

**A Novel Dry Toilet Complex Design for a Market Community in Nigeria
with Diverse Cultural Practices**

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Abstract

In Nigeria, 34 million people still lack sanitation and toilet facilities at the end of just concluded Millennium Development Goals (MDGs). They practice open defecation which is deplorable particularly in urban areas and public places. The common faecal disposable methods accepted by communities are ventilated improved pit toilet and septic tank system. The dry or waterless toilet and urine diversion toilets are not yet introduced in the country, though they have proven advantages in terms of low water consumption, better sanitation, resource recovery and effective pathogen removal. Women Friendly Initiative (WFI), a prominent Non-governmental Organization in Nigeria received a grant to initiate a waterless toilet in a market community in the Nation's capital, Abuja. This paper presents our efforts in developing a new toilet complex design and installation in a popular market, Kuje with 199 stalls and diverse cultures. A needs assessment appraisal revealed that the market was insanitary and littered with packaged faecal wraps; some preferred use water for anal cleaning while others tissue or any available paper; women bitterly demanded exclusive toilet privacy from males and for menstrual pad disposal due to religious and gender preferences. The market has three poorly managed 'pay and use' toilets with 'pour flush' type used by men only. We developed a novel composting toilet complex design. It has eight toilet units (four each for men and women) with urine diversion, a separate urinal, bathing facility, a composting chamber, roof rain water harvesting, and a handwashing facility with soap and a mirror. An organizational structure, a user Manual and documentation of skills are provided with gender equity for user fee collection, compost making, sale of fertilizer and urine, and regular upkeep of the complex. The Management Committee is drawn from the market community, local Government staff and a representative from WFI. Users and Managers are given training for sustainable use and management of the facility.

Key words: Dry toilet, Market community, Composting, Urine diversion, Women friendly

Introduction

Most markets in Nigeria are devoid of formal institutional sanitation facilities and when people are pressed to use the toilet, they resort to open defecation and urination; at close distances where minimal privacy is guaranteed. However, in most of the few markets where sanitation facilities abound, they are poorly managed. Hence, the need to evolve a sustainable conservative approach to evolving a solution to the problem in Nigerian markets through sustainable and integrated waste management through composting toilets. In this regard, composting is the art of converting organic raw materials (faeces and urine), previously designated as waste into manure and compost as resources that could be used for soil improvement and an alternative to chemical fertilizer. In composting, several technical designs and management models are available, based on type and volume of wastes generated, frequency of generation, existing management protocol and willingness to use the end products.

A Urine Diversion Dehydrating (UDD) or Composting or Ecosan toilet is an ecosystem approach to closing the water and sanitation loop by recycling nutrients and reusing the sanitized nutrients (Esrey and Andersson, 2000). It is based on 3 key principles- sanitation should be safe from a health perspective; "green" or non-polluting and reuse and recycling of valuable nutrients in human urine and excreta. There are two fundamental toilet types in ecological sanitation: urine diversion, in which urine and faeces are separated (which results in odour free and less attractive to fly breeding), treated and reused and Non-urine diversion, where urine and faeces are mixed, composted and sanitized into manure. In each type, emphasis is on managing the system with little or no water, and end products are separated from surface and ground water resources.

Most of the available UDD technologies do not make any provision for anal cleaning with water thus preventing access to some culturally sensitive sections in the communities. Thus a new idea introduced by our team in Kuje market, Abuja, Nigeria was a twin bowl system whereby, a user may just move his bottom after defecation in the main bowl to the next bowl where a small volume of water is allowed to pass through a spray hose operated by pressing a knob. In most of the European and Asian designs, the faecal matter mixed with saw dust or ash is allowed to remain in the compost tank below the toilet. In Nigeria such a design is not

practicable particularly for public use like a market where users may also discharge various pathogens including helminths in the defecation process. We felt that it is necessary to use a primary composting pit where the faecal material will be given adequate time for degradation of organic matter and then allowed to cure and stabilize which in turn also results in destruction of the pathogens.

The philosophy of using a dry toilet is to conserve water as it is a precious natural resource which is fast depleting. Communities in Europe are fairly educated with less taboos who can adapt to the new technologies. Since the composting toilet is being planned for Nigeria and other African countries which are known for their multi-cultural and multi-religious population, the first task has been whether people will accept a dry toilet system without using water for anal cleaning? Also, whether the composting toilet can serve large communities like market, schools and motor parks where the usage is rather rough. Hence, the establishment of the sustainability processes is key, based on the paradigm shift from conventional sanitation systems to ecological sanitation as one of the systems aimed at achieving MDG 7, i.e. to halve by 2015, the proportion of people without sustainable access to basic sanitation in public.

The Toilet Unit and the Facility Design

The uniqueness of this toilet complex is that:

- 1) Composting toilet is being experimented for the first time in Nigeria and that too at a community level serving larger number; this has been successful in East Africa, South Africa and some European and Asian countries.
- 2) The toilet has eight compartments (4 for men and 4 for women); sawdust or ash produced in the market or neighbourhood is used to make compost within the toilet tank; a curing tank, and other features are incorporated to sanitize the compost; it is self-sustainable; the project components include sensitization of the market associations, design, construction, test running, monitoring and performance evaluation.
- 4) A design is being incorporated to use very little water for anal cleaning for those culturally sensitive, and this water will be diverted from the main tank for separate collection and disposal.
- 5) A Urine diversion is incorporated and the urine is harvested and supplied to farmers who form a significant stakeholder group in the market.

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6) Separate urinals are provided for both men and women and the urine is also collected and used for farming purposes; we had some good results in the past.

7) The toilets are women friendly; as of now women (more in number than men among the market traders) are not patronizing the existing toilets as they have no privacy and they fear poor hygiene; they still go to bush or wrap their faeces in thin nylon bags and throw indiscriminately as they do not want to be seen by men; a menstrual pad disposal facility is also being incorporated to reduce embarrassment for women.

8) There is provision for rain water harvesting to reduce the problem of water scarcity and optimize the utilization of the toilet.

The machine is built on channel frame divided into two compartments (Figure 1). The first compartment consists of a bucket that is divided into two units. The outer unit is positioned to accommodate urinating discharge organs of both male and female. It is built with a drain that leads to a urine tank that is located outside the toilet chamber. The second unit is for defecation where faeces are dropped onto an auger held hopper. The second compartment consists of a bucket that drains cleansing water to a soak away pit inside the complex, away from the toilet. Other components in the machine are: the sawdust bucket with paddle dispenser, the mechanical drives mounted on the frame and operate the transport auger and sawdust dispenser, a continuous stand that position users on buckets placed for urinating and excreting purposes. The gear unit that drives the auger and sawdust dispenser rides in a grease bucket. This unit provides motion to auger and dispenser through a handle mounted on ratchet mechanism and operated manually to drive the gears and chain drives.

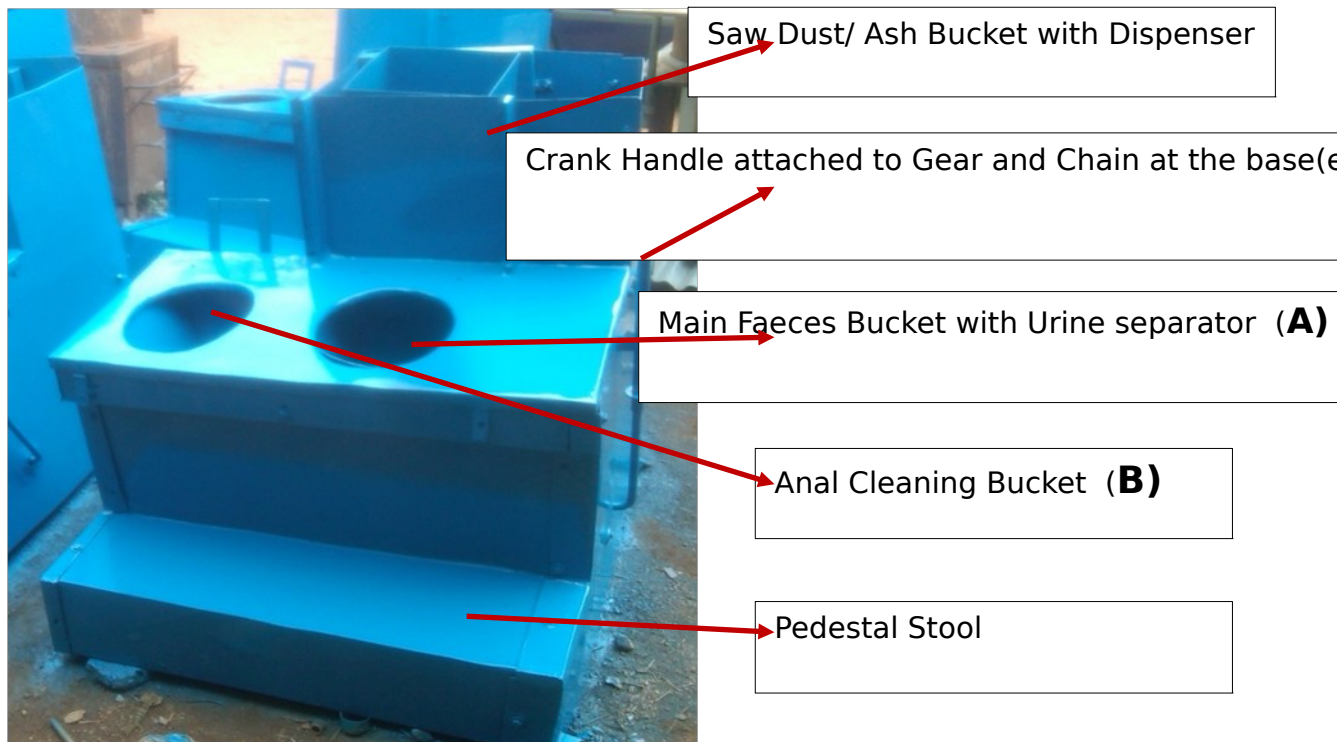


Figure 1. Features of the dry composting toilet

Operation of the Toilet

The system does not use water to flush excreta; it is devoid of odour, flies or other disease spreading vectors and does not contaminate soil compared to septic tank soil disposal system. Instead, it recycles human wastes and turns them into nutrient rich compost, thus adding value to the excreta generated. The toilet has twin units side by side (Figure 1). The main unit has a urine diversion partition suitable for men and women. In the main unit, faeces drops on to a screw type auger controlled by a hand pedal which allows a calculated amount of sawdust/ash to fall on the faecal matter and pushes into a primary tank. The unit is designed in such a way, the number of strokes determines the quantity of cover material which will also act as moisture absorbent. Ash has the added advantage of raising the pH which is good for destroying the pathogens. The faeces-sawdust/ash mixture is left in the primary tank for some weeks and then it is manually transferred into a secondary composting pit (Figure 2) where a caretaker allows the contents to cure until a proper compost quality is obtained. The urine is diverted into a storage tank which is sold to farmers for use on farms as organic manure.

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Those who use water for anal cleaning, the user moves his bottom to the adjacent unit which is connected to a water spray hose, which releases a small amount of water when pressed gently. This water is drained into a soakaway pit built in the facility. Male and female caretakers manage the facility as they are separated by a partition wall for effective segregation. In addition, the women's urinal unit has a menstrual disposal outlet with a sliding cover and when the pad is dropped, gets into a specially designed incinerator unit attached. The collected pads are burnt *in situ* at regular intervals.



Front view of the facility



Primary treatment pit



Central processing unit



Tools and product warehouse

Figure 2. Section of the toilet complex showing various units

Maintenance of the Toilet

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The twin buckets in the toilet compartments are removable for cleansing or changing periodically. To achieve this, toilet seats on both buckets are first removed, followed by the top cover and then the bucket edges exposed is pried with flat sharp object to remove each bucket. The faeces transport auger has a drain capped on the base of its hopper. This drain is placed in a hard to reach area and can only be used when the whole unit is tilted. However, the hopper can be cleaned by mopping with soapy water and dried with rag. To reach the drive system for greasing, the faeces bucket, as earlier described is removed and thus exposing the gear and chain drives. Grease can now be applied to the drive system.

The crank handle is removable from the ratchet mechanism as it only inserts in a square socket welded to the ratchet. Both ratchet and driving gear for the drives are both mounted on the same shaft. The chain that drives sawdust dispenser has a tensioned sprocket mounted on the main frame. The chain tension can be adjusted using this piece. Grease bucket is attached to provide lubrication to the drive mechanism so as to extend its life span.

The toilet facility has been commissioned on January 27, 2015 with participation by all market traders and other stakeholders. It had the blessings of the State and Local Government officials and the occasion was celebrated with all paraphernalia. A training manual was provided for the users and the management.

Since its commissioning, the usage has been monitored. A review of 4 weeks period showed that on an average 26 people have been using the toilet complex. On the market days, which are 3 times in a week, more people patronize the complex. Women are finding it comfortable with privacy, provision for menstrual pad disposal and also bathing facility. The market is currently being renovated and we hope that many more traders will start using it.

Conclusion

A novel urine diversion dry toilet was designed and installed in a market at Kuje, Abuja Federal Capital Territory in Nigeria. The design was developed based on the users' perceptions and expectations. It is women friendly where gender privacy and special needs were taken into consideration. The facility is ecofriendly as it incorporated toilet, urinal, bathroom, menstrual pad disposal, collection of urine in a special tank, soakaway pit to receive small water used for anal cleaning, and rain water harvesting. Separate male and female caretakers maintain the

facility. The faecal matter is converted into compost and used on farms along with the urine harvested. The stakeholders played a very active role in developing the facility and for sustainability, a structured management team has been formed with 'pay and use' revenue generating component. It serves as a model for other public institutions where sanitation is compromised.

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