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Experiences, associated capabilities and responsibilities of Landfill Management in Kampala Capital City authorityUganda.

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Abstract: *Landfills are common dumping places for garbage in many poor and developing countries.Even thought they are associated to environment risks, they remain the preffered means of waste due to their economic factor. Semi structured interviews were conducted with 19 employees of Kitezi landfill between June and November 2013 and they shared their lived experiences of the landfill daily tasks, sustainability ,achievements,mainteanance of infrastructure, control, treatment and monitoring of leachate, quality control, achievements of landfill under KCCA ,continued challenges and recommendations. Results show relatively high pH, Total Dissolved Solids (TDS), Conductivity and extremely low Oxidation-Reduction Potentials (ORP) for Leachate and its path through Bitarabeho's Farm.* ***Though proud of their contribution for a period of over 10 years, , they were concerned about their long term health outcome****.The lived experiences* ***provided*** *rich insights into the experiences of landfill management and exposed the pending challenges* ***for poor developing country like Uganda.***

Key words: *Landfill Management, Experiences, Solid waste disposal, leachate control, treatment and monitoring*

I. Introduction

In the 18th and 19thcencury management of waste involved the collection and disposal of municipal waste into dumps in far and isolated areas from the town were the smell will not be a problem to the residents and throughout the 1930s, the sanitary landfill started developing (Scott, J; Beydoun, D; Amal, R; et al.2005). Todate landfills remain desposal sites of choice due to their economic means. Approximately over 95% of generated garbage world over is municipal waste (El-Fadel, M., Findikakis, A.N., and Leckie, J.O.1997). Although landfills are economical**,** if not properly mmanaged can pollute the environment. (Scott, J; Beydoun, D; Amal, R; et al.2005).Due to the serious environment impact from the landfills around the world**,** leach tests where done to classify waste, for control, treatment and monitoring of leachate. In this study, the tests were done for monitoring purposes, control and treatment but classification of waste is outside the ambit of this paper. The purpose of this paper therefore is to share the lived experiences of the landfill employees in Uganda in terms in terms of daily tasks, sustainability ,achievements,mainteanance of infrastructure, control, treatment and monitoring of leachate, quality control, achievements of landfill under KCCA ,continued challenges and recommendations to KCCA management and residents.

There is a huge body of knowledge on landfill across the world but previous research covered thei**r i**mpact of landfilling and composting on green gas emissions Lou, X. F., & Nair, J. (2009), effects of solid waste treatment on public health and environmental safetyHamer, G. (2003), landfill cost and benefits Moutavtchi, V., Stenis, J., Hogland, W., Shepeleva, A., &Andersson, H. (2008), accounting of greenhouse gases and global warming contributions Manfredi, S., Tonini, D., Christensen, T. H.,&Scharff, H. (2009), bio-pretreated municipal solid waste by natural convection of air and its effects Mahar, R. B., Liu, J., Li, H., &Nie, Y. (2009); Mahar, R. B., Liu, J., Yue, D., &Nie, Y. (2007), landfill management, leachate generation in Australia Scott, J., Beydoun, D., Amal, R., Low, G., & Cattle, J. (2005), landfilling versus "backstop"Highfill, J., &McAsey, M. (2001), trends in sustainable landfilling in MalaysiaFauziah, S. H., &Agamuthu, P. (2012), review of economic valuation from incineration and landfillingEshet, T., Ayalon, O., &Shechter, M. (2005), environmental impacts of solid waste landfilling El-Fadel, M., Findikakis, A. N., &Leckie, J. O. (1997), landfilling operations being a good neighbor Eldredge, R. W. (1986), Constrained recyclingDiaz, R., & Otoma, S. (2013), from "less landfilling" to "wasting less Corvellec, H., &Hultman, J. (2012), landfilling with mixed wastes Beyazli, D., &Aydemir, Ş. (2008). Landfilling with mixed wastes: Beyazli, D., &Aydemir, Ş. (2008), and moving towards sustainable landfilling in Malaysia Agamuthu, P., &Fauziah, S. H. (2011).. There is only one study that covered the related experiences and tasks of landfill of 9/11 under World Trade Center Health Registry and Barge Workers in USA Ekenga, C. C., Scheu, K. E., Cone, J. E., Stellman, S. D., & Farfel, M. R. (2011).

Kitezi sanitary Landfill is about 13 km from the City Centre to the north of Kampala City, through Kampala-Gayaza road (about 9 km), branching off to the left at Mpererwe and following the bitumen road going to Namulonge (about 4 km). Kampala Capital City Authority landfill operations and management were under a contractor - OTADA Construction Company Limited, since August 2011.On 25th January 2013, the contract was formally terminated. However, since waste management activities in Kampala had to continue, and the operations of the Landfill is tentatively being managed by KCCA, therefore it become paramount to devise means to keep the Landfill operational as Managerial issues of termination were being addressed and among new developments was (i) operating 24 hours seven days a week, (ii) ensuring proper disposal of refuse, (iii) protecting the Environment and (iv) working in active partnership with the Catchment Community.

The tasks involved include but are not limited to the following;
(i)General management of the landfill and site operations.
(ii)Receiving, taking records and processing of accepted waste.
(ii)Mitigation of the direct environmental impacts associated with the landfill operations i.e. dust, noise, odour and insects (pests).
(iv)Routine maintenance and daily cleaning of access road from Gayaza road junction to the landfill.
(v)Control, treatment and monitoring of leachate.
(vi)Maintenance of landfill infrastructure including leachate treatment plant, weighbridge, fence, gate and buildings.
(vii)Provision of day and night security at the landfill site.
(viii)Provision of necessary inputs for landfill operations including cover material and chemicals for leachate treatment

The Site comprises all KCCA land that has been demarcated for Mpererwe Landfill. About 35 acres, have been developed for landfilling.

Characteristics of the studied population

Study participant	Department	Work site	Job Title	Nature of service
2	Records	Kitezi landfill	LandfillRecords Officer	Contract
3	Laboratory	Kitezi landfill	LeacheteTreatment Assistant	Contract
1	Transport	Kitezi landfill	Operator	Contract
3	Transport	Kitezi landfill	Truck Guides	Contract
6	Sanitation	Kitezi landfill	Sweepers	Casual
2	Sanitation	Kitezi landfill	Cleaners	Casual
2	Environment	Kitezi landfill	Managers	Contract

II. Methodology

Semi structured interviews were conducted with 19 employees of Kitezi landfill between June and November 2013 and an interview guide was used to keep the interviewee on track and the average time was 45 minutes to 1 hours and two focus group interviewees were also conducted among the salvagers sorting waste at landfill. Questions in the guide were based on literature view on sustainable landfill management and comprised sequences of themes about; employment information, experiences in the work site, leachatecontrol, leachate treatment plant, infrastructure management i.e., weighbridge, performance of the landfill leachate treatment plant, daily activities, quality control and workmanship, protective measures and concerns, problems and issues and achievements. Questions which are open-ended were employed to prompt themes of interest to enable **participants** connect and communicate their specific standpoint. All interviews were recorded using an mp recorder and transcribed on the basis of theme generation.

The KCCA technicial team used 'Water Quality & Environmental Testing' methodologies based on Wagtech Environment Technologies.The Portable Laboratory containing: Portable Kits with the following, Potalab, Potakit and Potaflex. Theinstruments usedincluded,Wagtech International pH meter (WE30200), Wagtech International Conductivity/TDS meter (WE30215) and Wagtech International Potalab Photometer 5000 (WE30210). The technology used has acomprehensive range of portable labs and kits by Wagtech Environmental Technologies that allows a complete range of tests to be carried out to WHO – World Health Organization & EU – European Union Guidelines. These include among others physico chemical parameters and heavy metals. The laboratory was done with assistance of KCCA staff i.e., city environment officer, nationalnazetted environment inspector/Chemist and two leachate treatment plant **a**ssistants .

Sampling Procedure

Samples were picked from seven sample points and analyzed for about 14 parameters in two parts i.e., field analysis and a comprehensive laboratory analysis.

III. Results

Field Analysis

Show relatively high pH, Total Dissolved Solids (TDS), Conductivity and extremely low Oxidation-Reduction Potentials (ORP) for Leachate and its path through Bitarabeho's Farm.

However, though this water is a potential source of pollution to the surface and ground water, analysis shows that this has not taken place yet by the same low parameters of stream water – **(Sample No. 5 North of the Landfill Stream)** and Borehole water – **(Sample No. 6 Borehole)** within the Landfill Fence.

The Leachate Treatment Plant registered reasonable positive performance exhibited by the consistently reducing 'Field Analysis' parameters along the path of Leachate from: (i) Sample No. 1 Raw Leachate, through, (ii) Sample No. 3 Clarifier values, (iii) Sample No. 2 Final Effluent, (iv) Sample No. 7 Wetland Stream up to, and (v) Sample No. 4 Bitarabeho's Farm. Parameters that reflect this are pH, Total Dissolved Solids (TDS), Conductivity & Oxidation-Reduction Potentials (ORP). Nonetheless, the Leachate Treatment Plant would perform far better if fed with the 'daily consumables' like hydrochloric acid, di-ammonium phosphate, anti-foaming oil and flocculant.

Laboratory Analysis

Laboratory Analysis shows that some parameters in this category are within World Health Organization (WHO) entitled 'Guidelines for Drinking Water Quality'.

Parameter	Sample No. 2 Final Water	Sample No. 4 Bitarabeho's Farm	Guideline Values
Nitrates (NO_2)-N ppm	Not Detectable	Not Detectable	50.0
Ammonia ppm	Not Detectable	Not Detectable	1.5
Ammonia (N as NH_3) (Ammonia x 1.2) ppm	Not Detectable	Not Detectable	1.8
Ammonia (N as NH_4) (Ammonia x 1.3) ppm	Not Detectable	Not Detectable	2.0
Chlorine ppm	Not Detectable	Not Detectable	5.0

Chemical Oxygen Demand (COD)

The Landfill Investigating Team attempted to carry out COD tests amidst the inadequate and limited Laboratory Consumables. Two independent methods had to be merged to try out this test:

The conventional distillation and titration method but since the titrating reagents were not available, the distilled samples were read of using Wagtech International Potalab Photometer 5000 (WE30210)

The combined methods gave some interesting results that compel follow-up for meaningful interpretation.

Therefore in conclusion, Chemical Oxygen Demand (COD) results are disquieting. August 2013, was the first time to carry out this test for financial year 2013-2014. Further investigations are essential before conclusive remarks can be made.

Analysis and Discussion

That KCCA Acquires a Wagtech digesting block and vials for the Landfill Laboratory so that meaningful investigations of COD are undertaken on the inference/interpretation and leachate and its path to Bitarabeho's Farm.

i. Raw Leachate is relatively sturdy as reflected by 'Field Analysis' of Raw Water. This is basically due to the prevailing dry conditions of the month.
ii. Clarifier Values of 'field analysis' are lower, but not up to acceptable standards. This is as a result of a stretched period (since January 2013) of not utilizing the daily treatment plant consumables that would have enfeebled the Leachate during the leachate treatment process.
iii. Also final water values of 'field analysis' are a bit lower but not up to acceptable Standards.
iv. It should be noted that the final water is the one channeled through Bitarabeho's Farm and the test results, though lower as regards 'field analysis', calls for immediate opening of the drainage channel to save the situation which is worsening as time rolls by.
v. The stream has been blocked by Cementers and it would necessitate enforcing its opening for natural cleansing to take immediate effect.

Impacts on Surface Water and Ground Wells

Results show that there is no pollution yet of the surface spring to the North of the Landfill as well as the Ground water, as reflected by Borehole Water results. However, KCCA should try to offset any potential pollution sources to obviate future contaminations.

For the qualitative analysis generated themes in common categories and thematic traces generated themes like; terms of employement, responsibilities and tasks, ability of landfill, Quality control and workmanship,control, treatment and monitoring of leachate , Leachate flow at the Landfill, Performance of the Landfill Leachate Treatment Plant-Way-Forward,achievements Challenges and issues,major works and health risks.

Terms of employment

All interviewees are were not happy with the terms of service. Since the inception of KCCA, their terms of services were not upgraged, they are considered as former Kampala City Council (KCCA) employees thus their renumeration is still poor and this demotivates them considering the fact that the work environment is very risky to their health yet they work for long hours since the landfill is open 24 a day and seven days a week seven in order to manage the garbage.

Responsibilities and tasks

There are a lot of activities i.e, general cleaning, sweeping, recording trucks that off load garbage**,** leachete treatment, fueling equipments, driving tractors, management of sorters and guiding trucks that off load garbage. The nature of activities at the landfill are hectic and one of the interviewees had this say; 'we work a lot, for long hours but we are paid low salary yet if we stopped working, this landfill can be a problem to this country, we want management of KCCA to consider our contribution and value us as equally relevant by increasing our salaries'.

Ability of landfill

The KCCA Mpererwe Landfill Site as a Engineered Sanitary Landfill (**ESLF**) is operating properly and currently it meets the National Environment Requirements and International Standards especially because; we ensure proper disposal of refuse, protecting the environment and workin active partnership with the catchment community. All interviewees agreed to the fact that the landfill was a wasted place during KCC management and they stated that; 'old management would not send logistics to the landfill we lacked resources to manage that landfill and it became a menesy to society which led to community to strike so that they seek management's attention which was one of reasons that caused change of management which by any measure is better that previous KCC'. All interviewees agreed that; 'under KCC the landfill activities were out sourced to private contractor who did not fullfill is obligations which led to cancelation of contract when new management took over'.

Major works

There are quite anumber of developments at the Landfill and the management team came up with fundamental planned **i**nterventions to operationalize Mpererwe Landfill so that it performs better. Some of the plans and outputs by August 2013 involved**;** 'mobilising equipment to manage the landfill successfully, format equipment tracking from August 2013, mobilising the skelton staff to Successfully perform their duties, team building of the workforce and sharing responsibilities,interim reports to be generated on time, mobilise logistics and maintaining a constant supply for the consistent activities of Mpererwe Landfill and developed format of fuel trailing and leachate treatment plant chemicals should be acquired on time. One of the interviewees argued that; 'there is need to initiate site meetings and site inspections on a monthly basis at the landfill, this will lead managers to appreciate their duty'. During the first site meeting, one of the interviewees recalled one of the managers who commented loudly that, 'These people seem to be doing a better job than the Former" i.e., These people are; public health and environment Directorate including landfill staff and Former was, the Contractor OTADA construction company Limited. These meetings results into achievements like, 'fencing Mpererwe Landfill'.

Quality control and workmanship control

Quality control was carried out in accordance with the provisions of the specifications. A health and safety board has since been placed on sight to highlight issues pertaining to safety of site users.The direct environmental impacts were mitigated resulting in the reduction of dust and insects, minimisation of noise and bad odours. Management of the landfill lamented that, 'they experience challenges where some salvagers do not want to wearprotective gears which exposes them to a lot of health risks'.

Control, treatment and monitoring of leachate

KCCA Landfill Management Team submits requisition for daily consumables for the Leachate Treatment Plant. The daily consumable chemicals include but are not limited to: hydrochloric acid, di-ammonium phosphate, anti-foaming oil and flocculant.

The main activities at the Leachate Treatment Plant included: (i) controlling Leachate flow rates for treatment. Record of Leachate flow rates, (ii) tracking of sludge and de-sludging whenever necessary, (iii) record of sludge measurements and de-sludging, (iv) taking rainfall measurements and record of rainfall (v) trailing power and turning on generator during long spells of electricity black-outs.

Leachate flow at the Landfill

All Leachate from the Landfill has continued to flow unobstructed from all sides of the Landfill after construction and upgrading as well as maintaining the Landfill drains during September 2013.Unfortunately, September 2013 was extremely heavily wet and all storm water from upstream ended up in the Leachate Collection Sump, silting it up.

Maintenance of landfill infrastructure including leachate treatment plant and weighbridge.

During the month of August 2013, no renovations were carried out. Thesite infrastructure was not well attended to and most of the infrastructures, like the Laboratory, Toilet and kitchen are in need of immediate repairs.

Kitezi landfill management team said that; 'the weighbridge was successfully tested for functionality during the month of August but it is not operational to date'. The records office computer got a problem during the testing exercise and this has not been rectified to date. KCCA is undertaking acquiring an Indicator for the system in order to operationalize the weighbridge and the process is ongoing under close supervision of KCCA landfill administrative officer.

It should be noted that the leachate treatmentplant requires major repair works and replacement of many components. The works on the fence to re-enforce with a chain link has been finalized in areas without impediments.

Performance of the Landfill Leachate Treatment Plant-Way-Forward

To divert all storm water away from Leachate for enhanced treatment by the Leachate Treatment Plant.During October 2013, the Landfill Team made a diversion of the storm water off the Eastern side of the Landfill i.e.,from Buwambo Road, through landfill office road down to the wetland downstream.Recommendation is for works at the extension should also include diversion of storm water from the upper catchments to separate it from storm water of the western side of the Landfill from Leachate as well.A follow up independent check on the chemical composition of the leachate to check on the monthly performance by Directorate of Government Analytical Laboratory – Ministry of Internal Affairs. However, this was not possible during last year due to budgetary constraints. The Landfill Work-force of Kampala Capital City Authority in July 2013 initiated monthly comprehensive investigations on Leachate, Catchment Surface and Ground Water. Monitoring regular Landfill Leachate Treatment Plant Performance is way forward for KCCA.

Challenges and issues

Inspite of the modest achievements of KCCA, there is need for urgentadditionalworks on the leachate treatment plant, to replace the items that are beyond maintenance after being in operation for over seven years i.e., ; (i) cclarifier walkways and (ii) cclarifiercenter support.

The corroded Clarifier support and walkways

Figure: 1 Clarifier center support photo taken on 30th Nov. 2013.

Repairs at the Clarifier should be given top priority, the deformed beams have compromised the alignment of the gear boxes and scrappers causing frequent break downs. It should be noted that the clarifier effluent is very poor whenever the clarifier is not working.

Figure: 2 Clarifier stairs and dilapidated center support 30thNov 2013

Insulating the Aerators

Finally, there is need to replace the epoxy (fiberglass) coating insulation layer on the Aerators in order to extend their life especially Aerator C "see **figure 3** below", (one near the clarifier). This coating is broken in some places for all the three Aerators causing corrosion as shown in the pictures below. Aerator C could sink if this is not done early enough because there is already corrosion on one of its floaters.

Figure: 3 Corroding floater and stairs for Aerator C

Figure:4 Aerator B with signs of corrosion

Aerator Motors

The motors require replacement for better performance. The Motors currently being utilized are re-wound now and again in order to perform to a bare minimum.

Information Board/Electronic Screen

There is need for an Information Board at Mpererwe – Kiteezi Landfill Site as discussed in several Landfill Site meetings. However, in the July and August 2012 meeting, it was reflected that Mpererwe Landfill has a lot of information. The meeting agreed that this information would be better disseminated to the public in form of videos. Members further planned for an electronic screen at probably Mpererwe Trading Centre that would regularly be uploaded with this information for the public to enjoy and react to KCCA activities at the Landfill in a bid to guide Mpererwe Landfill improvements in the near future.

Sign Board

During Mpererwe – Kiteezi Landfill meeting of 24th February 2012. Members then agreed to make three Sign Posts. Two to be placed on either side of Buwambo Road, warning Road Users of Heavy Garbage vehicles turning at the Landfill, while the third to be placed at the Junction showing Road Users where the facility is located.

Achievements

Current KCCA management provides the necessary equipment when need arises, further, logistics like fuel are provided as and when requested

The Septemberweather was extremely wet with heavy erratic rain-spells. However, these were interrupted by hot sunny days softening the working environment at the Landfill. The conditions generally were a platform to tease Landfill Work-force's ability to perform during extreme and unpredictable weather conditions and in the erratic weather conditions they managed to develop the Southern & South-Eastern tipping fronts by the end of September 2013 i.e., (i) South-Eastern tipping front had been successfully extended, (ii) Southern tipping front had been successfully extended, and (iii) soft areas within Southern tipping front relatively reinforced. The two tipping Fronts – Southern and South-Eastern were planned tipping areas for the month of October- December 2013, as Landscaping for developing further North-Eastern access road and accompanied radiations were being undertaken. The constructions refined the advance of Mpererwe Landfill and it was a respite that garbage trucks can swiftly deposit garbage at the planned tipping fronts for eventual handling by the landfill workforce.

Figure before major works

Figure: 5 Unobstructed Leachate flow as well as stormwater at the Leachate Collection Sump - September 2013

After major works

Figure:6 Animator – D-85 handling Landfill actvities swiftly. Dozing waste at the North-Eastern Tipping Fronts after dozing marrum at the South-Eastern Tipping Front September 2013

IV. Recommendations

i) KCCA acquires the daily consumables for the Leachate Treatment Plant. The daily consumable chemicals include but are not limited to: hydrochloric acid, di-ammonium phosphate, anti-foaming oil and flocculant. Once the above mentioned consumables are used daily, the Sturdy Leachate would be enfeebled. This is forecast to counterbalance the potential pollution sources in Mpererwe Landfill Catchment.

ii) Continuous recycling of Leachate at the Treatment Plant until National Standards for effluent release are attained.

iii) Enforce Cementers to open the blocked drain for natural water cleansing to take effect.

V. Conclusion

The landfill management team registered reasonable success in opening the landfill tipping fronts that had been totally closed in 2012. By end of September 2013, more than 90% of the landfill tipping fronts were accessible by garbage trucks.However the challenges remain huge for the sanitary landfill since it is shared among the five divisions of KCCA and the neighbouring districts. Since it is free landfill where trucks enter freely and off load the garbage, this has been a challenge for KCCA to manage the landfill. The land is not enough and there government needs to allocate new land for garbage disposal, become an enterprising government were garbage trucks especially private are charged to off load since they charge fees for collection of the garbage from the residents. In this way, the landfill will generate funds that later will be used in maintenance of the landfill.

There is urgent need for Kitezi landfill to start charging a reasonable fee for the trucks off loading garbage to enable it sustain its operations. The private companies are not subscribing to KCCA yet they are charging reisdents for collecting garbage only to dump it free of charge. The is need to slowly educate people to reduce on the generation of waste and one of the ways is making garbage collection for big muncipalities an expensive charge this will force people to reduce garbage.

There other way of reduction of garbage is to teach people how to eat differently i.e., Ugandan have to adopt different meals like; in Aisia, they eat the water melon cover, as greens and they prepare it with any form of sauce, wild grass is also used as greens i.e. passparam, banana peelings can be used for improving skin, **polish your shoes,** feed them to your worm farm, use them to fertilize plants, rub them over your teeth to whiten them, use them to make a face mask, chop them into small pieces and stick under rosebushes as an aphid deterrent, place banana peels over your mosquito or ant bites, small scratches or poison ivy rash they ease pain, eat them. They can be eaten raw or cooked; look for Asian or Indian recipes, use them to attract butterflies to your garden, include small pieces of banana sitting along the peel, compost them they are good for compost

material and make vinegar from the peels and all parts of the chicken can be eaten i.e., legs, intersteins and the head and bones can be used for fertilizer and the feet for broth.

Governments today are enterprising, before you spend, there is need to generate money, for the long term sustatinability of kitezi landfill, is to charge fees to enable KCCA introduce other sustatinable activities on the landfill like recyclying in the near future.

Grabge should be turned into investment, KCCA needs to invest in training people more creative ways to turn garbage into wealth. There is also a provision where KCCA can found those communities and indivisiduals with ideas that reduce waste by so doing they make garbage a shared responsibility hence reducing generation.

Generally the landfill is in a better shape than it was under the contractor this explains how policy enactment has significant impact in improving efficiency and effectiveness in service delivery. Since the onset of the KCC Act 2010 waste management has improved by 15% from 45% to 55% collection increase. This implies that government should be aggressive in enacting policies that will impact on service delivery improvement. One can argue that changing administration from local government to central government has enabled solid waste management improvement in Kampala City which witnessed a change in model of operational delivery of services hence new methods of work that supported efficiency and effectiveness improvement.

Although landfills are the most economical ways of disposing solid waste, they have their constraints which are not restricted to health hazards, lasts and fires, damaging vegetables, unfriendly smell, pollution of underground water and air.

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