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She works at SCS Engineers on their solid waste management team performing Construction Quality Assurance and reporting for field projects, as well as OM&M on landfills and assisting with landfill reporting and compliance. Outside of work, Lindsey is a self-described “bird nerd” who has two parrots: A Green Cheek Conure (7 years old) and a Yellow-Naped Amazon (34 years old). She often volunteers at Feathered Friends Sanctuary and Rescue where they provide care for around 65 surrendered parrots.

## Finding Solutions for an Open Dumpsite

SOLID WASTE IN THE GAMBIA



**W**aste/resource management industry professionals are well aware of how essential our services are. We have an enormous responsibility to manage what our society doesn't want in the most economically, socially, and environmentally optimal way possible. Important regulations, such as RCRA's Subtitle D, helped to incentivize this practice and serve to protect ground water, soil, air, and human and economic health from our solid waste. While we recognize the importance of the role we are charged with, I'm sure most of us take for granted or don't reflect on just how privileged we are for having these regulations and resulting infrastructure, such as sanitary landfills, in place. We simply cannot fathom a functioning society without them.

Unfortunately, the reality is that there are places in the world that are not so privileged, which use open dumpsites as a means to manage waste. Madison Wisconsin's sister city, Kanifing in The Gambia is one such community. The Gambia, which is a tiny sliver of a country in West Africa, has a population just under 2.5 million. About a fourth of the country's population is under the jurisdiction of the Kanifing Municipal Council (KMC), and is the most densely populated area of The Gambia. Over 60% of The Gambia's population lives in urban areas and this trend is only increasing. This statistic is significant because urban populations create significantly more waste per person compared with rural areas, and there's a strong correlation between urban waste generation rates and greenhouse gas emissions. According to ISWA's report on “A Roadmap for Closing the World's Dumpsites,” by 2025 it is expected that open dumpsites around the world, such as the Bakoteh dumpsite in Kanifing, will attribute to an estimated 8-10% of global greenhouse gas emissions.

In addition to being a major contributor to global climate change, there are acute health and socioeconomic concerns with open dumpsites. Uncovered waste is a breeding ground for mosquitos and other hazardous vectors. Degradation of groundwater, surface water, soil, and air quality are obvious effects which have a profound negative impact on environmental and human health, and significantly hinder economic development. Unbuffered residential dwellings surround the 45-acre Bakoteh dumpsite in Kanifing, with an orphanage and health clinic located immediately across the street from waste limits. Livestock can be observed grazing the refuse, and over 300 scavengers have forged a living from picking valuables from the waste. In fact, there is one Kanifing resident who has called the dumpsite his home for the last 25 years!



Just follow the KMC Facebook page and you will see how much emphasis they place on managing solid waste in their community. Much like the political and social unrest that led to environmental regulations in the U.S. (think 1970's—Love Canal and the Cayuga River fires), the Kanifing municipality is experiencing some of their own, which has led to solid waste being a priority for the current Kanifing leadership. While the previous mayor took some actions to address the Bakoteh dumpsite and other challenges, his actions were not enough. In return, frustrated citizens made a point by dumping waste, which would have otherwise been hauled to the dumpsite via donkey carts or motor bike, all over his front lawn. This sent a strong message to the KMC that the citizens want change to how their waste is managed.

The people and leadership of the Kanifing municipality are united in their desire to have positive changes in solid waste management in the community and at the Bakoteh dumpsite. The community agrees that urgent action is necessary to prevent further environmental damage and to start taking steps in the right direction for positive development of the KMC.

In this spirit, the new Mayor of Kanifing, Talib Ahmed Bensouda, visited his community's Sister City of Madison, WI in September 2018 to gather ideas and resources for improving the KMC.



*Livestock can be observed grazing the refuse*

He was welcomed by members of the Midwest Gooh Group, a local business formed by Madison area Gambians who work to consult on various African development initiatives. Key partners of Gooh Group, Samba Baldeh, Jerreh Kujabi, and Kaba Bah had connections with Madison area resources and acted to bring them together to improve solid waste management in The Gambia.

Samba serves on Madison's municipal council, which helped to establish the Sister City connection between Madison and Kanifing. During the mayor's visit, he also met with John Welch, Director of Dane County's Department of Waste and Renewables, to see a sanitary landfill for the first time, and other comprehensive resource management infrastructure, such as the C&D Material Recovery Facility and the construction of the RNG Biogas Plant.

In December 2018, Samba and Kaba visited The Gambia to learn more about the development initiatives in the KMC. As a result of their visit, the Gooh Group submitted a grant to the United Nations Development Program (UNDP) to help evaluate the solid waste issues plaguing the KMC, specifically the Bakoteh dumpsite, and were awarded \$25,000.

In May 2019, Chris Jimieson of SCS Engineers was pulled in to be the Madison area solid waste expert for the project. His education and background as a geological engineer for solid waste projects, along with his experience in African communities facilitating environmental and education projects made him an ideal fit for the team. With a short turn around date to complete the requirements of the grant, the team worked fast to pull together the necessary arrangements and equipment to conduct a beneficial evaluation of the current conditions and potential solutions. An important preface to tangible action is thorough investigation of the issue at hand and the team set out to do just that.

Quickly, travel day arrived and in early June 2019 Chris and Kaba traveled to The Gambia to investigate the waste problem. Their approach during their visit was to:

- Meet with as many local stakeholders as possible to take in their perspective on the Bakoteh Dumpsite/desired solutions
- Evaluate the Bakoteh dumpsite
- Evaluate options for closing/remediating the Bakoteh dumpsite
- Evaluate a potential new sanitary landfill location

As with any conflict, a crucial step in addressing it is to gather input from the stakeholders. The Madison team consulted leaders of districts in wards closest to the Bakoteh dumpsite to better understand the depth of the problem and hear their aspirations for potential end use of the 45-acre parcel. Because over 300 individuals make a living off of scavenging the waste at the Bakoteh dumpsite, the problems related to solid waste management would not be solved simply by closing the dump after constructing a new sanitary landfill.



*Momodu has spent the last 25 years of his life living in the Bakoteh dumpsite*

One of the biggest issues facing Gambians is not having enough jobs to support the people and their economy. Of course, any effort to make positive change for solid waste management in The Gambia would be for naught if the community is unable to take ownership of the new changes and integrate them into their way of life. Ideally, solving the problem will implement a means of positive change for many aspects of the KMC citizens' lives.

During Chris and Kaba's June 2019 visit, they also evaluated the dumpsite's conditions by observing current operations, evaluating characteristics of the waste, and collecting environmental data in the form of groundwater and air quality samples. The site had heavy operating equipment in the form of bulldozers from a prior incentive. However, all but one of the five pieces of equipment designated to move/handle waste were broken down due to a lack of capacity in The Gambia with both parts to fix the equipment and mechanics with experience fixing this type of equipment. Also, the equipment onsite has no compaction capabilities. This observation of capacity building is an important one to consider in thinking through potential solutions.



*A semblance of a MRF; hand sorted scavenged waste featuring a piles of shoes, plastic and glass bottles*

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The 45-acre area is partially fenced and has a landfill supervisor and security team. Although a formal waste characterization was not part of the scope during the one-week site visit, reference to previous studies and some visual observation estimates that approximately 50% of the waste is silt/sand from household and municipal cleaning. Mango peels were also prominent during their visit, and typical municipal solid waste articles could be observed in the waste (i.e., plastics, cardboard, textiles, etc.). More waste characterization study will be needed to evaluate the energy potential of the waste as the KMC works to close the Bakoteh dumpsite.

Kaba and Chris conducted groundwater and air quality evaluations during their visit, which included collecting depth to water table measurements, conducting Dräger Tube testing for vinyl chloride, and collected both groundwater and air samples. The groundwater and air samples were returned to the U.S. for analysis. Both air and water samples showed some low-level detections for toluene. These results should be taken at face value as travel delays hindered ideal sample temperature preservation. An additional round of groundwater samples with additional coordination to ensure temperature and chemical preservation is recommended for further evaluation.

Regarding air quality, the June visit occurred at the end of dry season, which correlated to a time when landfill odors were minimal. Also, with the high frequency of landfill fires due to both a lack of daily cover and human actions that cause fires, it is believed that the air quality at the time of sampling represented a good air quality period. An additional round of air samples representing the air quality during the rainy season would be helpful data to better understand the magnitude of the air quality issue associated with the Bakoteh dumpsite.

One of the other goals during the June 2019 trip was to evaluate options for closing/remediating the Bakoteh dumpsite. A common practice for closing dumpsites is to address slope stability issues and then cap with a clay cover. Fortunately the Bakoteh dumpsite, which

had served as a sand/gravel quarry 40 years earlier, was fairly flat. With the introduction of a new solid waste collection vehicle fleet in KMC in the summer of 2019, the KMC is cleaner than ever. At the same time, this waste continues to be delivered to the Bakoteh dumpsite. Without constructing a sanitary landfill, slope stability will become more of an issue at the dumpsite.



*Chris Jimieson and Bubacarr (a local) collect water samples for lab analysis*

In the interest of employing the KMC residents and extend the available capacity of a future sanitary landfill by diverting waste, the Bakoteh dumpsite would ideally be the location for a new Materials Recovery Facility and Waste Transfer Station to maintain the central hub for waste collection and materials recovery within Kanifing. Conversations with those who scavenge the waste showed that those individuals liked the idea of doing their materials recovery in a controlled working environment with appropriate Personal Protective Equipment (PPE).

One of the Madison team's other objectives of the June 2019 visit was to evaluate a location for a new sanitary landfill. The KMC proposed a site about 13 miles south of the dumpsite. The Madison team determined that the proposed site was only about 14 acres in size, so they recommended purchasing surrounding parcels for possible expansion and buffering from neighbors.

They observed onsite soil to be low plasticity clay based on some hand roll plasticity testing, which would work for a clay compacted liner. However, they recommend soil borings to further evaluate the suitability of this location for a sanitary landfill.



If the size of this parcel cannot be expanded, the limited area available would hinder development of this location as a long term solid waste facility, thus an unlikely investment by the KMC or outside supporters.

With the KMC desperate to show progress to their citizens, word got around quickly that this location would be a potential area for future waste disposal. This information led to illegal dumping. The illegal dumping demonstrates the need for capacity building. Many residents in the vicinity of the proposed area are served by a different municipality that is doing far less outreach than the KMC, thus residents on the outskirts of urban development have few options for waste disposal, including burning it on individual properties, paying private haulers to haul it to the Bakoteh dumpsite, or finding somewhere to dump it nearby. The Madison team recommended positive messaging for the new location so it does not meet the same fate as its unengineered counterpart.

Despite some challenges with messaging, already the community and its supporting groups are coming together to make positive change. A few things that have already happened are:

- The City of Madison has donated over 1,000 waste collection carts for eased collection
- A Chinese entity made a loan agreement with the KMC and the local business investors to provide 20 collection trucks for the KMC's use, along with operational/maintenance training and support
- The KMC has taken steps to empower the youth to come forward with ideas to shape a cleaner, more environmentally friendly Kanifing; One youth group is repurposing old tires to serve as waste receptacles in public spaces around Kanifing. Other groups have planted trees on the perimeter of the dumpsite to help in enhancing the buffer

The desire of the KMC leadership and the passion of the community to come

together to remedy this issue is inspiring.

As a follow-up to the June 2019 field study, Kaba and UW-Madison College of Engineering Professor, James Tinjum, conducted a second trip in September 2019 to deliver a feasibility report to the KMC. After participating in the trip, Professor Tinjum weaved the experience into this fall coursework with his graduate level Remediation Geotechnics class, which further developed ideas that work toward potential solutions to closing the Bakoteh dumpsite in an environmentally responsible manner.

An important next step for the Madison team is to support the KMC's efforts to obtain funding. Upon obtaining that support, the KMC has primary goals to collect more feasibility data to start design for Bakoteh dumpsite closure and sanitary landfill construction. COVID-19 has delayed the timeline of these plans. In the meantime, the Gooh Group and other Madison area team members have increased frequency of phone conversations to advance the timeline on remedying solid waste matters in the KMC.

Ultimate hopes for the Gooh Group and Madison team are to return to The Gambia to conduct further feasibility study. This would include further evaluation of waste characterization/ waste depth, set up a landfill gas pilot, gather more information on the utility grid, collect more groundwater quality samples, and conduct an aerial survey with drone to collect waste topography and emissions data. To support the development of the sanitary landfill, goals would be to conduct another investigation for a larger site for the next sanitary landfill, and if viable in terms of space, complete geotechnical borings to evaluate on-site materials and subsurface characteristics.

Although the technical aspects of this solid waste problem are substantial, the biggest challenge moving forward is funding and empowering the community to sustain sound solid waste practices. Volunteers and partners with diverse skill sets and resources are needed to empower the KMC community to reach

their development goals. The problem is vast, but successfully addressing it will immediately improve the lives of hundreds of thousands of people, and in the long term undoubtedly millions. Granted, this community is nearly 5,000 miles from our own and can seem far removed. However, as a greater solid waste community and human society we need to combine resources to address our global solid waste problem.

Your expertise may lie in increasing recycling markets, diversion, geotechnical engineering, education, solid waste infrastructure planning, operations, project management, administration, or simply passion to make change- but regardless I implore you to encourage change from business-as-usual to something greater. Our society is capable of so much more and it is our responsibility, individually and collectively, to be the change we want to see in the world, to reduce suffering of our fellow humans, and to reduce the impact we have on the environment. Stay bothered about the issues that speak to you, whatever those may be. If each of us picked one cause dear to us and acted to make positive change to fix that issue, our world would be a much better place.

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If this is an issue that speaks to you, please reach out to Lindsey Carlson to get connected with the Madison team.

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