sanitation of the past and the present of Ghana against the millennium development goals target of 2015 and to propose meaningful and achievable solutions that can propel the country in achieving the target on sanitation.

## ECONOMIC IMPACT OF POOR SANITATION

Malaria, sanitation related disease remains a killer disease with nearly 1 million people losing their lives every year. Today 81% of malaria cases occur in Africa but it nevertheless remains a global problem also affecting countries in large parts of Asia and Latin America. (International Federation of Red Cross, 2009).

Globally, about 1.7 million deaths a year, 90 percent of which are children are attributed to unsafe water, poor sanitation and hygiene, mainly through infectious diarrhoea (WHO, 2009). Access to sanitation, the practice of good hygiene, and a safe water supply could save 1.5 million children a year. Poor sanitation also contributes significantly to water pollution adding to the cost of safe freshwater for households, and reducing the production of fish in rivers and lakes. More than 15,000 children die in Ghana annually of sanitation related diseases before attaining the age of five (Ghana News Agency, 2009).

## SOURCES OF DATA

This work is basically a review of various reports on the sanitation situation in Western Africa sub region in general and Ghana in particular. Most of the reports concentrate on sanitation situation in past (1990 onwards), the projection into the future and what is seen in the future (today) and the way forward that can help Ghana achieve the target on sanitation by 2015. The author also worked with Environmental and Sanitation Unit of the Ministry of Local Government, Bibiani Anwhiaso Bekwai District between 2002/2003.

## SANITATION IN THE PAST

Over the years, sanitation in Ghana has been mainly:Open defecation

- Communal pit latrines
- Individual household toilets
- Open dumping (household and street refuse).
- No proper control on waste water
- Control by Environmental Health Officers and Assistants
- 

Open defecation, communal pit latrines and open dumping are mainly practiced in the rural areas; these resulted from improper institutional structures to handle sanitation issues in the country. The sanitation in the past, did not achieve the expected outcome due to unclear indicators to monitor sanitation progress. Also, it is impossible to quantify the funds allocated for sanitation since it is impossible to isolate the funding for sanitation as a function of the national budget. Corruption has also eaten into sanitation issues. District assemblies quote such a huge figure as the cost of sanitary facilities upon completion, meanwhile, ordinary citizen can put up the same structure at the cost of about 30% of the amount. Water and sanitation comprise a very fragmented sector in terms of institutional responsibilities at the national level. WHO (2000) report reveals that in Africa, many ministries, public corporations and non-governmental organizations can be found in charge of water or sanitation services in the countries. No general pattern of institutional responsibility seems to exist in the region.

The government's efforts to score political points have also resulted in the deplorable state of sanitation in Ghana. This is because all funds allocated for the implementation of sanitation policies form part of the decentralized district assembly budget and as such the head of the various district assemblies, who have little or no background in dealing with sanitation issues, tend to exert so much control as to what sanitation policy is good for the local people.

The institution; environmental health and sanitation unit which is entrusted with sanitation issues in Ghana is woefully lacking the technical expertise required for a good work in that unit. The training institutions; Schools of Hygiene, Accra, Tamale and Ho, only focus so much on sanitary 'witch hunting' thus how to identify  sanitary cases which require prosecution of offenders and this usually results in extortion.

Data collection which forms the basis for proper forecasting and decision making in the sanitation sector is either not available or too scanty to capture the necessary parameters required for proper planning. The personal attitude of the people has also contributed so much to the low level of sanitation in Ghana. Little or no effort has been made by the local people to sustain the scanty sanitary facilities in the various local communities much of which can be attributed to the literacy rate in that country. Most people do not understand why there is a need for personal and environmental hygiene and as such they are not committed to sanitary projects.

## SANITATION TODAY

Sanitation today is not quite different from the sanitation of the past though there has been insignificant improvement in public toilet facilities and public waste collection. The government has given the biggest contract of public waste collection to a company called Zoomlion. Though this might help reduce public piling of waste, the fundamental principle of sanitation cannot be achieved as most of the staff are recruited from the public Environmental Health and Sanitation Unit. The sanitation sector is still limited by the lack of adequate trained capable staff and other problems of the sanitation of the past still persist.

In addition to fragile sanitary system, there has been dramatic assistance from foreign waste and sanitation agencies such as Danish International Development Agency (DANIDA), Canadian International Development Agency (CIDA) e.tc. The government has also started the construction of insanitay gutters to take care of waste water and run-off.

## RESULTS

**Table 3.** Basic facts and figures about African sanitation (WHO/UNICEF, 2008)

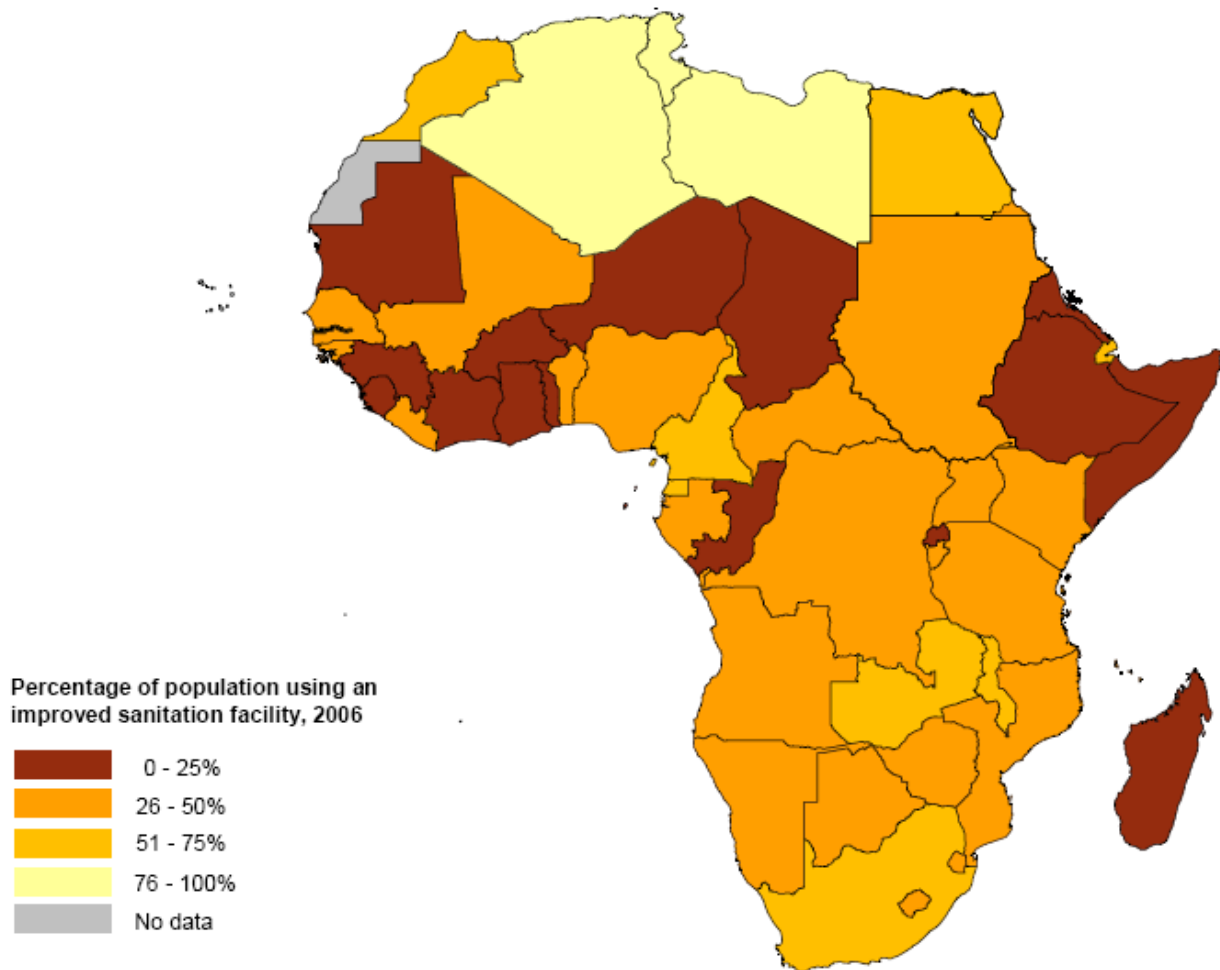| year | population using improved sanitation | | | population using shared sanitation | | | population using unimproved sanitation | | | population using open defaecation | | |
|------|-------|-------|--------|-------|-------|--------|-------|-------|--------|-------|-------|--------|
| | urban (%) | rural (%) | **tota**l (%) | urban (%) | rural (%) | **tota**l (%) | urban (%) | rural (%) | **total** (%) | urban (%) | rural (%) | **Total** (%) |
| 1990 | 52 | 23 | 33 | 24 | 8 | 13 | 16 | 25 | 22 | 8 | 44 | 32 |
| 2000 | 52 | 26 | 36 | 27 | 9 | 16 | 13 | 25 | 21 | 8 | 40 | 28 |
| 2006 | 52 | 28 | 38 | 28 | 10 | 17 | 12 | 26 | 21 | 7 | 36 | 25 |
| 2015 | - | - | 66 | - | - | - | - | - | - | - | - | - |

The percentage of people in Africa who have access to improved sanitation facilities has risen from 33% in 1990 to 38% in 2006, as shown in table 3. A little progress has been achieved both within the urban and rural l settings.

**Table 4**. Trends in the proportion of population using either improved, or shared or             unimproved sanitation or practising open defaecation at sub-regional levels, 1990-2006 (WHO/UNICEF, 2008).

| | population using open defaecation (%) | | population using unimproved sanitation (%) | | population using shared sanitation (%) | | population using improved defaecation (%) | |
|------|------|------|------|------|------|------|------|------|
| | 1990 | 2006 | 1990 | 2006 | 1990 | 2006 | 1990 | 2006 |
| North Africa | 20 | 11 | 18 | 15 | 5 | 7 | 57 | 68 |
| Southern Africa | 16 | 13 | 12 | 8 | 20 | 21 | 52 | 57 |
| Central Africa | 28 | 20 | 45 | 36 | 5 | 12 | 22 | 33 |
| Eastern Africa | 44 | 33 | 18 | 23 | 13 | 16 | 25 | 29 |
| Western Africa | 35 | 31 | 27 | 23 | 17 | 22 | 21 | 24 |

As of 2006, less than 25% Ghanaians (extrapolated from the Western Africa) had access to improved sanitary facilities. The number of people practising open defecation and the use of unimproved sanitary facilities are still high. One in four people in Africa still practise open defection.

**Figure** **1**. WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, 2008



Percentage of population using an improved sanitation facility, 2006

| | |
|---|---|
| (dark red) | 0 - 25% |
| (orange) | 26 - 50% |
| (amber) | 51 - 75% |
| (pale yellow) | 76 - 100% |
| (grey) | No data |

Sub Sahara African countries account for a higher proportion of MDGs target on sanitation off-track countries. Sanitation facilities in Ghana are less than 26% (2006).

**Figure 2.** Sanitation coverage in Western Africa, 1990-2006. (WHO/UNICEF, 2008).
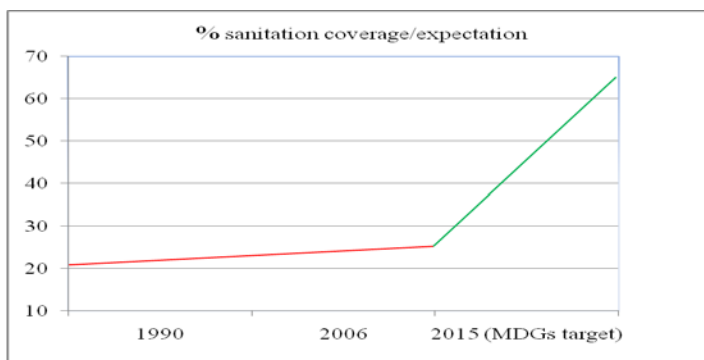


It is expected that for the western African sub region including Ghana to meet the MDG, there should be substantial increase in the provision of sanitation facilities from 2006-2015. Sixteen year project has achieved insignificant results in the western Africa region and extra weight is required if the target is to be achieved in the next nine years.

**Figure 3.** Percentage sanitation coverage in West Africa (WHO/UNICEF, 2008)
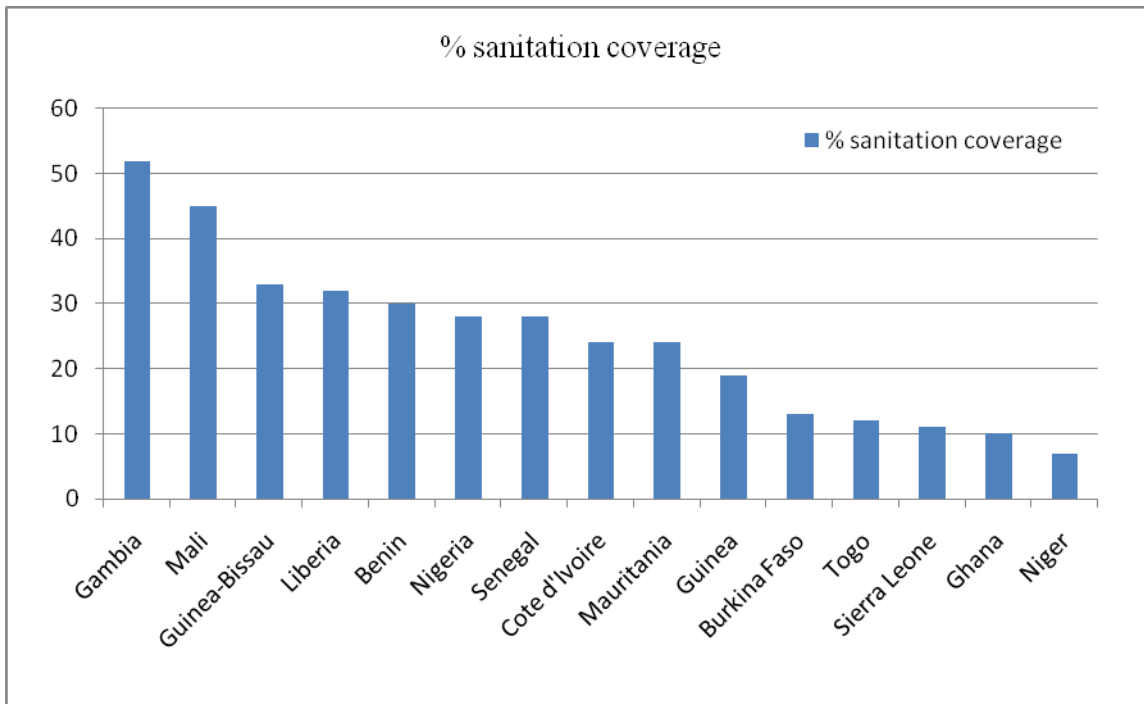


Ghana as of 2006 had achieved sanitation coverage of 10%, the last but one, in the Western African sub region

**Fig 4**: Estimated sanitation facilities in Ghana (WHO/UNICEF, 2008).
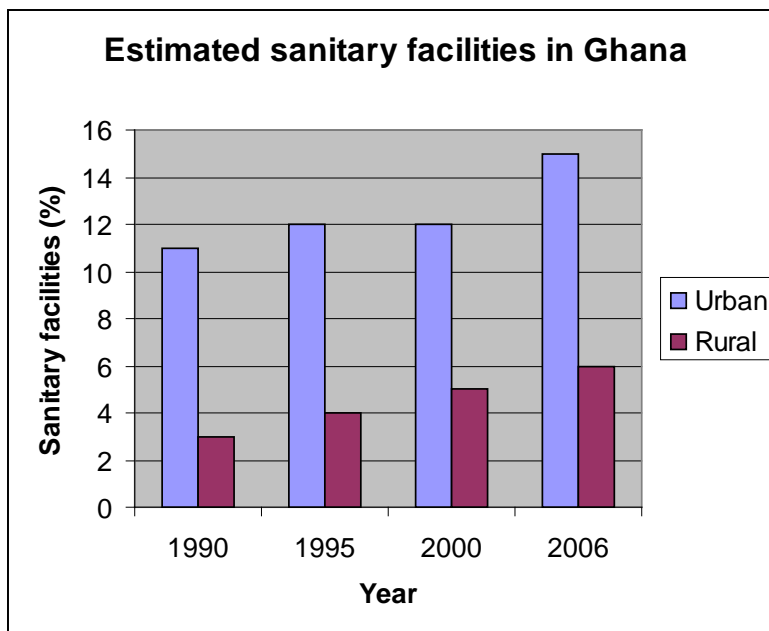


The estimated number of people in urban centres in Ghana who have access to sanitation facilities increased by only 1% from1990 to 1995. From 1995 to 2000, there was no change in sanitary facilities and an increase of 3% afterwards to 2006. In the rural settings, there has being 1% increase for every five year period in sanitation facilities from 1990 to 2006.

The trends from the results show that the MDG sanitation target is unlikely to be met, with a global target of 74% in the year 2015. Enormous work is required to get sanitation in Africa and Ghana in particular on track if the MDGs are to be realised in 2015.

## LOOKING AHEAD

From the above results, it is clear that Ghana is not on tract to meeting the UN's millennium development goals of 2015, unless all concerned are committed to that course. In other for Ghana to meet the MDG, there should be:

- ✓ Individuals should embark on their own initiatives to promote and build sanitary facilities. This is the giant step that can see a different sanitation situation in the ground since individuals will be much committed to keeping.
- ✓ There should be a national policy on sanitation and all concerned should be committed to seeing it work.
- ✓ Sanitation should be part of the all school's curriculum so that right from the scratch, there will be the need for sanitation in every pupil's mind.
- ✓ There should be mass education on sanitation to educate the entire populace, child, youth and adult alike on the need for sanitation.
- ✓ Individuals should be committed to national legislation regarding sanitation and offenders dealt with in accordance with the law without any excuse.
- ✓ The government should restructure the Environmental Health Division and seek more qualified and competent expertise to handle the sanitation situation.
- ✓ The government should consider sustainable waste water disposal drainage systems in the national sanitation policy.

To re-stress on the need of the commitment of individuals to the sanitation course, the failure and success of every sanitation program depends mainly on the people who will benefit from such facility. It is therefore very important that Ghanaians should be committed to seeing a better sanitation in Ghana.

"The people of Africa who drink polluted water and live in contaminated environments know what the costs are. They are paying them right now in the currency of illness, death and stunted lives. The costs of neglecting their needs are far greater than the costs of meeting them" (WHO, 2000).

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# IMPROVING SANITATION AND HYGIENE PRACTICES TO ACHIEVE MILLENNIUM DEVELOPMENT GOALS IN ZIMBABWE

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## Abstract

Every year millions of people, most of them children, die from diseases transmitted through human excrement in water, illnesses associated with inadequate water supply, sanitation and hygiene. Millennium Development Goal (MDG) 7, sub-target 3, focuses on the attempt to halven the proportion of people without access to water and sanitation services worldwide. Sufficient treatment and disposal of excreta and wastewater plays a vital role in ecosystem management and puts less pressure on freshwater resources, as it reduces the transfer of human excreta into waterways, helping to protect human and environmental health.

Over the past decades mainly centralized sanitation systems have been built to serve densely populated areas. Now it has been assessed that these centralized systems result in large investment costs, especially for the sewer lines required. Therefore it is high time to focus on sustainable solutions, modelled on decentralized systems, especially for rural areas that still suffer from inadequate sanitation. Zimbabwe suffered a major cholera outbreak in 2008 and is in urgent need of a land-wide improved sanitation system. Ecological sanitation, community-based waste management and most of all, the hands-on mentality involvement of rural inhabitants, might be the key to this dilemma.

Everyday life of women would be improved immensely by an increasing quantity and quality of water for households and improving the management of human excreta, as well as promoting hygienic practices, such as hand washing and safe water storage in the home. These are the most effective health interventions for the world's poorest countries.

**Key words:** sanitation, community-based waste management, Zimbabwe, UN Millennium Goals

## 1. Introduction

Today, nearly two and a half billion people in rural and urban areas do not have access to adequate sanitation services. In developing countries over 90% of sewage is discharged untreated, polluting rivers, lakes and costal areas (Langergraber & Muelleger, 2004).

The UN Millennium Development Goals were set to give the world an opportunity to improve the lives of billions of people by adopting practical approaches and strategies to eliminate poverty by scaling up investments in infrastructure and human capital, while promoting gender equality and environmental sustainability.

Still 40% of women, men, and children have no choice but to defecate into buckets, polythene bags, in open fields and alongside roads and footpaths, not occasionally but every single day. This continuing yet largely unrecognized humanitarian crisis should end in order to be able to reduce disease and achieve environmental sustainability (Lenton et al, 2005). Approximately two in ten

people have no source of safe drinking water. This kills a number of 3,900 children every day and robs mostly women and girl of their health, time, and deprives them of their dignity (WHO, 2005).

At any given time, close to half the people in the developing world are suffering from one or more of the main diseases associated with inadequate provision of water supply and sanitation services: diarrhoea, ascaris, dracunculiasis (guinea worm), hookworm, schistosomiasis and trachoma (UN, 2004). The vicious circle of poverty and ill-health is common among the poorest, because poverty renders people ill-equipped to protect themselves from biological pathogens and chemical hazards. Their poor health hinders them to seek treatment for illness and also impairs their ability to work and earn their living costs.

Billions of cases of diarrhoea each year cause 1.6 million deaths, the vast majority being children under five. More than half the hospital beds in the world are filled with people suffering from water-related diseases. Research has shown, that improved water supply would reduce diarrhoea morbidity by 21% and improved sanitation diarrhoea morbidity by 37.5%. Most importantly, simply washing hands at critical times can reduce the number of diarrhoeal cases by as much as 35% (WHO, 2005). The improvement of access to safe water sources and better hygiene practices could reduce trachoma morbidity by 27%. Additionally Schistosomiasis, which is strongly related to unsanitary excreta disposal and absence of nearby sources of safe water, causes tens of thousands of deaths every year, mainly in Sub-Saharan Africa. The availability of only basic sanitation would reduce disease by up to 77% (WHO, 2005).

## 1.1 UN Millennium Development Goal 7, sub-target 3

In 2000 the UN Millennium Declaration was adopted by the Millennium Summit, committing their nations to a new global partnership to diminish extreme poverty and establishing a series of time-bound targets, with a deadline of 2015, which have become known as the Millennium Development Goals (MDGs) (UN, 2006). In the following paragraphs these targets are considered in more details.

Goal 7 of the Millennium Development Goals aims to ensure environmental sustainability. Sub-target 3 states that the objective is to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation. In addition, sound water resources management and development is a key to achieving all of the Millennium Goals (UN, 2006).

Target 3 refers primarily to the contribution of sanitation to dignity and social development and the benefits it brings to the environment. It focuses not only on the collection, treatment, and disposal of human excreta but also on the drainage and disposal of household wastewater and that improved sanitation would generate economic benefits (UNICEF, 2008a,b).

Meeting the Millennium Development target for sanitation demand improved sanitation for nearly half a billion of people over the next few years, for more than 383,000 people every day. Sufficient water supply and sanitation, together with hygienic behaviours, like hand washing, safe water handling and storage as well as the safe disposal of faeces are essential to health, because the main cause for transmitting water-related diseases is the "faecal-oral" route (UN, 2006).

## 1.2 What is Sanitation?

Sanitation is foremost the safe collection, storage, treatment and disposal, as well as reuse, or recycling of human excreta (faeces and urine), but also the drainage and disposal, or recycling of household wastewater, which is often referred to as sullage or grey water. It further includes the

management, reuse, and recycling of solid wastes also for industrial waste products. Besides these, sanitation ranges from drainage of stormwaters, to treatment, disposal and reuse and recycling of sewage effluents. Furthermore it represents the management of hazardous wastes, including hospital wastes and chemical, radioactive and other dangerous substances (Lenton et al, 2005).

Consumption of contaminated water transmits waterborne faecal-oral diseases like cholera, typhoid, diarrhoea, viral hepatitis A, dysentery, and dracunculiasis (guinea worm disease). Insufficient quantity of water for washing and personal hygiene causes bacteria and parasites to thrive, leading to skin and eye infections, including trachoma, and the easy expansion of faecal-oral diseases. When open-defecation is the norm, particularly flies are major vectors for disease (UN, 2004).

Breaking the faecal-oral cycle depends on the adoption of healthful practices, like hand washing and the use of technologies that contain and sanitize faecal matter and prevent contamination of water and soil. Faecal matter should be treated as close to the point of defecation as possible. The control of worm infections would be of particular importance. Mostly children suffer from diarrhoeal diseases, either waterborne or water-washed and they also present the most likely source of infection. Therefore the safe disposal of children's faeces is of utmost importance. Improving access to water supply and sanitation particularly for children is one of the most effective ways of improving health and quality of life (UN, 2004).

## 3. Zimbabwe

### 3.1 Facts

The Republic of Zimbabwe is a landlocked country in the southern part of Africa, with a population of approximately 13 million, and belongs to the so called Sub-Saharan countries. The total area spans over 390,580 km$^2$, bordering South Africa to the south, Botswana to the southwest, Zambia to the northwest and Mozambique to the east.  The centralised government is divided into eight provinces (Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Masvingo, Matabeleland North, Matabeleland South, Midlands), each with their own capital, and two further cities with provincial status (Bulawayo and Harare), for administrative purposes. These provinces are subdivided into 59 districts, which are headed by a District Administrator, appointed by the Public Service Commission. The major ethnic groups consist of 98% Africans (Shona 82%, Ndebele 14%, other 2%), 1% Asian and less than 1% white (Wikipedia, 2008).

Hyper-inflation with prices doubling every 1.3 days, the highest inflation rate in the world, the impact of HIV and AIDS, and the decline in recent years of commercial farm production, have all led to a widespread lack of food and other essential items across Zimbabwe (Wikipedia, 2008). The government faces a variety of difficult economic problems as it faced an unsustainable fiscal deficit, an overvalued official exchange rate, hyperinflation, and bare store shelves (CIA, 2009) and 80 % of the population live on less than US$1 a day and lack access to basic commodities like food and water (Oxfam, 2009).

(USEA, 2009)

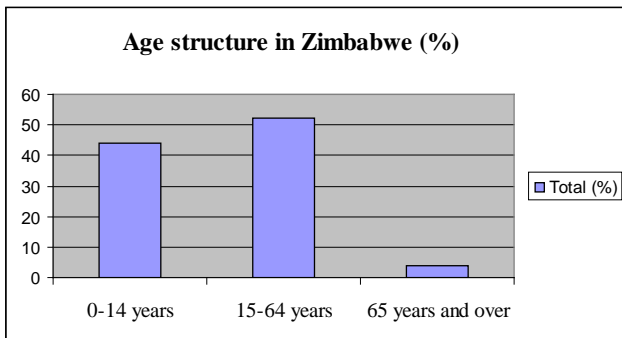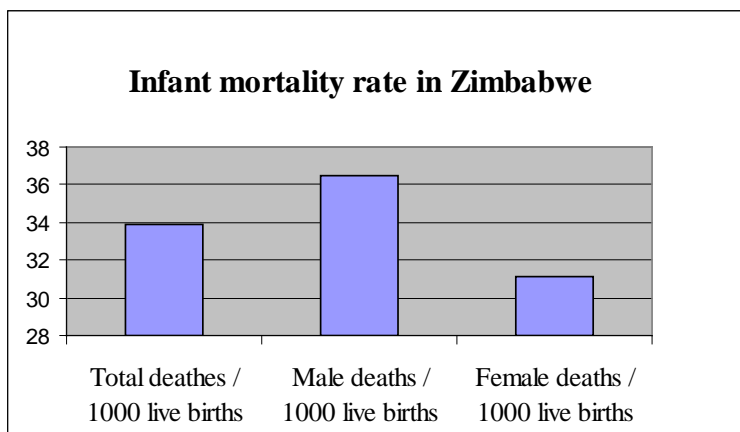Figure 1. Age structure (%) in Zimbabwe 2008 (Wikipedia, 2009).



Figure 2. Infant mortality rate (%) in Zimbabwe (%) (Wikipedia, 2009).

Life expectancy for men is 37 years and for women 34 years of age, the lowest in the world in 2006, taking into account the effects of excess mortality due to AIDS, as 1,8 million Zimbabweans currently live with HIV and also infant mortality is one of the highest (Wikipedia, 2009).

Major occurring infectious diseases are food or waterborne diseases like bacterial and protozoal diarrhoea, viral hepatitis A, and typhoid fever, vector borne diseases like malaria, water contact diseases like schistosomiasis and animal contact diseases like rabies. Cholera, has broken out recently due to the collapse of city sewerage systems, poor maintenance of water supply systems including hand pumps, acute drinking water shortages, and the lack of basic hygiene items like soap (Oxfam, 2009).

## 3.2 Cholera Epidemic

At the end of 2008, problems in Zimbabwe reached crisis proportions in areas like living standards and public health. The countries health system had collapsed and many hospitals had shut down due to hyperinflation and emigration of medical personal because of the ongoing political and economic crisis. All these facts contributed to a major outbreak of cholera in December 2008.

By December 2008 more than 10,000 people had been infected and the outbreak had spread to Botswana, Mozambique, South Africa and Zambia. The expansion of cholera from urban to rural areas from December 2008 onwards was caused by infected city-residents visiting their families' rural homes for Christmas and the burial of infected city-residents in rural areas. In February 2009 76,127 cholera cases and 3,623 deaths were reported. The lack of access to clean water in urban areas was the principal cause of the outbreak. The collapse of the urban water supply, sanitation and garbage collection systems, in addition to the onset of the rainy season, caused faecal matter with cholera bacteria being washed into water sources, especially into public drains (Wikipedia, 2009).

Figure 3a and b. Cholera cases in Zimbabwe 2008 and the cumulative number of cases up to early 2009 (Wikipedia, 2009).
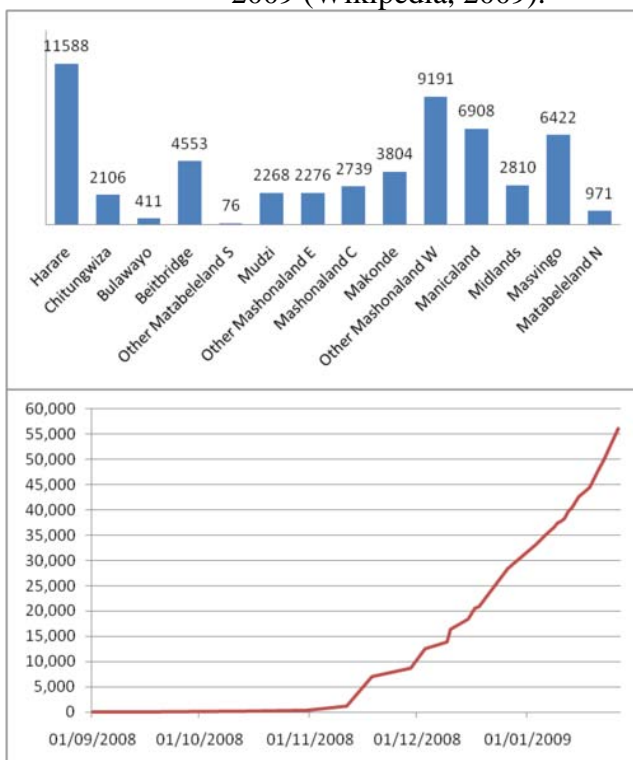


Cholera, an infectious, life-threatening disease is caused by the gram-negative bacterium *Vibrio cholerae*. Trans-mission to humans takes place orally through eating food or drinking water infected with cholera vibrios and inadequate sanitation (Fuchs et al, 2007).

Due to variations in the O-antigen (consisting of lipopolysaccharides, LPS) it shows various serovars. Cholera pathogens belong usually to the serovare 0:1, which can be divided by physiological characteristics into the biovars 'cholerae' and 'eltor'. For a cholera outbreak normally a relatively high amount of bacteria is needed ($10^8$-$10^9$), but through food a considerably lower amount of bacteria is needed to cause infection. (Fuchs et al, 2007).

An untreated patient will loose 20l of fluid daily and suffer from exhaustive diarrhoea in form of

pale fluid stools. The enterotoxin constantly activates the enzyme adenylatcyclase of the cell, which causes a change in the ion-flow over the cell membrane, ultimately causing the high loss of fluid. Therapeutical measures are taken by trying to compensate the water-ion loss by an electrolyte-glucose solution (Fuchs et al, 2007).

## 4. Sanitation Practices

UNICEF has set up four steps of sanitation practices.

Open defecation is a practice whereby defecation occurs in fields, forests, bushes, in bodies of water or other open spaces, or the disposal of human faeces with solid waste (UNICEF, 2008). Open defecation has decreased in developing regions, dropping from 31% in 1990 to 23% in 2006. In sub-Saharan Africa, 221 million people are defecating in the open, the second largest total for any region. Open defecation is predominantly a rural practice, as nearly 1/3 (31 %) of the world's rural population practises open defecation, while only 13% of urban areas (WHO/UNICEF, 2006).

Unimproved sanitation facilities do not ensure hygienic separation of human excreta from human contact. They include pit latrines without a slab or platform, hanging latrines and bucket latrines. Included are also improved facilities which are lacking adequate disposal, like pour-flush toilets that discharge directly into open drains, ditches or other bodies of water (UNICEF, 2008).

Shared sanitation facilities are shared between two or more households and also include public toilets (UNICEF, 2008). This type remains largely an urban sanitation facility, as the 2006 coverage estimates confirm. More than two thirds of shared sanitation users are urban residents and in urban areas of Sub-Saharan Africa, every third person uses a shared sanitation facility.

Improved sanitation facilities ensure hygienic separation of human excreta from human contact. They include flush or pour-flush toilet/latrine to piped sewer system, septic tank, or pit latrine; then the ventilated improved pit (VIP) latrine, the pit latrine with slab and the compost toilet. Facilities are not considered improved when shared with other households, or open for public use (UNICEF, 2008).

These findings reflect the limited sanitation options available in many crowded cities and towns of Zimbabwe and this issue is becoming increasingly serious due to the constant increase in population of urban and peri-urban areas.

Conventional sanitation systems collect and transport wastewater through a sewer system, using drinking water as transport medium. Here the system mixes comparatively small quantities of potentially harmful substances with large amounts of water, which in an instance increases the problem to manifold. Secondly, the construction, operation and maintenance of the necessary sewer, wastewater treatment and drinking water supply, constitute extreme financial costs and so these systems have only a low chance to ever become financially sustainable (Langergraber & Muelleger, 2004).

Figure 4. Trends in the proportion of Zimbabweans using different sanitation facilities from 1990 and 2006 show no development in sanitation coverage in urban areas (WHO/UNICEF, 2006).
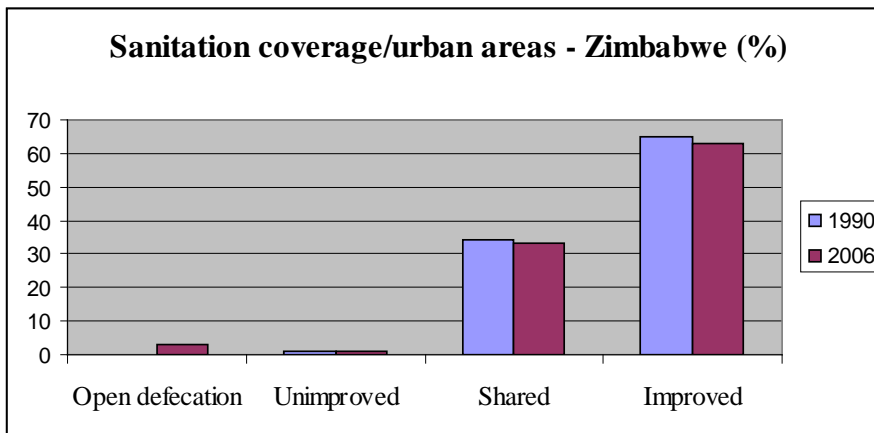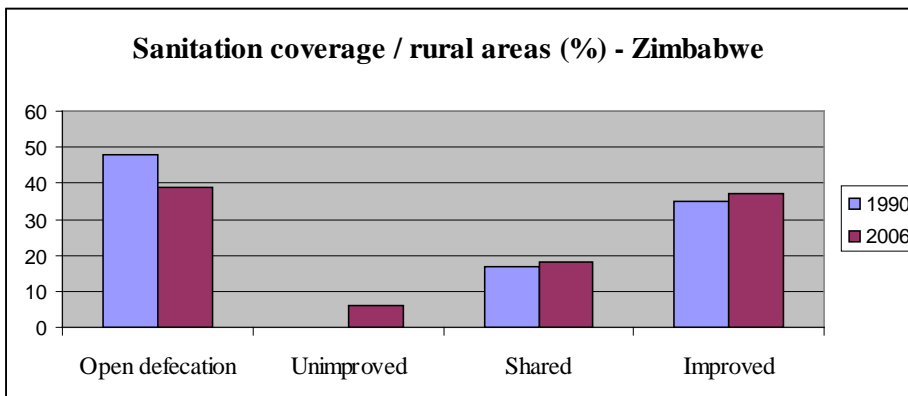


Figure 5. Trends in the proportion of Zimbabweans using different sanitation facilities from 1990 and 2006 with sanitation coverage in rural areas show very slow development (WHO/UNICEF, 2008).



The various forms of pit latrines are still the foremost used device in developing countries. Although the obvious disadvantages, with pathogens contaminating soil and groundwater, bad smell, fly and /mosquito breading, pit collapse or the distance from the house, make clear that this is not the best alternative. In densely populated areas this kind of latrine is limited by the lack of space (Langergraber & Muelleger, 2004).

## 4.1 Hygienic Hazards

Human faecal excreta can obtain large amounts of pathogenic organisms and therefore be responsible for major hygienic hazards, as they pose the main risk in contaminating the environment by being spread next to places where people and animals live, and especially next to drinking water sources. Awareness of the risk, prevention, diversion at the source and sufficient treatment, as well as proper handling guarantee the minimisation of health risks (Langergraber & Muellegger, 2004).

A direct recycling of human excreta could be used for agricultural and crop fertilization purposes. This would not only increase soil fertility and water holding capacity, but also prevent the

eutrophication of receiving water bodies, if water is used as the faecal transport medium. In this case urine would be the part which contains most nutrients (90% of the nitrogen, 50-65% of phosphorous and 50-80% of the potassium) (Chandran et al, 2009). Human urine normally does not contain pathogens, but in special cases like faecal cross-contamination, pathogenic organisms can also be detectable in urine (Langergraber & Muellegger, 2004).

Enteric infections are often caused by enteric viruses, pathogenic *E. coli* and a variety of *Salmonella* strains, which include *Salmonella enterica* serovar Typhi and *Salmonella enterica* serovar Paratyphi (Chandran et al, 2009). In diverted urine faecal bacteria is thought to have a rapid inactivation, but viruses are responsible for most gastrointestinal infections in developing countries. So the separation of urine and faeces alone cannot be a zero-risk solution, rather a search for new possibilities. Especially for the reuse of urine in agriculture, the contributing factors to the survival of enteric pathogens must be determined in order to estimate the potential health risk (Chandran et al, 2009). The critical factors for the survival of various enteric organisms are high pH, ammonia and temperatures, as well as long storage time. The survival time are reported to be between two to six months.

Figure 6. Survival curves of *E. coli* in fresh, diluted and stored human urine at 30°C and 15°C (mean±SD) (n=4) (Chandran et al, 2009).



□ Fresh 30°C, ■ Fresh 15°C, ○ Diluted 30°C
● Diluted 15°C, × Stored 30°C, △ Stored 15°C
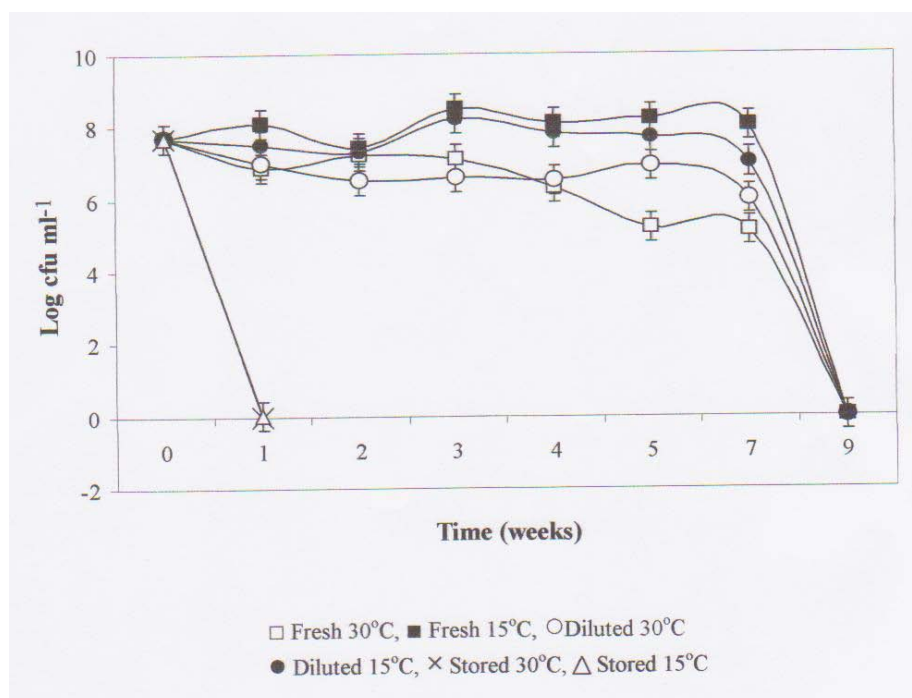
In urine at 30°C and 15°C (Chandra et al, 2009) *Salmonella* was inactivated completely after nine weeks of exposure and in fresh and diluted urine, E. coli survived for up to nine weeks. The different storage temperatures and pH values had a great significance for the survival period of the urine samples and micro-organisms survived longer at low temperatures and in diluted urine compared to fresh urine. For tropical countries this study also suggests, that the storage time needed to inactivate enteric pathogens would be much shorter than previously thought, as the high ambient temperature enhances the destruction of pathogens. Nevertheless should the urine be stored without dilution, due to the better survival rate of micro-organisms in diluted urine (Chandran et al, 2009).

Table 1. Recommendations for storage treatment of dry excreta and faecal sludge before use at the household and municipal levels (UN & UNDP, 2006).

| Treatment | Criteria | Comment |
|---|---|---|
| Storage: ambient temperature 2-20°C | 1,5-2 years | Will eliminate bacterial pathogens; re-growth of *E.coli* and *Salmonella* may need to be considered if rewetted; will reduce viruses and parasitic protozoa below risk levels. Some soilborne ova may persist in low numbers. |
| Storage: ambient temperature > 20-35°C | >1 year | Substantial to total inactivation of viruses, bacteria and protozoa; inactivation of schistosome eggs (<1 month); inactivation of nematode eggs, e.g. hookworm; survival of a certain percentage (10-30%) of *Ascaris* eggs (≥4 months), whereas a more or less complete inactivation of *Ascaris* eggs will occur within 1 year. |
| Alkaline treatment | pH > 9 during > 6 month | If temperature > 35°C and moisture < 25%, lower pH and/or wetter material will prolong the time for absolute elimination. |

Stormwater on the other hand may be highly contaminated with faecal matter, especially in areas with open-air defecation and it may also contain high loads of zoonotic pathogens originating from animal or bird faeces (Langergraber & Muellegger, 2004).

## 4.2 Management of Toilets / Gender Inequality

The management of toilets lies usually in the hands of women, who perform most maintenance work and therefore programmes on health and hygiene should be targeted more for women than for men, because they handle excreta more frequently than any other member of the family (WHO, 2005).

Gender inequality shows itself best in the traditional roles and tasks women have to perform, as they are the ones waiting in line for water, or other domestic duties which rob them of the possibility to get education. Having mostly to dispose of the family's wastewater and faeces, they have the most physical contact with contaminated water and human faeces, exposing them largely to pathogens and chemical hazards. Even in case of already existing toilets, they usually do not have hand-washing facilities and make it difficult to wash after using the toilet (Lenton et al, 2005). During case-studies in communities it was observed that the decision to construct toilets is usually made by women. However the financial costs of a toilet are shared among men and women depending on whose level of income is higher (Guzha, 2002). In many developing countries women still have limited political and personal power, which means that the ones most in need of sanitation are often absent from decision making and priority-setting processes (Lenton et al, 2005).

Additionally, changes in hygiene related behaviour should be promoted, or else all the substantial investments in water supply and sanitation hardware will not be enough, as the wrong hygiene behaviour will still remain a substantial risk to health.

Table 2.  Gender Roles in toilet management % (Guzha, 2002)

| Gender Roles in Toilet Management (%). | | | | | |
|---|---|---|---|---|---|
| Management activity | Mother | Father | Boy | Girl | Other (employee or both) |
| Refills ash/ soil/ saw dust container | 92,9 | 7,1 | 0 | 7,1 | 0 |
| Cleans toilet | 84 | 4,9 | 1,2 | 0 | 2,5 |
| Puts faecal bucket in place | 78,6 | 7,1 | 7,1 | 0 | 7,1 |
| Cleans faecal bucket | 78,6 | 7,1 | 7,1 | 0 | 0 |
| Empties faecal bucket | 71,5 | 14,3 | 7,1 | 0 | 7,1 |
| Responsible for the plot / garden | 64,2 | 18,5 | 1,2 | 3,7 | 3,7 |
| Attends meetings | 59,3 | 27,2 | 1,2 | 0 | 0 |
| Contributes labour during construction | 51,5 | 21 | 27 | 27 | 0 |
| Pays for construction | 42 | 50 | 3,8 | 0 | 3,8 |

## 5. Ecological Sanitation

Ecological sanitation presents alternative approach to evade the disadvantages of standard wastewater systems, but the technologies should be suitable for local users' and not only be flexible, but most of all affordable (Langergraber & Muellegger, 2004).

A range of technologies are known, from natural wastewater treatment techniques to separating toilets and simple household systems to installations of complex, mainly decentralised installations, all focusing on the main objectives for sanitation systems to minimise hygienic risks and protect the environment. Ecological sanitation presents an excellent option to evade the disadvantages of conventional wastewater systems. In order to succeed with this, all elements involved, such as the natural environment, the society, the occurring processes and the device for defecation have to be taken into account (Langergraber & Muellegger, 2004).

The compost latrine is often diverted into two non-urine squats or/ and pedestal leading to each vault. These two are used alternating, one of them always being closed. Organic materials like leaves, ash, soil, saw dust or grass are put into the toilet after it has been used.

Earthworms can also be added to the mix and together with fly-maggots help to digest the organic matter. The contents are left to mature for six months before they can be used as manure (Guzha, 2002).

1.
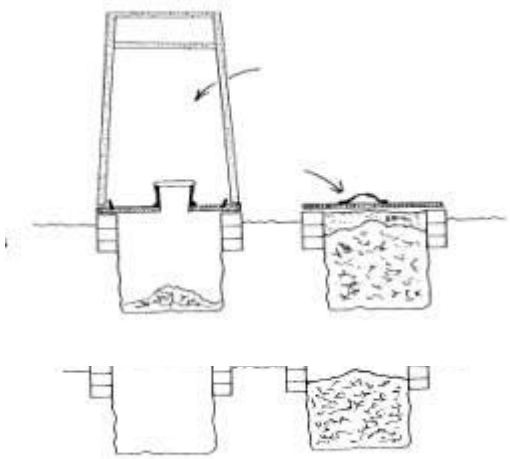
2.
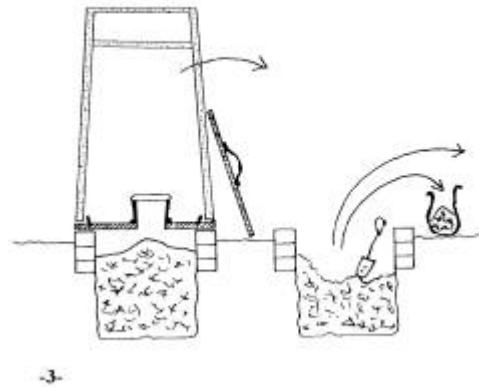




1. The latrine is used over the first vault, adding soil, etc. After being almost full the structure is moved onto the next vault.

2. The first vault is covered with soil and with a lid; water is added from time to time. The other latrine is used for defecation and soil, etc. is added.

3. After 6 - 12 months the lid is removed lid on the first vault and its compost content transferred to bags or for use in gardens. The pit is then re-used.
http://aquamor.tripod.com/Fossa2.htm Fossa Alterna "alternating pit" (Morgan, 2001)

The Abhor-loo "tree toilet" is another version for a compost latrine. After the pit has filled up to ¾, a layer of soil is added and a fruit tree is planted. This toilet has been used in orchards (bananas, guava, mango, etc.) and helped to eradicate sanitation and deforestation problems in several peri-urban settlements in Zimbabwe. A similar device, the Blair Toilet was developed in Zimbabwe in the 1970s and since then has been used for large-scale projects to improve rural sanitation. It is a septic tank like pit, on which an upper structure with an open light-trap entrance. A ventilation pipe runs from the bottom pit attached with a fine wire grate to keep flies out, also trapping flies inside, so they are unable to spread diseases. This latrine is hygienic and the gases produced by the decomposing waste are redirected outside (Morgan, 2001).

Untreated wastewater has always been problematic as it poses hygienic hazards, and contains organic matter as well as eutrophying substances in the form of nitrogen and phosphorus. These problematic substances, but on the other side, could be valuable for agriculture purpose. On the other hand especially nitrogen, phosphorus and potassium in urine and faeces are valuable for agricultural purposes and be utilized instead of artificial fertilizers. Ecological sanitation is a way to turn human excreta into something useful without threat to human health and minimum pollution of the environment. In Zimbabwe applied research has shown that the latrines used in ecological sanitation are designed in such a way, that the end products, whether they be urine of faeces can be easily and safely transferred into agriculture or forestry (Guzha, 2002).

## 6. Community-based Waste Management

Communities play a significant role in the management and maintenance of their own communal water infrastructure. Planning and decision making processes should be participatory, by providing the users with information to enable an informed choice. It is generally agreed that creating awareness brings better results, if people are more involved and participate actively in decision making.

Nevertheless a participatory planning process should not exclude the gender perspective of sanitation. Therefore women and men should both be involved, as their needs and priorities often differ slightly from one another. Women usually prioritize water for domestic uses like for drinking and washing, whereas men may find the use for irrigation more important. As a result, they often evaluate the adequacy, equity, timeliness, convenience, and quality of various interventions differently (Lenton et al, 2005). Therefore involving all stakeholders as one homogenous group is not enough, but instead the different roles of women and men have to be recognized and several activities have to be adjusted. New parameters should be set up for every local situation, always with strong involvement of the stakeholders, as the technologies applied have to be appropriate for the respective circumstances of the users, whilst being flexible and affordable. Emphasis should also be placed on local designs and affordable materials (Langergraber & Muellegger, 2004).

The size of sanitary problems is different for rural and urban areas. Rural population lives usually in remote, scattered villages or in small, but very high density settlements. While household solutions may be sufficient in a rural environment or in a dispersed settlement, they would be inadequate in an urban area, especially in urban slum areas or in crowded urban areas and mega cities. What is required is a significantly scaled-up approach that can be applied simultaneously over a wide area, an approach that centres on community mobilization and actions that support and encourage such mobilization. Such an approach can support

community members in their efforts to consider and discuss sanitation practices with other households within their boundaries and to develop locally appropriate and affordable strategies for improved sanitation (Lenton et al, 2005).

The stakeholders should be provided with the relevant information, enabling them to make "informed choices." In addition, project planning requires consideration of several different issues, identified through the involvement of stakeholders applying participatory method. It begins with a community-organized appraisal of current sanitation practices. Residents draw up a map identifying the places where their households and defecation areas are situated. Experts accompany residents on their tour through the community, visiting defecation areas and calculating the amounts of faeces produced, also including an analysis for the routes of contamination. Governmental, civic, and external organizations may support these community-planning processes by providing information, technical support, or even financial support or loans for facility construction (UN, 2004).

Most importantly, programmes intended to improve environmental health must be driven by the impact they have at the household level to be able to improve health. This is where most people, especially children, spend most of their time and are most vulnerable to contamination. Improvement in households to preserve water quality at home has the best health benefits, is cost-effective, and contributes directly to meeting the Millennium Development Goals (Lenton et al, 2005).

## 7. Technology and Infrastructure

Climatic factors play a vital role in a country's ability to provide and maintain water supply and sanitation services for its citizens. Many developing countries in Africa suffer alternately from floods that damage infrastructure and droughts during which water sources run dry. There might be inexpensive solutions, like rainwater harvesting, possible in some cases, but sometimes expensive  infrastructure is required for controlling droughts and the storage of water for the dry seasons (Lenton et al, 2005).

When sanitation services and water supply systems are poorly planned or managed, the consequences can lead to excessive loss of water through leakages and waste, and further more a possible loss of the income needed to run it effectively (Lenton et al, 2005). Achieving environmentally acceptable sanitation solutions is a major technical challenge, particularly in urban and peri-urban areas, where some approaches may lead to a period of transitional environmental pollution, since increasing access to sanitation under conditions of water stress means that there will be more and more pollutants being disposed into less and less water. In some instances, sustainable access to water may be limited by the physical availability of water itself, when countries or communities have an inadequate water supply either in terms of quantity or quality, due to low rainfall, topography, hydrology, or geography, or might face such constraints in the future, because of such factors as population increases or climate change.

There is a need for guidance on technology selection, strategies for cost reduction, and the need for innovation in technology and infrastructure. It is also important to recognize that, although water and sanitation are often seen principally as a challenge of capital investment, the provision of water and sanitation services is an ongoing business that has to be understood and managed as such if it is to achieve and sustain its goals. Therefore transference of responsibility for water supply and sanitation from the national level to the local government

level using community-based approaches, accompanied by policy reforms and an accompanying legislative framework should be targeted for the future. It would also be desirable to introduce incentives to stimulate the creativity of communities in developing locally appropriate technologies for both water and sanitation. This is likely to happen if externally developed technologies are not imposed on developing countries or made a condition for receiving financial or technical support (Lenton et al, 2005).

A programme should be set up, which should provide infrastructure to meet the needs of Zimbabwe's millions of rural people. Currently the Zimbabwe Red Cross in co-operation with the British and Finnish Red Cross will construct 1.200 latrines in households, schools and health centres and train 44 volunteers in latrine construction as part of a project. The latrines are predominantly being constructed for the most vulnerable people to sanitation related diseases, including more than 2.000 people infected with HIV and additionally 2.500 orphans and young children in the Mount Darwin district. Training will also be provided for 1.200 members of community water committees, to manage the operation and maintenance of water pumps, which would allow a few of them to set up their own small businesses repairing water points (Red Cross, 2009).

7.1 **What would it cost?**

Table 3. Estimated costs for sanitation services per person in US $ including 15% overheads, operation and maintenance costs (Lenton et al &  UN Millennium Project, Task Force on Water and Sanitation, Earth scan, 2005 and Van de Guchte and Vandeveerd, 2004).

| Site | Treatment method | Annual price/person (US$) |
|---|---|---|
| Mainly urban and peri-urban | Tertiary wastewater treatment | 800 |
| | Sewer connection and secondary wastewater treatment | 450 |
| | Connection to conventional sewer | 300 |
| | Sewer connection with local labor | 175 |
| Mainly rural services | Septic tank latrine | 160 |
| | Pour-flush latrine | 70 |
| | Ventilated improved pit latrine | 65 |
| | Simple pit latrine | 45 |
| | Improved traditional practice | 10 |

A practical financing strategy should be compatible not only with existing institutional arrangements and accessible or existing economic and financial resources, but also with a certain degree of community involvement and ownership in the projects being financed. Deep-rooted community ownership and involvement will appeal to solid and favourable

finance mechanisms and terms. Communities should be aware of their own contribution to the situation in which they find themselves and not only assume the responsibility but also take a leading role in addressing the problem.

## 8. Future Trends

### 8.1 Sustainability

To ensure sustainability for sanitation related ventures in operational and service terms, access should be secure, reliable, and available on demand by users on a long-term basis. For this, the following are required:

• A choice of technology that is responsive to demand and what is possible.

• Proper design of the chosen technology.

• Installation of the infrastructure in accordance with the design.

• Use of the installed facility as intended in the design.

• Maintenance of the facility to ensure proper functioning.

• Availability of competent technical staff or technical support for all of these requirements.

• A reliable flow of revenue to pay for all of these requirements.

It has been noted that the concept of sustainability has an operational or service aspect and an environmental aspect. Sustainability suffers when any one of these factors is absent. Access to sanitation, should not be evaluated simply by whether a toilet is installed, but it must also be ascertained if that toilet is working and is being used for safe disposal of excreta according to improved hygienic practices. If it is not safe, the contribution of the toilet to human health will be negligible or even negative. In terms of service, sustainable access indicates foremost a type of service, which is secure, reliable, and available for the use on demand by users on a long-term basis (Lenton et al, 2005).

### 8.2 Trends in Sanitation Coverage

It seems that the world is not on track to meet the MDG sanitation target, as the proportion of people without improved sanitation decreased by only 8% between 1990 and 2006. (WHO, 2008)

It will need an immediate accelerated improvement progress for the world to achieve even half the MDG sanitation target by 2015. Relying on current trends, the total population without improved sanitation will have decreased only slightly by 2015. Worldwide the MDG sanitation target will be missed by over 700 million people at the current rate. At least 173 million people on average should start using improved sanitation facilities per year in order to meet the target (UNICEF, 2008).

### 9. Conclusions and Priority Actions

Meeting target 3 is particularly important for issues such as poverty, gender and health goals, and it also has considerable impact on other goals. The means to meeting the target on water

and sanitation need to be identified, including indicating the actions needed in other sectors and identifying the actions needed in the water resources sector to meet the Millennium Development Goals as a whole. A continuing increase of population will lead to greater water consumption and amount of waste. Especially the urban population in Zimbabwe and other developing countries is growing dramatically, creating demand far beyond the capacity of already inadequate water supply and sanitation infrastructure services. Therefore an operational plan would be desirable, to outline the actions during the period of 2009 and 2015 (Lenton et al, 2005).

All it takes for is conscious recognition that basic sanitation requires a community-based approach, and to introduce actions that support and encourage that mobilization. In addition the focus should be on sustainable sanitation service delivery, rather than on construction of sanitation facilities alone. Therefore a strong focus on sustainability is needed to ensure that improvements in expanding access to water and sanitation services and improving water resources management will be maintained long term. Activities are needed to create support and ownership for water supply and sanitation initiatives among both genders in poor communities. Zimbabwe should see that it is important that the role of local government, community organizations, and smaller private providers should grow, especially for services on community-level, in parallel with the growth of centralized service delivery agencies to provide public sanitation services in complementing private ones. Special attention should also be given to the improvement of sanitation in public institutions like schools, as well as to promotion of safe hygiene practices through better education, so to further foremost behavioural change in children (Lenton et al, 2005).

The Zimbabwean government and other agencies should move the countries sanitation crisis to the top of the agenda. Working together, the government and donor agencies should simultaneously pursue investment and reforms. Innovative financing and partnership mechanisms and actions are needed to reduce corruption at all levels, as well as the promotion of affordable, socially and culturally acceptable technologies and practices. There is an urgent need for customized water and sanitation strategies to suit specific circumstances at the regional, national, and sub-national levels, for rural and urban environments, also promoting institutional, financial, and technological innovation. According to The Water Life Foundation, action plans should be detailed and approaches, costing, and financing mechanisms highly context-specific and not kept in general.

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# THE REDUCTION OF POVERTY AND HUNGER AS A MDG IN NIGER REPUBLIC

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## Abstract

Niger is rank one of the poorest countries in the world according to United Nations Human Development index (HDI). Her low export base was due to the landlocked economy which depends heavily on drought-prone subsistence agriculture. Even with the careful fiscal policies and efforts to boost domestic revenue and consolidate public expenditure management, Niger is likely to require external support over the medium term. The assistance of external body, prudent macroeconomic policies and improvements to the investment environment are vital if Niger is to attain higher economic growth and reduce poverty and hunger, as emphasized in the recently finalized Millennium Development Goal (MDG) by the year 2015. Today, combating poverty and hunger and searching for sustainable and sustained economic growth are very important for the people of Niger Republic.

## Introduction

The eradication of extreme poverty and hunger by the year 2015 was the first out of the eight goals set up by Millennium Development Goal (MDG). This was the historic promise of 189 world leaders made at the United Nations millennium summit in 2000. They sign into millennium declaration and agreed to meet MDG by the target year. These goals provide a road map with measurable targets and clear guidelines for improving the lives of the world's poorest people for example Niger Republic. The MDGs are common commitment whose achievements demand a true and more effective partnership between the rich and poor nations. The Republic of Niger covers areas of 1,267,000 km$^2$. Two third of the country population are located in the Sahara desert of Africa. The population of the country was estimated about 13 million inhabitants and 83% of the population live in rural area. In 2006, Niger Republic was classified as one of the poorest countries in the world, her annual capital Gross Domestic Product is about CFAF141,800 (equivalent to US$284). Indeed, poverty and hunger are still widespread, particularly in the rural areas; two people out of three persons in Niger live below poverty line, whose income is less than one dollar per day. The level of education is low, malnutrition is common among a large part of the population, mortality rates are high, and access to potable drinking water is inadequate and poor health facilities. Access to energy, transport and communication infrastructures, as well as markets is low.

After a decade of socio-political instability which led to a deterioration of the country's economic situation, Niger in December 1999 established a new Republic with democratically elected authorities. The main challenge of the government was thus to lay the basis of sustainable and sustained socio-economic development. It is in this challenge, that the country in January 2002 adopted a Poverty Reduction Strategy (PRS) alignment on the Millennium Development Goals (MDG), Non Governmental Organisation (NGO), World Bank and International Monetary Fund on the integration and poverty reduction strategies to serve as reference framework for its economic, financial and social policy. After five years of implementation, the PRS stands out as a coordinating instrument for all development actions as it integrates partner operations around priorities defined by the Government.

Table1:    Summary status of key MDG indicators in Niger republic. Source: QUIIB survey 2005

| Objectives | Adopted Targets | Adopted Indicators | Initial Level | Current Level | Projected Level in 2015 |
|---|---|---|---|---|---|
| 1. Eradicate extreme poverty and hunger | 1. Reduce by half the proportion of people living below the poverty line by 2015. | 1. Proportion of the population below the poverty line (in %) | 65[1].1 in 2001 | 60.7 in 2006 | 50.0 |
| | 2. Reduce by half the proportion of people suffering from malnutrition by 2015. | 2. Percentage of children under 3 years of age who are under weight | 50% in 1998 | 43% in 2006 | 29.7 |
| 2. Achieve universal primary education | 3. Provide primary education to all children of school age by 2015 | 3. Gross enrolment rate in primary education (in %) | 42% in 2001-2002 | 54% 2006 | 79.4 |
| | | 4. Completion rate in primary school (in %) | 26% in 2001-2002 | 40% 2006 | 96 |
| 3. Promote gender equality and empower women | 4. Eliminate gender disparities in primary education by 2005, and in all levels of education by 2015 | 5. Girls/boys ratio in primary and secondary education (in %) | 55,7 | 69 | 87 |
| | | 6. Literacy rate among persons of 15 and above (in %) | 19.9 in 2000 | 28.7 in 2005 | 46.3 |
| | | 7. % of women employed in the Public Service | 24.4 | 24.5 | - |
| | | 8. Proportion of women in Parliament (in %) | 1.2 in 1998 | 12.4 in 2006 | 23 |
| | | 9. Proportion of women in Government (in %) | 17.9 | 20% in 2006 | |
| | | 11. Proportion of women in local authorities (%) | - | 17.6 | - |
| 4. Reduce mortality of children under 5 | 5. Reduce by 2/3 the under-five mortality rate between 1990 and 2015 | 12. Mortality rate of children under 5 (per thousand) | 274 in 1998 | 198 in 2006 | 115.7 |
| | | 13. Infant mortality rate (per thousand) | 123 in 1998 | 81 in 2006 | 33.8 |
| | | 14. % of 1 year old children vaccinated against measles | 35 in 1998 | 47 in 2006 | 60.5 |
| 5. Improve maternal health | 6. Reduce by ¾, the maternal mortality rate between 1990 and 2015 | 15. Maternal mortality rate (per 1000 births) | 6.52 in 1992 | 6.48 in 2006 | 6.45 |
| | | 16. Proportion of births assisted by qualified health staff (in %) | 14.6 in 1998 | 17.2 in 2006 | 20 |
| 6. Combat HIV/AIDS, malaria and other diseases | 7. Halt the spread of HIV/AIDS and reverse the current trend by 2015 | 17. HIV/AIDS prevalence rate among persons 15-49 years of age | 0.87 in 2002 | 0.7 in 2005 | - |
| | 8. Control malaria and inverse the trend | 18. Dead rate due to malaria (in %) | 1.6 | 2.7 in 2006 | - |
| 7. Ensure environmental sustainability | 9. Integrate the principles of sustainable development into country policies, and reverse the current trend of loss of environmental resources | 19. Surface area of protected lands for biodiversity (as % of the national territory) | 6.6 | | - |
| | 10. Reduce by half the percentage of population without access to drinking water by 2015 | 20. Proportion of the population with access to drinking water (in %) | 43 in 2000 | 68.7% in 2005 | - |

## Scope of Poverty and Hunger in Niger Republic

There are several types of indicators are used in measuring poverty: **The incidence of poverty** measures the percentage of individuals or households whose consumer spending is below the monetary poverty line. The poverty line corresponds to a minimum annual consumer spending for an individual or household. It should be noted that the subjective incidence of poverty (perception of poverty) is generally higher than the objective incidence of poverty. **The depth of poverty** measures the average gap in percentage between the level of well-being of the poor households and the poverty line. It is used in theoretical for calculating the minimum amount of additional resources to be transferred to poor households to place them on the monetary poverty line. **The severity of poverty** measures the average gap between consumption by the poor and the poverty line. It gives relative proportion of the poorer people in a given group.

Table 2. Human Development Index Rank and per Capital GDP

| Country | HDI Rank  (2006)       (1) | Real per Capita GDP(US$,2006)          (2) |
|---|---|---|
| Togo | 147 | 259 |
| Senegal | 156 | 511 |
| Benin | 163 | 398 |
| Cote d'Ivorie | 164 | 580 |
| Guinea Bussau | 173 | 135 |
| Burkina Faso | 174 | 278 |
| Mali | 175 | 300 |
| Niger | 177 | 178 |

Source:  UN Human Development Report 2006; and

Sub-Saharan African Regional Economic Outlook, IMF.

   (1) Rank out of 177 countries
   (2) At 2000 prices at exchange rate.


## Territorial Distribution of Poverty in Niger Republic

In 2005, according to the QUIBB survey, the levels of poverty in Niger Republic are quite different from area to area the incidence of poverty is higher in rural areas (65.7%) than in urban areas – excluding Niamey (55.5 %). In Maradi region, nearly eight out of every ten persons (79.5%) live below the poverty line, while in Niamey Urban Community the incidence of poverty is only 27.1%.The proportions of the poor with consumer spending far from the poverty line (depth) are higher in Maradi (35.1%), Dosso (28.8%) and Tillabéri

(26.8%) regions. However, even though the incidence of poverty is the same in Agadez and Tahoua (45.9%), the depth of poverty is more in Agadez (16.1%) than in Tahoua (14.5%).

**Figure 1. MAP OF NIGER REPUBLIC**
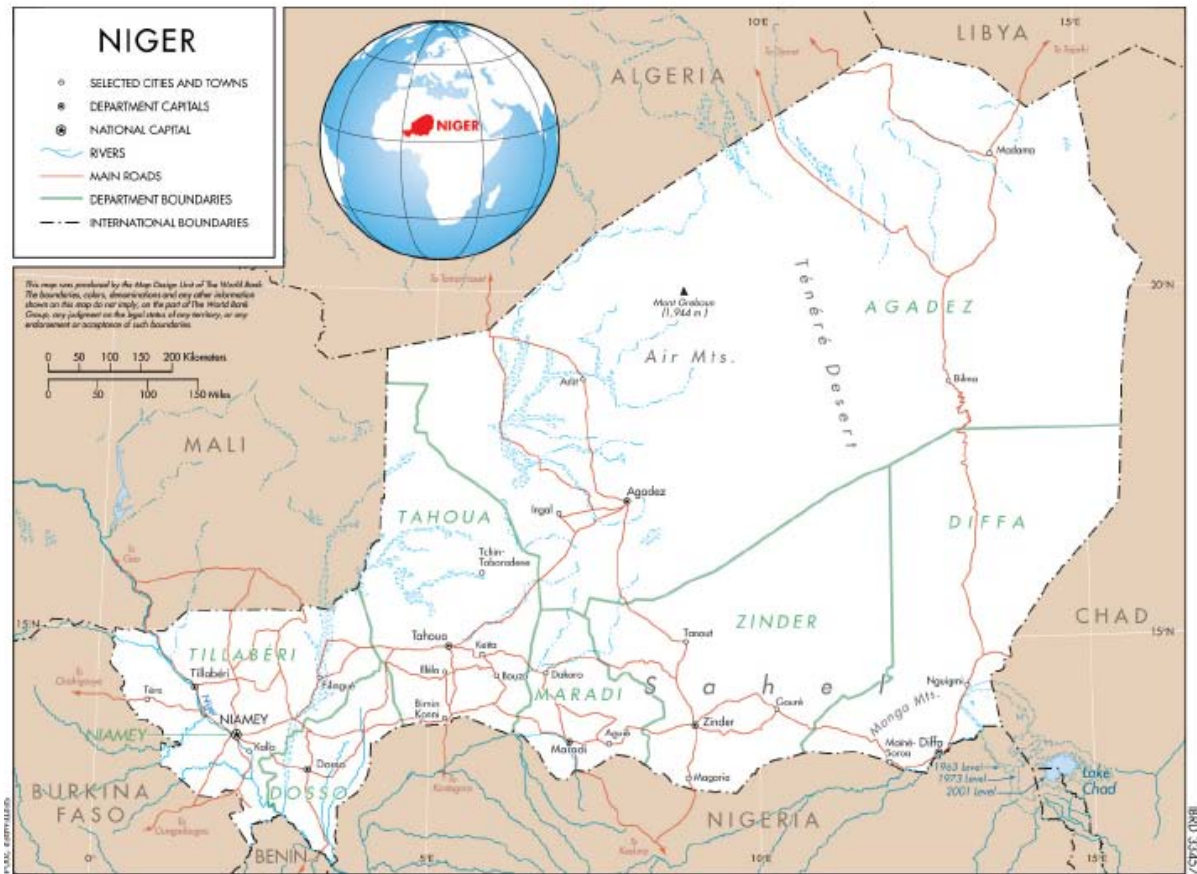


Table 3:        Breakdown of Poverty Status by Geographical Area in 2005 Source: ME/F/INS/QUIBB_2005

|             | Incidence of poverty (%) | Depth of poverty (%) | Severity of poverty (%) |
|-------------|--------------------------|----------------------|-------------------------|
| Agadez      | 45.9                     | 16.1                 | 8.8                     |
| Dosso       | 67.3                     | 28.8                 | 15.3                    |
| Maradi      | 79.7                     | 35.1                 | 19                      |
| Tahoua      | 45.9                     | 14.5                 | 6.2                     |
| Tillabèri   | 68.9                     | 26.8                 | 13.9                    |
| Zinder-Diffa | 63.1                    | 23                   | 23                      |
| Niamey      | 27.1                     | 7.2                  | 7.2                     |
| Total Niger | 62.1                     | 24.14                | 12.28                   |

**Characteristics of Poverty in Niger Republic**

In the republic of Niger poverty are characterized based on different factors used by the QUIBB survey (2005) by carrying out an analysis of the incidence of poverty in terms of the size of the household in which the poor live, the level of education, the gender of the head of household, and the economic status of the head of household. Furthermore, the analysis of the incidence of poverty, depending on the level of education, shows a significant impact of education. Indeed, the level of poverty is between 63% and 65.2% when the head of household has not completed primary education. It falls to 59.7% when the head of household is of primary education level, and reduces to less than one-third in households headed by a person of secondary education level or higher (Table 4). In other words, the more one is educated, the less one is poor. The results of the QUIBB survey show that poverty affects more the of people whose head of household is self-employed (with 65% of the cases), followed by those headed by unpaid apprentices (61.3%), by domestic servants (54.3%) and, to a lesser extent, by employers (45.9%) and wage earners (23%).

Table 4: Breakdown of Poverty Status by Geographical Area in 2005.

| Level of Education of Head of Household | Incidence of poverty (%) | Depth of poverty (%) | Severity of poverty (%) |
|---|---|---|---|
| None | 65.1 | 25.3 | 12.9 |
| Coranic education | 65.2 | 26.6 | 13.8 |
| Literacy education | 63.4 | 25.7 | 14.0 |
| Primary education | 59.7 | 21.1 | 10.0 |
| Secondary education | 31.8 | 10.2 | 4.6 |
| Vocational and technical training | 12.6 | 3.0 | 1.0 |
| Higher education | 7.7 | 0.5 | 0.1 |
| National | 62.1 | 24.1 | 12.3 |

Source: ME/F/INS/QUIBB_2005

**The Objectives and Focus of MDGs in Reducing Poverty and Hunger in Niger Republic**

To eradicate hunger and poverty by half the proportion of people living below the poverty line by 2015 Reduce by half the proportion of people suffering from malnutrition by 2015. The proportion of the people below poverty line (in %). The percentage of children under 3 years of age who are under weight. See table 1.

**Visions and Overall Goals in 2012 of the MDG**

- ➢ An annual economic growth rate of at least 7%;
- ➢ A poverty rate of 42% for individuals;
- ➢ A malnutrition rate (underweight) of 24%;
- ➢ A gross primary education enrolment rate 94%;
- ➢ An adult literacy rate of 45% ensuring gender equality;

- ➤ A child mortality rate of 108‰ ;
- ➤ Maternal mortality rate of 200 for 100,000 live births;
- ➤ HIV/AIDS prevalence rate kept below 0.7%.
- ➤ Drinking water access rate of 80%;
- ➤ Increase the electricity access rate to 3% in rural areas and 46% in urban areas;
- ➤ 35% utilization rate of impregnated mosquito nets for children and pregnant women ;
- ➤ A total fertility rate of six children per woman;
- ➤ Area of protected lands at least equal to 8% of the national territory;
- ➤ 110% coverage of national cereal requirements.

## Major Challenges

Several factors affect Niger's performance in accelerating economic growth and poverty reduction. Some of these are discussed here.

**The climatic conditions of Niger follow medium-term cycles**: The country has witnessed several successive periods of low rainfall – in the early 1970s, the 1980s, and to a lesser extent, in the mid-1990s – which endangered agro-salvo-pastoral production, leading to long-term degradation of the environment and living conditions of the populations (particularly in rural areas). Moreover, climatic conditions have been deteriorating since 1960 (average of 445.8 mm of rainfall in the 1960s ; 423.5 mm in the 1970s ; 354.7 mm in the 1980s ; 300 mm in the 1990s).

**Natural disasters and locust invasions**: These are also frequent in Niger, thereby accelerating vulnerability of agricultural production. The frequent heat (temperatures above 35 degrees for most of the year) and locust invasion on agricultural crops does not foster productivity, and sometimes reduces Niger's attractiveness to foreign investors.

**Deforestation and desertification are progressing unrelentingly**: Natural forests have been reduced from about 16 million hectares in 1982 to about 5 million hectares in 2006, due to farmland requirements and climate change.

**Low soil fertility and the effects of human action, animals and climatic phenomena on the earth reduce yields**: The Niger population is concentrated on a very small area of land, particularly on the southern strip of the country conducive to agriculture. Consequently, there is a strong pressure on land availability which forces people to use increasingly marginal lands. Furthermore, in view of the archaic production methods and limited use of agricultural inputs, the possibilities of improving farm yields are limited.

**The geographic size:** Niger Republic has a total land area of 1,267,000 km$^2$, two-thirds of which is desert land and this generated high transport costs. It also increases difficulties in providing the territory with economic and social infrastructures.

**The country's landlocked position**: This is a serious handicap for the import of inputs and capital goods, as well as for exports, and is therefore unfavorable for the country.

**Vulnerability to shocks in terms of trade**: This continues to affect the country, due to lack of economic diversification and heavy dependence on export of a limited number of products (particularly uranium and agricultural products).

**Rapid population growth**: This (3.3% per year) makes Niger one of the countries with the highest fertility rate in the world (7.1 children per woman), it doubles the population every 21 years, generates low per capita income and high poverty rates. Indeed, due to low levels of income and capital stock, rapid population growth is a major constraint on economic growth, because the net per capita savings rates are not enough to allow for capital accumulation. Furthermore, the poor populations, in rural or urban areas with very large families, very often have the lowest resources and consequently they cannot afford adequate health and education services, as well as drinking water or sanitation. Consequently, in these areas, poverty increases and becomes a self-sustained phenomenon. The narrow domestic market is a handicap with an annual per capita income of CFAF 141,800 (US$ 284). Niger's market is narrow and is not conducive to large scale production that could reduce unit production costs and make products competitive against similar foreign products.

**Difficulties in the promotion of women and gender mainstreaming into policies are also major constraints**:  Beliefs and values affect the position of women in society, limiting the access of girls to quality education and they reduce women to employment; and thereby reducing the country's human capital potential.

 **Low level of literacy**  as well as health and nutrition conditions of the population affect the quality of human capital and overall factor productivity, possibilities of access to employment and income-generating activities, as well as the hygiene, health and environmental behavior of the populations. All these factors make it difficult to achieve poverty reduction indicators.

A combination of these different factors "traps" Niger in a weak economic growth balance and in a "poverty trap". Indeed, the cause and effect relation between poverty and growth is bidirectional. Accordingly, growth is required to reduce poverty; a high incidence of poverty can also be a major constraint on growth. Niger's challenge is to transform this vicious circle by using its resources to generate strong sustainable growth that is favorable to the poor.

### Progress made by Niger in Achievement of some MDGs

The following evaluation bases on the report of International Monetary Fund Report 2008. It can be taken from Internet address www.imf.org.

Figure 2:    Conceptual framework for MDGs



Figure 1 : Conceptual Framework for the MDG-based-ADPRS
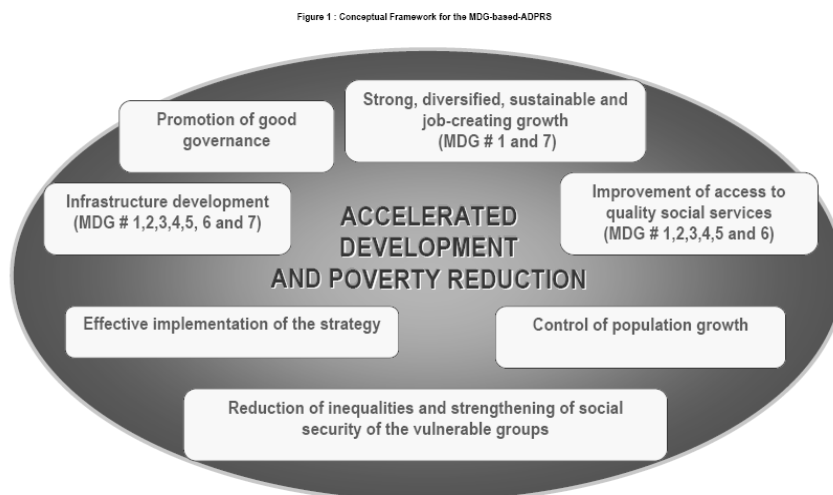
**The political situation in Niger Republic is stable.** Niger is today a very stable, democratic and well-governed country. In seven years, the country has organized two presidential elections, two parliamentary and municipal elections generally recognized as fair and transparent, thereby leading to the establishment of several institutions, enduring peace in the country and improvement of dialogue between political actors, the civil society, the private sector and development partners.

**At an estimated rate of 5.6 percent, real GDP growth in 2007** has been strong for the third year in a row since the drought-induced contraction of 2004. Good rains have strengthened agriculture and improved food security. Mining, telecommunications, and construction have also supported economic activity. Private investment, after its surge in 2005, remains above 15 percent of GDP.

**Inflation remains very low**. The real effective exchange rate (REER) depreciated modestly in the year to July 2007, as lower inflation than in trading partners more than offset the appreciation of the trade-weighted nominal exchange rate. The REER remains however about 8 percent above the 2000 level, as a result of the steady appreciation of the euro-pegged CFA franc. Despite this appreciation, an updated analysis of the equilibrium real exchange rate for Niger indicates that the REER is close to equilibrium, in view of the strong improvement of the terms of trade since 2000.

**The estimated 2007 external current account deficit** (excluding official grants) has widened, in spite of the strong increase in the value of uranium exports, Niger's main export product. This deterioration reflected increases in mining-related imports and the replenishment of the stocks of petroleum products and cereal.

**Macroeconomic policy and reform implementation was broadly satisfactory.** The basic fiscal balance to June and to September 2007 was much better than programmed, with a significant surplus rather than a deficit.

**Strong uranium and other mining activities have improved the medium-term prospects**. Increased investment in mining and related sectors (such as construction and transportation) and private sector-led expansion in agriculture for export should buoy growth, which could reach 6 percent in 2011-2012. The basic fiscal deficit is projected to remain low over the medium term due to increased mining income, notwithstanding a strong increase in high priority spending and recurrent costs related to higher government investment. Strong growth, however, is predicated on security being maintained in reducing hunger and poverty in the region.

## CONCLUSION

In a nutshell, the Republic of Niger is no longer on the path to MDG achievement. The situation is mainly due to inadequate economic growth, the impact of high population growth on activities carried out, inadequate infrastructures, lack of financial resources for heavy investments that can stimulate the growth, the inefficiency of some programmes, poor governance in implementation and monitoring-evaluation of development policies.

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# MICROBIAL ASSESSEMENT IN FOOD SECURITY IN NIGERIA AS MILLENNIUM DEVELOPMENT GOALS

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## ABSTRACT

This study reports the comparative studies of microbial assessment in food security in Nigeria. Food safety is a difficult issue which is inclined by a number of factors connected with the eating of processed food. The market places where these foods are displayed for sale are usually dirty and unhygienic and constitute a veritable source of microbial contaminant such as bacteria, virus, fungi and protozoa which is the major public problem that causes significant morbidity and mortality worldwide.

## INTRODUCTION

Food safety is a complex issue, which is predisposed by a number of factors. Growing national agricultural production cannot alone guarantee better food security. The Food and Agricultural Organization of the United Nations (FAO) and the World Health Organization (WHO 1983), state that illness due to infected food is perhaps the most widespread health problem in the contemporary world and an important cause of reduced economic productivity (Edema et al., 2005). In Nigeria, there are a large number of food processing services distributed along the country, where a considerable number of people buy food products daily. Serious consequences relating to national productivity and development can arise from lack of hygiene and sanitation in such outlets.

There have been several reports on the health risk associated with the consumption of processed seafood, ranging from allergic reaction, stomach and intestinal cancer, a general degeneration of peripheral cellular tissues, to gradual breakdown of the digestive and excretive systems. Few of these reports, have looked at the likely risks from a microbiological food safety point of view (Edema et al., 2005). According to Higgins (2007), anyone who works in food safety sooner or later discovers that one of the most valuable tools for prevention simply understands how the past outbreaks have occurred. Using major and frequently famous or at least newsworthy outbreaks, Phyllis (2007) illustrate how critical factors come together to produce tragic and largely preventable result. Modern microbes often team up with old practices, short sighted decisions, or current consumer trends to produce an outbreak. Recipes that do not include an adequate final cooking step have become increasing popular with consumers and can be a significant source of food-borne illness.

## WHAT IS FOOD SAFTY?

Food safety is a major public health problem that causes considerable morbidity and mortality worldwide most especially developing countries like Nigeria given her literacy level and political instability and policy inconsistencies. Government, in an attempt to control this menace and ensure food security has promulgated food standards and control law.

However, partly due to the downturn of the economy, the proliferation of unregistered and unmonitored food processing and handling establishments has been a matter of great concern in Nigeria, especially as they failed to conform to approved standard specifications and handling for safety. The market places where these foods are displayed for sale are usually dirty and unsanitary and constitute a veritable source of microbial contamination. Environmental, as well as poor domestic and industrial effluent disposal system, have caused the pollution of rivers, lakes and ground water thereby impacting negatively on the ability to produce water of acceptable or potable quality for food producers and consumers. Thus, it is challenges to vendors and agencies for standardization and quality control to ensure that the food we eat and the water we drink are safe and wholesome.

The Nigeria government have also established agencies (such as National Agency for Food and Drug Administration & Control, Decree No. 15, 1993; Standards Organization of Nigeria, Act No. 56, 1971 with amendments in 1976, 1984 and 1990 to mention a few) to enforce these laws and monitor their practices in Nigeria. The Nigeria government, through its agencies, has embarked on the education of food handlers and vendors on health consciousness in the sales of food.

There are quite a few non-governmental and community-based organizations and associations that regulate the practice of food safety among their members through, sometimes, by-laws. Such organizations include cooperative societies, food vendors associations, food sellers union, restaurants operators associations, etc. Consumers are equally being sensitized on their choice of wholesome foods. This enabled an individual to insist on certain standards in a food supply, or resist the purchase or consumption of contaminated or sub-standard food. This should in no time send unscrupulous producers out of business. Food processing industries have been encouraged to establish GMP management systems based on the principles of Hazards Analysis Critical Control Points (HACCP). HACCP system can be applied at any stage, from raw material to consumption of food. It permits a systematic approach to the identification and assessment of hazards and risks associated with the production, distribution and use of processed. International bodies, such as the Codex Alimentarius Commission, have advocated a harmonized approach for the introduction of the HACCP system in the food Sector. This has become the code of practice for all food manufacturing industries in Nigeria. However, many food processors in both formal and informal economic sector of Nigeria are yet to adopt this code of practice, which may be as a result of lack of necessary skills by the food processors/handlers coupled with the unstable environment.

Genetically modified foods and their potential to contain new allergens or toxins have begun to receive attention as well. All countries share similar concerns about food safety, but the relative importance of different risks varies with climate, diets, income levels, and public infrastructure. Some food safety risks are greater in developing countries, where poor sanitation and inadequate drinking water pose greater risks to human health than in developed countries. The World Health Organization estimates that about 70% of the approximately 1.5 billion episodes of diarrhoea occurring globally each year have been caused by biologically contaminated food. Other risks, such as mycotoxins and food-borne parasites, are also more common in developing countries than in developed ones. Certain food safety hazards are closely linked with sanitation, water supply, food preparation, and marketing of food. Because food safety is the result of many different actions in the food

supply chain, it may be difficult to address food safety issues separately from health, nutrition, and food production and marketing issues.

## BIOLOGICAL PATHOGENS AND THEIR HEALTH CONSEQUENCES

Biological contaminants such as bacteria, viruses, fungi, and protozoa and helminthes constitute the major cause of food-borne diseases with varying degrees of severity, ranging from mild indisposition to chronic or lives threatening illness, or both, such contaminants are responsible for food borne diseases such as cholera, campylobacteriosis, *E.coli* gastroenteritis, salmonellosis, shigellosis, typhoid fever, brucellosis, amoebiasis and poliomyelitis. Diarrhoeal diseases, taken together and especially infant diarrhoea are the dominant food-borne illness problem in Nigeria, and indeed one of massive proportions.

Table 1. Total counts, Salmonella-Shigella (SS) counts and most probable number (MPN) of coliform/100 ml of different processed frozen seafood samples. Source: Okonko et al. 2008.

| Sample | Total count (CFU/ml) | Coliform count (CFU/ml) | Salmonella-Shigella count (CFU/ml) |
|---|---|---|---|
| Jambo praws | $1.9 \times 10^4$ | $0.87 \times 10^4$ | $2.24 \times 10^2$ |
| Peeled shrimps | $1.27 \times 10^4$ | $0.56 \times 10^4$ | $1.86 \times 10^2$ |
| croaker filets | $2.04 \times 10^2$ | $1.12 \times 10^2$ | $0.35 \times 10^2$ |
| sole filets | $2.86 \times 10^4$ | $1.36 \times 10^4$ | $0.96 \times 10^4$ |
| head-on shrimps | $1.08 \times 10^2$ | $0.76 \times 10^2$ | $0.26 \times 10^2$ |

Although many different pathogens have been identified, food contaminated with pathogenic *E. coli* causes up to 25 % of all diarrheal episodes in infants and children, while *Campylobacter jejuni* and *Shigella spp.* account for 10-15 % and 5-15 %, respectively. Infections due to helminthic parasites, such as *Trichinella spiralis, Taenia (T.) saginata,* and *T. solium*, are a worldwide public health problem, particularly affecting developing countries like Nigeria and are acquired through consumption of undercooked or uncooked meat. *Ascariasis*, one of the most common parasitic infections, is estimated to affect about one billion people. *Trematodes*, another type of parasite, infect some 40 million people worldwide, particularly in Africa, Asia and Latin America. More than 10 % of the world's populations have at risk of becoming infected by these parasites, transmitted through raw or inadequately processed freshwater fish, shellfish, or aquatic plants. Food-borne illness, with the exception of a few diseases such as botulism, brucellosis, listeriosis, and typhoid fever, is often viewed as mild and self-limiting. Although this may be true in a number of cases, in many other cases the health consequences can be serious, even life threatening. This false perception has in part contributed to the lack of attention the problem has received.

Food-borne diseases vary in their health consequences depending on the disease agent, the stage of treatment, and the duration of the illness, as well as the age and susceptibility of the individual. Acute symptoms include diarrhoea, vomiting, abdominal pain, cramps, fever, and jaundice. In the case of many food-borne diseases, healthy adults recover within a few days

to a few weeks from acute health effects. Some food-borne diseases can, however, cause serious and chronic sequelae on the cardiovascular, renal, articular, respiratory, or immune systems. Examples of health complications associated with food-borne illness are reactive arthritis and rheumatoid syndromes, meningitis, endocarditis, Reiter's syndrome, Guillain-Barre syndrome, and haemolytic uremic syndrome (HUS). It is estimated that up to 10 % of patients with enterohemorrhagic *E. coli* (including *E. coli* O 157) infection may develop HUS, with a case-fatality rate ranging from 3 % to 5 %.The manifestations of listeriosis may include *septicemia,* meningitis, encephalitis, osteomyelitis, and endocarditis. The liver flukes *Opisthorchis viverini* and *Clonorchis sinensis* cause mechanical obstruction of the biliary tract as well as recurrent pyogenic cholangitis, and are carcinogenic to humans.

Table 2. The different types of bacteria found on the surface of the different processed frozen seafood products. Source: Okonko et al. 2008.

| Bacterial Isolates | Frequency | Frozen seafood samples | | | | |
|---|---|---|---|---|---|---|
| | No. (%) | Jambo praws | Peeled shrimps | croaker filets | sole filets | head-on shrimps |
| *Bacillus cereus*. | 5 (29.4 | + | + | + | + | + |
| *Enterobacter aerogenes* | 5 (29.4) | + | + | + | + | + |
| *Flavobacterium* sp. | 2 (11.8) | + | _ | _ | _ | + |
| *Micrococcus* sp. | 1 (5.9) | _ | + | _ | _ | _ |
| *Salmonella* sp | 3 (17.6) | + | + | _ | + | _ |
| *Staphylococcus auerus* | 1 (5.9) | _ | _ | _ | _ | + |
| TOTAL | 17 (100.0) | 4 | 5 | 2 | 3 | 4 |

### WHY IS FOOD SAFETY RECEIVING GREATER ATTENTION

Food safety is receiving increased attention due to several worldwide trends affecting food systems. The growing movement of people, living animals, and food products across borders with rapid urbanization in developing countries increase food safety risks. In addition the rising numbers of immune-compromised people, changes in food handling and consumption and the emergence of new antibiotic-resistant pathogens all contribute to increasing food security risks. Changes in food handling and consumption, for instance, include more frequent preparation of food outside the home, increased consumption of fresh and minimally processed foods, and greater consumption of fish, seafood, meat, and poultry around the country. These trends have altered both the nature and incidence of food safety risks in the world's interdependent food production and marketing system. Concerns about intentional adulteration of food from bio-terrorism have also increased attention to food safety. As the

sources and consequences of food-borne illness are better understood, developed countries are strengthening their food safety control efforts.

New regulatory standards have been introduced for previously unknown or unregulated hazards, such as Bovine Spongiform Encephalopathy (BSE, or "mad cow disease") in cattle. Existing food safety standards in developed countries, such as those for aflatoxins in the E.U. and pesticide residues in the U.S., have been made more stringent during the past decade. Many new regulations involve requirements for process controls such as the Hazard Analysis Critical Control Point (HACCP) system an approach for the prevention, monitoring, and control of hazards that can be applied to any production process. New regulations are based on a scientific assessment of risks, and because hazards can enter the food supply at any one of several points. Such assessments are now undertaken from farm to table. New regulations in developed countries certainly have implications for developing-country food producers and processors, and can increase the costs of exporting. During the last decade or so, developing countries' exports of fresh and minimally processed products have increased markedly, and include seafood, fish, fruits, and vegetables. As the case study briefs in this series clearly document, developing-country exporters frequently face difficulties in meeting the increasingly stringent food safety regulations imposed by developed countries. Technical assistance, investments by producers, and new policies in developing countries, however, have all played a role in helping developing-country exporters maintain market access.

The food system is also changing in developing countries them selves, not least because new food safety standards required by the developed world shape expectations among urbanizing consumers. Moreover, food processing and preparation has tended to move outside the household as economies develop. Supermarket chains increasingly dominate in urban food retailing in middle income countries, creating new supply chains that coexist with traditional food processing and retailing. Many kinds of hazard-mitigation activities are shifting from the household to the food industry as the food system changes, and it is not always clear who bears responsibility for food safety or its cost. Briefs in this series discuss some of the difficulties faced in the rapidly modernizing food sectors of developing countries where consumers are demanding improvements in food safety.


 **THE CHALLENGES**

Major challenges facing food processing practices in Nigeria include urbanization, new products and processes. Urbanization is associated with changes in food consumption patterns; together with human population and income growth. This growth in urban populations and the subsequent increase in the demand for food in urban areas are certainly one of the great challenges of the near future. Amongst others, the food sector has a role to play in providing reliable, accessible and nutritious food for urban areas at affordable prices. Consumers now require variety of products like low calorie foods, fortified foods, nuetraceuticals and herbs, convenience/prepared foods, biotech products etc. Process quality systems development, flexible manufacturing, innovation, business restructuring in an activity sequence, investing their intellectual and emotional commitment in the food industry and creating 'leadership' products; realizing vision via perseverance and sustainability of efforts and acknowledging the challenges of multi-stilling.

Above all, the age of the new information order and the opportunities it offers food processing practitioners and professional food scientists and technologists are enormous. Increase globalization: implications for convenience, quality and safety of the novel or improved foods. The exchange rate also remained high and this surely affects the productivity of the food processing sectors. The incessant change in government policy on food imports and exports also dampens the morale of major indigenous food industries. Marketing/Extension Strategy: the greatest inhibition of our professional practice in Nigeria is the absence of an organized and regulated extension service. Yet many beginning entrepreneurs need assistance in food safety, quality control, sources of ingredients and equipment or locating a contract partner; developing business and Marketing plans, determining if their product fills a need or meets consumer wants, finding financial assistance, as well as laboratory and legal considerations. There is insufficient awareness today on many of these information requirements and availability of such services, especially giving room to a situation where professionals are exploited, public safety is at risk and at the mercy of all manner of 'quacks' and regulatory agencies cannot keep track.

## POSSIBLE METHODS OF CONTROL OF FOOD SAFETY

The health and economic consequences of food contamination often differ among countries and regions of the world and depend on factors such as climate, geography, type of crops produced, and the degree of social and economic development. Nonetheless, the basic principles for prevention and control of food contamination and thus food-borne diseases are similar. In general, three lines of defence may be envisioned.

The first line of defence aims to improve the hygienic quality of raw foodstuffs at the agri/aquacultural level. Certain zoonotic diseases, such as brucellosis or tuberculosis, can be eradicated in animals so that food of animal origin (for example, meat and milk) is free of the pathogens. But for most other animal-borne pathogens (for example, *Salmonella spp., Campylobacter spp.*), eradication of the organisms in most animal populations in Nigeria is currently not possible, even if good animal husbandry is strictly applied. Yet, by applying the principles of good agri/aquacultural practice and animal husbandry and by improving the environmental conditions under which animals and plants are grown, the hygienic quality of raw food products can be improved.

The second line of defence utilizes food-processing technologies. For example, pasteurization, sterilization, fermentation, and irradiation can increase the availability of foods by extending their shelf life and can contribute to their safety by reducing or eliminating pathogenic micro organisms. In countries where milk pasteurization is common practice, it has been possible to prevent many diseases transmitted through milk. While many food technologies can be used to render food safe, accidental contamination can occur during processing and manufacturing. Therefore, the application of an effective food safety assurance system is essential. The Hazard Analysis and Critical Control Point (HACCP) system is an important development in this area. Its application would help to ensure the safety of processed and manufactured foods. Contemporary approaches to food safety foresee extension of the HACCP system throughout the food chain, from farm to table.

The third and last line of defence is the most critical for microbiological hazards and will protect the health of consumers when the first two fail. It concerns the education of food handlers in the principles of safe food preparation. The term "food handlers" includes

professional cooks, persons handling food in food service establishments, including street vending stands and mass catering services, as well as those in charge of the preparation of food in the home. Special efforts should be made to educate those responsible for the preparation of the family's food. In this context, particular attention should be paid to women, who are usually responsible for the care of infants and young children population groups in which morbidity and mortality rates for food-borne diseases are high.

The microbiological safety of food is achieved by as far as likely ensuring the non-appearance of pathogenic micro organisms and by all means preventing their development (Edema and Omemu, 2004). The Hazard Analysis critical control Point (HACCP) concept is used to identify microbiological vulnerable points in the food production process and processing, to determine the most appropriate methods of control to be applied, usually such methods as improved treatment techniques, monitoring of temperature and more concentrated supervision (Edema and Omemu, 2004) food, Most fresh mainly that of animal origin like beef, is highly susceptible to microbial invasion and food poisoning
.

**REGULATION**

Most importing countries regulate mycotoxins, thus affecting international trade. The Food and Agriculture Organization of the United Nations (FAO)/ World Health Organization (WHO)  2000 Codex Alimentarius Commission concluded recently that populations with a low prevalence of hepatitis B infection are unlikely to achieve a dramatic decrease in liver cancer cases by imposing more stringent aflatoxin standards for foods, including milk and nuts. Hence, more stringent international aflatoxin regulatory standards are not considered an option by international organizations such as FAO and WHO 2002

**CONCLUSIONS**

Food should be considered not only an agricultural and/or trade commodity, but also a public health issue Therefore, food safety has to be seen by the public health community as an essential public health function. Food safety must be integrated along the entire food chain, from farm to table, with the three sectors government, industry and consumers sharing responsibility. It is indispensable that food safety forms an essential constituent of health-based nutrition policies and nutrition education. Under these situations, incidence of mycotoxins in agricultural products will continue to remain on the health and economic policy agenda. In parts of the world where food supplies are limited, drastic regulatory measures to lower mycotoxin values would show the way to food shortages and higher prices. Thus, any anticipatory measures must be pro-poor, well-focused, and gainful. A centre on high-risk agricultural merchandise through high-risk seasons in high-risk areas among high-risk population groups for selected mycotoxins would yield the greatest public health advantage. Monitoring human inhabitants groups for diseases attributable to mycotoxins coupled with implementing suitable anticipation and manages procedure, including sanitization and detoxification, would guarantee a food supply liberated from mycotoxins. Such reserves would be returned several times above in enhanced human and animal physical condition and compact economic wounded.

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