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Full Length Research Paper

Economic advantage of rainwater harvesting over water borehole: A sustainable development at the Extension Site Federal Polytechnic, Oko

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This paper analyses the economic advantage of rainwater harvesting over water borehole. The management of the polytechnic (Oko Poly) believed since the year 2000 that the provision of water supply and sanitation services is an important basic need. And they also wish to ensure long-term sustainability of the facility. Water is an essential ingredient for maintaining life in an environment as well as a fundamental resource for socio-economic development of the people. It is essential for human life, and therefore enabling access to a safe and reliable water supply to the polytechnic community is a key development strategy of the management. Obviously, with an estimated population of about sixteen thousand people, over 45% of these stay at the extension site. There is therefore an urgent need to provide them with the basic necessities of life including provision of water supply and sanitation service, as their right.

Key words: Economic advantage, rainwater harvesting, sustainable development, water borehole, sanitation.

INTRODUCTION

The effort made by the polytechnic management towards providing safe water supply and sanitation at the extension site for over six years has exposed the challenging task ahead, and it will relentlessly work towards addressing the challenges and will build on the lessons to be learnt and experience to be gained.

Water is a basic resource and a necessity for human life. It is also a basic need for all human beings for direct consumption and sanitation (Okereke, 1996). Regarding human hygiene, water is required for cleaning and sanitation; a specific daily minimum volume and quantity of water is required simply for survival and to minimize health risk. Therefore, to improve water provision, construction or improvement of the physical water supply infrastructure is a necessity which goes side by side with economic development.

Students and lecturers need water supply service to enhance their quality of lives by addressing the over increasing need for safe water supply and sanitation service. Increasing access to a sustainable supply of safe and potable water and sanitation will contribute towards improving the livelihood of the polytechnic community particularly for female students and lecturers who expose their nudity while trying to convenience themselves in the surrounding buses. Available statistic indicates that only 6% of the populations have access to improve water supply services while for sanitation, the figure is estimated at 1% in the institution. It is in this regard that the management focuses on the fight against lack of water in the institution which requires a concerted effort of both the management and Alumni. The establishment of water and sanitation programme at the extension site will help alleviate the problem of water borne and related diseases. It will also distribute the benefits equally among the lecturers and students, and the perception of the beneficiary will improve the management, staff and students relationship.

The concept of rain water harvesting is very old but came into prominence only in recent years, Maddock D 1975 conceived this idea,as water harvesting essentially means storing/conserving rain water collected from house roofs made of galvanized aluminum or surface runoff through storage reservoir or tanks. The typical rain tank set-up includes roof top collection and storage chamber; conserved rain water has been a common supplementary drinking water option in some parts of

Table 1. The size of the roof and quantity of water to be collected

SN	Department	Size of roof (M^2)	Quantity of water (Litre/year)
1	Civil engineering (CVE)	375	450,000
2	Computer engineering (CPE)	350	420,000
3	Electrical electronics engineering (EEE)	485	582,000
4	Science laboratory (SLT)	335	402,000
5	Banking and finance (B/F) / Marketing (MKT)	485	582,000
6	Business administration (BAM), Public administration (PAD)	1520	1,824,000
7	Total		4,260,000

Nigeria since the ancient past.

Technique and methods used for collection of rain water were not systematic or properly done. However, in the past decades the concept on application of rain water harvesting in rural water supply system has been developed and established as a satisfactory domestic water option (University of Nairobi, 1979). On the other hand, borehole is a hole bored into the ground to find water.

It composed of UPVC (unplasticised Poly Vinyl Chloride) casing and screens, gravel pack and cement grout. The design and construction of this borehole starts from geophysical investigation, followed by suite drilling with final diameter of 200 mm by rotary mud flush technique in sedimentary formation of Imo shale. Therefore, plain casing will be installed down to the aquifer at 305 m deep and wire screens are also to be installed together with natural gravel packs. All the annular space will be grouted between the underground geological formation and casing with an impervious material, and thereafter reticulating from pump to the overhead tank.

Objective of water supply and sanitation at the extension site

In the year 2000, the first well articulated national water supply and sanitation policy was adopted. This policy stipulates the provision of sufficient potable water and adequate sanitation to all Nigerian in affordable and sustainable manner through participatory intervention (Offodile, 1992).

Therefore the objective of the paper is:

1. To tackle the issue as health and hygiene education.
2. To expand service coverage to give about 100% of the population access to safe water and appropriate sanitation
3. To achieve sustainability of service delivery and reduce burden on the management.
4. To ensure that a basic adequate level of service is affordable through low-cost service delivery.
5. To ensure that water being a social good is managed in a way in order to achieve the consequent benefits in terms of infrastructural development and good public health.

METHODOLOGY

The procedure is done, as a careful study by data collection through structural questionnaires administered to the staff, students and traders of the population.

Accurate numbers of classroom blocks were taken into consideration including shops and stores of the traders, and then the population of the students, staff per each block of classrooms.

According to Johnson and Renwick (1979), the method of rainwater harvesting can be reasonably affected by collecting water from the aluminum long span sheets, of all the class room blocks in the extension site. The roof guttering is sloped evenly towards the down pipe, because of its sagging tendency which can provide breeding places for mosquitoes.

The size of the roofs will depend on the size of the class room blocks (Table 1). The quantity of rainwater that can be collected through roof catchments will be largely determined by the effective area of the roof and the local annual rainfall. One millimeter of rainfall on one square metre of roof will yield about 0.8 L of water allowing for evaporation and other losses.

Coefficient of catchments: $C = 0.8$.
Roof measurement $L \times B = A$
Annual rainfall intensity $I = 1500$ mm
Quantity of water = Q
$Q = C \times A \times I$

The water borehole will be drilled using rotary mud flush at diameter of 200 mm to a depth of 305 m. The bore will be lined with UPVC 100 mm casing with 70% of the saturated zone being with 1 mm slot screen and backfill with appropriately sized washed gravel pack 3 mm. Also, the bore will be developed using surge compressed air, protected using puddle-clay cement sanitary seal, head works and will be fitted with rising main, connected to submersible pump (Driscall, 1995).

Protection and maintenance of rain water harvesting and water borehole

Arrangement should be made to remove, dust, dead leaves and bird droppings accumulated on the roof during the dry period. These will be washed off by the first new rain. The down pipes are carefully made so that the first water from each shower can be diverted from the clear water storage tank and allowed to run to waste.

To minimize the pollution of borehole water source, protection

Table 2. Population forecast for 10 years.

Department	CVE	CPE	EEE	SLT	B/F	BAM	PAD	MKT
Population (10 years)	230	340	610	600	840	760	800	680

Table 3. Estimate of the Rain water construction.

S/N	Block/ department	Cost of material and reticulation	Cost of storage tank (Concrete)	Cost of labour	Total cost (~~N~~)
1	CVE	152,000	290,000	140,000	582,000
2	CPE	145500	272500	130,000	548,000
3	EEE	244,500	487500	240,000	975,000
4	SLT	132500	262500	125,000	520,000
5	B/F	-	487500	240,000	975,000
6	BAM	522250	842500	320,250	1,685,000
Total					5,285,000

zones must be established for this water source. The borehole must be covered up to an area at least 50 by 50 m for inner protection and this area must be fenced and have a lockable gate. There should be no septic tank, pit latrine storage of fuels, oils and lubricants without a leak proof chamber. The outer protection should not allow the location of solid waste disposal and commercial or industrial activities. Sufficient space should be allowed for separate 200 mm diameter access pipe for water level monitoring and maintenance equipment to be lowered down.

Method of population forecast

Arithmetic method: (Table 2)

$P_T = P + k\ (t)$
P_T = Predicted population
P = Existing population
t = Ten year prediction
K = Coefficient of growth.

Quantity of consumable water by the staff, students and traders
Total population = 4860
Rater of consumption = 20 L / capita/day
4860 × 20 = 97200 L
For 12 months = 1166400 L.

BENEFITS

Obviously, there are many benefits derived from construction of permanent water and sanitation scheme at the extension site and of the institution (Table 3); there are:

1. Establishes water and sanitation coverage of the extension site.
2. Reduces any prevailing water borne disease
3. Improves school attendance of the students with ill-health resulting from water born diseases.
4. Reduces Burden borne disproportionately by women (female students) limiting their access to water and sanitation.
5. Improves proportion of budget used on water and sanitation in the management strategies.
6. Reduces time spent in searching and collecting water.
7. Improves quality of life by providing convenient facilities of both water and sanitation.
8. Creates an enabling environment for studying.
10. Promotes sanitation and hygiene of the school, so that student imbibes good sanitation and hygiene.
11. Sustainability of access to water supply and sanitation in all year round.

Conclusion

The paper observes unnecessary inconvenience of water and sanitation problems the staff and students population are passing through at the new extension site of the institution since its creation in the year 2000. Despite the notable portability of the borehole construction, with regard to contamination, rain water remains economically viably accepted, considering the financial problem of the Institution. It is also important to recognize that rain water harvesting is less labour intensive and economically benefiting to the polytechnic community, based on the fact that there is appreciable difference in the cost of construction and maintenance of the option (Table 4). Therefore adequate safe water supply is the prerequisite for significant socio-economic development. Rain water collection is an inexpensive water supply alternative to hygiene promotion in comparison to borehole water system and can be easily installed and maintained by the school authority (Ofeze, 1976). Rain water can be beneficial to the environment in that, it reduces the demand for ground water (via borehole). Drilling of borehole through a viable option could be very risky, due

Table 4. Estimate for water borehole.

S/N	Activity	Amount (₦)
1	Geophysical investigation, drilling, logging and casing	3,800,000
2	Development, pumping and test for portability	750,000
3	Reticulation, pump and accessories	1,925,000
4	Pump house and generator set	1,850,000
5	Erection of 10,000 gallon overhead tank	2,500,000
6	Total	10,825,000

to lose in circulation which subsequently will lead to additional cost.

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