

# **WASTE MANAGEMENT IN THE NAIVASHA BASIN**

## **A Report for the Arkleton trust**



**April 2016**

## EXECUTIVE SUMMARY

The Kwa Muhia Environmental Group (KMEG) has been working to improve solid waste management in the village of Kwa Muhia for four years. The Group has experienced some success in cleaning up the environment.

At the end of February 2016, the Arkleton Trust provided funding for a technical adviser from Waste Aid UK (a UK-based NGO working on waste management) to work with the community group in order to facilitate a two-year waste management strategy.

The new strategy focuses on creating a financially sustainable system by reducing the amount of waste that needs to be taken to the rubbish tip (at a cost) and increasing income for the group. Specifically:

- High density plastic and cardboard can be collected sold to dealers for recycling in Nairobi;
- Charcoal dust and biodegradables can be turned into charcoal briquettes and sold;
- The group may be able to offer its services to clean up or collect waste from nearby hotels and farms.

This approach will supplement existing income streams. These include:

- Income collected from plot owners (of which there are 60 in Kwa Muhia);
- Selling compost and liquid fertilizer (leachate) produced from the biodegrading of waste in the village's nine refuse bins.

The new plan requires

- A plot of land where waste can be processed and stored safely, and where products can be showcased and sold;
- Consolidation and strengthening of the organizational capacity of the group and employment of a project manager to support the network of committed volunteers already working to improve solid waste management in Kwa-Muhia;
- Improvements to the current waste management service the group provides initially by repairing the existing bins, adding dividers to further segregate the waste and removing the accumulated waste not collected by a truck.

## **WASTE MANAGEMENT – A GLOBAL DEVELOPMENT PRIORITY**

A lack of adequate waste management infrastructure is a global issue affecting three billion people. 40% of the world's waste is not collected or treated, but is instead discarded in open dumps or burned. This is a direct cause of serious health issues - including gastrointestinal and respiratory infections (especially in children) – and also encourages vermin and the spread of viral disease. A lack of waste management has harmful environmental consequences; blocked drainage contributes to flooding and the release of poisonous chemicals during processes of decomposition and burning causes air pollution, groundwater pollution and ocean contamination. This is one of the great public health issues of our time.

And the issue is getting worse. The populations of developing countries are growing. More waste is being produced than ever before.

Like many detrimental global trends, the effects are felt worse in developing countries. Municipal infrastructure has not caught up with rapid urbanization, population growth and the expansion of the global middle class. Lower income cities in Africa and Asia are set to double their municipal solid waste generation within 15-20 years. And, as only 0.3% of international development aid is spent on waste management, the issue risks being overlooked by the global sustainable development agenda.

Solid waste management is an essential service; the costs of inaction outweigh the per capita costs of mitigation by 5-10 fold. But affordability is a major challenge in poorer countries. A truly sustainable waste management system – where the life cycle of every product is designed to reduce its end of use impact – is, at present, a pipe dream. Emphasis must be placed upon reducing uncontrolled dumping and burning, by using less and re-using more.

### **Waste Management in Lake Naivasha**

Communities surrounding Lake Naivasha, (80Km North of Nairobi, Kenya), are experiencing the full range of issues associated with a lack of sustainable waste management systems. Lake Naivasha is nominally a Ramsar Site (a wetland of international importance) and previously attracted scores of tourists travelling through the Rift Valley. In recent decades, the region has become one of Kenya's most prosperous economic powerhouses. During the 1970s, the agricultural industry began to develop large swathes of the Naivasha basin for the production of cut flowers and vegetables, incentivized by the plentiful supply of fresh water and a temperate climate. Development has not stopped since; in 2011, the vegetables grown in Lake Naivasha contributed \$95 million to the Kenyan economy. 95% of Kenya's

exports of cut flowers are produced in the region (WWF, 2011).



Figure 1: Location of Lake Naivasha, Kenya

Such rapid economic growth creates the pre-requisite conditions for mass inward-migration. Between 1979 and 2011, the population of the basin grew 173%, from 237,902 to around 650,000 (WWF, 2011). Developments, both formal and informal, have sprung up around the flower farms and continue to grow in size year-on-year.

One of those places to have experienced significant population increase is Kwa Muhia, the smallest informal settlement (2,100 households in size) on the southern shore of the lake. The village was built without infrastructure (drainage or sewage systems) and practically no utilities; living conditions are not dissimilar to those of Kibera, the well-known slum on the outskirts of Nairobi. Like many of the communities surrounding the basin, the rapid population increase has not been matched by developments in municipal waste collection services and, despite the fact that families and landlords pay their taxes, management systems have proved inadequate. As a result, waste of all kinds is thrown out into the streets and onto roads, is buried or burnt.

Besides the health implications for the local population and livestock, waste is washed into the lake during the rainy season causing damaging pollution. In previous years, the condition of the Lake has deteriorated to such an extent that its Ramsar status is in danger of being revoked.



Figure 2: Waste on the ground in Kwa Muhia (2016)

A group of residents wanted to help find a solution to the problems in the village and so, in 2011, formed the Kwa Muhia Environmental Group (KMEG). The Group is comprised of both male and female community members with an interest in reforming poor waste management practices. Importantly, all of the committee members are plot-owners (representing roughly 1% of the Kwa Muhia community), which has implications as discussed later. Nevertheless, KMEG is a well-structured organisation, headed by Duncan Oloo (Chairman) with an elected Secretary, Treasurer and Member for Gender Diversity. Their ethos: to encourage social inclusion and a more sustainable lifestyle. Their aim: to become a model “green village” and to set an example for other communities – across the developing world – to follow.

The Arkleton Trust have provided funding to support the Group's activities since September 2015. This arrived in two phases; an initial grant to fund a waste management survey and a second, larger contribution to pay for a waste management expert (Founder of WasteAid UK Mike Webster) to visit the Group and help strategize the up-scaling of a sustainable waste management system. This written case study details the impacts that these contributions have had to the situation on the ground in Kwa Muhia, and the lessons that have been learnt from the process over the last five years.

## KMEG'S INITIAL WASTE MANAGEMENT SYSTEM

In an effort to end the unrestricted dumping of waste, the Group developed a management system to collect and clear refuse from the village. In 2012, the Group applied for a capital grant from local funding organization Imarisha Naivasha, to construct nine concrete waste bins at strategic intersections throughout the village. These were designed as a place for residents to deposit their biodegradable and non-biodegradable waste, which would be separated by four full-time laborers (employed by KMEG). The biodegradable waste would be turned into compost and leachate, which would be sold by the Group in order to fund the system. The non-biodegradable waste would be transported to a landfill site 30Km away, at a cost to KMEG.



**Figure 3: Initial community waste clearing efforts (2011)**

After local authorities had undertaken an Environmental Impact Assessment, the bins were built and KMEG's initial system was implemented. This system remains in its original form at the time of writing (April 2016). The Group pays the running costs (which include the wages for laborers and the waste collection service), which are raised from plot owners (landlords) in the village, numbering 66 in total. Trial plots have proved that the compost and leachate developed in the bins does improve the growth of vegetables, but more testing is required in order to confirm that the product is safe for commercial use.

### The First Involvement of the Arkleton Trust

The initial scheme showed relative promise. Although a number of issues undermine the sustainability of the system (see later section) the improved environmental conditions attracted the attention of other local villages and Kenya's Principal Secretary, who asked KMEG to extend their work into the

neighboring village of Kamere (population size 28,800 - 9,600 households). In order to inform the up-scaling of KMEG's scheme to fit the scope of a much larger settlement, it was decided that a waste survey should be undertaken in Kamere. This would help detail the quantity and different types of waste that the settlement produces; vital information in order to design an appropriate waste management strategy on a much larger scale. The Arkleton Trust helped to fund the study through a £200 grant. The study took place over the course of five days in September 2015, by volunteers from KMEG. The salient findings are outlined below:

- The community in Kamere produced 10 tonnes of waste per day;
- 67% of this is biodegradable;
- 27% is non-biodegradable
- 6% is hazardous
- All the waste generated ends up in common dumping areas within the settlement.



Figure 4: KMEG members before the waste survey in Kamere (2015)

The data obtained from the survey provided vital information in the later development of Kwa Muhia's waste strategy.

Over the ensuing months, a significant unforeseen eventuality forced the project in Kamere off course. The World Bank (as part of the Kenya Informal Settlements Initiative Programme) proposed a grant to build a bio-digester in Kamere to fuel a community kitchen, offering the dual purpose of reducing the waste sent to landfill and creating on-site energy. The intrinsic sustainability credentials of such an arrangement are highly questionable. Not only were KMEG concerned that the community prefer to cook in their own homes, but the core tenants that KMEG's original system was built on – community

sensitization, appropriate technologies and self-financing – were all missing from the industrial, high-capital, high-maintenance infrastructure project the World Bank had proposed. Consequently, KMEG made the decision to maintain focus on improving the system in Kwa Muhia until a decision on the World Bank bio-digester had been made.

## KWA MUHIA IN 2016 – WASTE MANAGEMET ISSUES

Five years after the formation of KMEG and the environment in Kwa Muhia has improved significantly. Most obviously, thanks to the construction of the refuse bins, waste pollution along the roads and streets has dramatically reduced. However, the approach the Group has taken has not kept pace with the amount of waste that the growing population of the village is producing. As the pictures from the a visit to Kwa Muhia in February 2016 show, waste is still piled high around the refuse areas and is collected infrequently. The significant threat to the health of residents, livestock and the environment largely remains.



**Figure 5: Waste expert Mike Webster on a tour of Kwa Muhia**

With essential waste production and management data to hand (although the waste survey took place in Kamere, the results offer a realistic insight into the relative quantities / types of waste produced in Kwa Muhia) KMEG were in a strong position to re-strategize their approach at the start of 2016. After much deliberation it was decided that the Group was at an inflection point. Specialist guidance was needed to inform the design of a sustainable waste management system; a system which can take account of the potential to turn much of the waste (60% biodegradable) into a resource and reduce the quantity to be sent to landfill, thus saving KMEG considerable costs.

### The Second Involvement of the Arkleton Trust

It was in this capacity that the Arkleton Trust provided funding for waste-management expert Mike Webster (founder of NGO WasteAid UK) to visit Kwa Muhia for eight days in February 2016. Mike was identified after an extensive search of industry specialists on LinkedIn. His considerable experience in facilitating community-based waste management programs across the world, most recently in The

Gambia, and the combination of his participatory approach to decision-making and thorough knowledge of sustainable waste management in the context of developing countries set him apart as someone who could help tease out a community-led, financially sustainable system.

Whilst the primary rationale for the visit was to help design a more sustainable system with the community, we also learned a great deal about why the initial system, established in 2012, had not developed as planned. Given the desire for their project to serve as an example to other communities throughout Kenya, the lessons which can be drawn from KMEG's experience are likely to be useful to a wide audience. A mixture of financial, social and administrative factors prevent the up-scaling of the scheme in line with demand. Each of these three issues is explored in greater detail below.

### **Sustainable income – the challenge**

A lack of reliable income has been KMEG's most fundamental challenge. Without the steady inflow of cash from plot owners and sales of leachate, the service provisions upon which the whole system relies have become undermined.

The most significant barrier has been the difficulty in obtaining a consistent source of income from plot owners. Despite the money required from each plot owner being relatively small (about 500 shillings per month) roughly half offer contributions on a monthly basis. Money often arrives in an ad-hoc manner – as and when suits the landlords– making financial forecasting and activity planning incredibly challenging. The KMEG committee, especially the treasurer, endure a monthly struggle to acquire funds, and often resort to knocking door-to-door, risking destabilizing the relationship between the committee and the remaining plot owners in the process. To make matters worse, the government recently outsourced waste collection to a third-party contractor who increased collection rates by three-fold. KMEG were able to negotiate prices down to a manageable cost, but at the expense of settling for an “off-peak” collection service, fueling irregularity of collection.

Having spoken directly with plot owners and members of the KMEG committee, it appears that their reluctance to offer financial contributions stems from the lack of any jurisdiction that the Group has to enforce collection. KMEG are effectively placing an additional tax requirement upon plot owners, who already pay taxes to the government based on their incomes. Waste collection is a municipal service within Kenya and, as such, the plot owners feel as if they are being charged twice for a service that is not

necessarily reliable. If as many as half the plot owners are not contributing on a frequent basis, the peer-pressure to contribute to the community's waste issue is negligible.

In addition, the structure of the KMEG committee may also be hindering the project financially. As all of the committee members are landlords themselves (besides the Chairman), the potential for a conflict of interests arising is clear; the plot owners within the committee (whilst supporting the Group's activities) will inevitably be placing a charge on themselves. The greater issue surrounds how the lack of wider community representation might restrict the Group's mandate within the community and the appropriateness of strategies developed.

In addition, the project to produce and sell leachate to local growers has proved impractical. At the heart of the issue is the lack of any reasonable space to produce and store the bottled leachate. The initiative, whilst successful in producing a useful end product, has not been profit-focused. KMEG have lacked the up-front capital to scale-up the physical production process and the ability to market the product widely enough to generate interest. A meager stock of leachate sits idle in the KMEG office; a testament to the Group's resourcefulness and willingness to adopt innovative, ambitious projects, but a tangible reminder of the financial, administrative and resource-related hurdles that the Group face.

As one of the only appropriately structured community organizations in Kwa Muhia, KMEG were also approached to run the village's water shops. These facilities, set up as a joint venture between the World Bank and Water Aid, were built to service the village with a reliable source of clean water, pumped from over 20KMs away. In exchange for administering the system, some proceeds would be distributed to KMEG as an additional source of income. The shops, however, have suffered from technical malfunction from the very start, severely limiting their operational use.

### **Community Engagement**

Community sensitization has been a critical aspect of KMEG's efforts over the past five years. It is important for the community members to appreciate that everyone has a part to play in establishing a functioning waste management system in the village; from disposing of waste according to the rules of the system to making small financial contributions on a regular basis (plot owners only). Without widespread buy-in from local residents, the development of normative waste disposal behaviors will be suppressed and the scheme will fail to become self-governing.

Through walking around the village and talking to local residents, it is clear that the efforts have KMEG are highly valued. Residents understand the importance of waste management, both from a personal health perspective and from an animal welfare perspective. Whilst the streets of Kwa Muhia are far from litter-free, they are markedly cleaner than neighboring settlements including Kamere. The local community are rightly proud of their village and officials from surrounding settlements are keen to emulate what KMEG have started.

Despite this, the complexity surrounding the waste management process as it currently stands forces significant pressure on relationships between KMEG and the community. Issues will come to a head when the waste truck fails to appear for the weekly refuse collection. This might be due to a variety of reasons. For example, as a result of the “off-peak” arrangement that KMEG were forced into accepting, the waste truck might be simply oversubscribed. Alternatively, corruption and tribal strife were cited as a cause for inconsistency. It is not unusual for a collection to be missed for as many as three weeks in a row, causing the refuse bins to pile high with rubbish.

At this point, community members frequently become frustrated and their anger is directed at KMEG itself. Despite the apparent investments that have been made, old issues reappear. During our own visit only one collection had been missed, yet livestock could be found grazing on overflowing rubbish which had begun to spill back into the streets. Despite the best efforts of the one remaining waste martial, the issue presented an uncontrollable situation.

In many ways, KMEG are a victim of their own success. The organisation is run efficiently, operates out of a modest (yet desirable) office and has implemented highly-visible infrastructural upgrades requiring access to significant financial resources. From speaking to committee members, it appears that some within the community assume that KMEG is a rich organisation, with the necessary funds available to deliver a reliable service. There is a lack of wider understating of the complexities behind the system. On occasion, accusations of corruption have landed at KMEG’s door.

Fortunately, an overwhelming majority of the community are highly appreciative of the work KMEG have carried out. With a view to strengthening community support for waste management, Mike Webster emphasized the importance of reinforcing the public health message of proper waste management and the benefits it will bring to the health of livestock. Continuing to make transparent, fact-based decisions informed by studies such as the waste management survey was also deemed important. Making KMEG’s accounts public is something that the Group already do (anyone can walk

view a summary on the noticeboard within the Group's office) – but these must be kept up-to-date and accessible to all.

## **Administration**

KMEG is further restricting in maintaining and expanding the waste system by the lack of administrative resources. Committee members lack the appropriate skills to carry out more technical tasks necessary to the proper functioning of a committee. For example, the Group's secretary has expressed a difficulty in taking meeting minutes and no member feels confident enough to take on the chairmanship of the Group. As a result, the Chairman has almost single-handedly maintained the necessary momentum of action for the previous five years.

For a village with a population of around 8,000, this is no easy task. Duncan has become the "go-to" person for all queries relating to waste management, and not just in Kwa Muhia. As the neighboring village of Kamere (population estimated at 30,000) begins to embark on their own (albeit connected) waste system, the expertise and experience Duncan possesses are increasingly called into command. Duncan time is offered on a voluntary basis and, when not working on with KMEG, has his own electrical engineering business to run from which he makes his livelihood. With two sons, both about to embark on secondary education (schooling past 11 is not free in Kenya), the Group is seriously in need of administrative support in order to implement the two-year waste management strategy and shift the project onto a new phase of growth.

The most significant issue that the committee faces lies in its composition. Simply put, it is not representative of the socio-economic demographic within Kwa-Muhia; all of the committee members are plot owners (who make up roughly 1% of the population) and come from the more affluent section of the community. Without representation from the rest of the community, the decisions that are made risk becoming viewed as irrelevant by a majority of Kwa Muhia's population. (Frazer, 2006).

## **TWO-YEAR WASTE STRATEGY**

The week's activities – holding meetings with community groups and stakeholders, visiting local waste management facilities and spending time absorbing the situation in Kwa Muhia – were wound up with a day brainstorming, to develop a two-year sustainable waste management strategy. The strategy was based on the reflections of key members of KMEG, under the structured guidance of Mike Webster. The strategy sets out a clear pathway effectively up-scale Kwa Muhia's current waste management system, taking into account the financial and administrative difficulties outlined above, as well as other practicalities such as the need for more space to store plastic waste.



**Figure 6: Strategy building with KMEG members**

The sustainability of Kwa Muhia's system was defined by a number of foundational principles. First and foremost the system must be financially sustainable – capable of being self-supporting or even income generating in the medium to long term. It must be community led, underpinned by technologies that are appropriate to the skills and resources accessible to community members. Moreover, whilst it is the intention of the Group that any scheme might act as a model for rural communities suffering similar circumstances, any solution must be geared towards the specific needs of those who reside in Kwa Muhia.

From the strategy building session, three pillars emerged: the need to make the scheme financially sustainable, the need for increased administrative support, and the need to find more space to carry out waste management activities. An overview of these facets is provided in figure one with an explanation of each provided below.

Table 2: An overview of KMEG's two-year strategy			
Goals	Financial Sustainability	Administration	Space
<b>Short-term (6 months)</b>	<ul style="list-style-type: none"> <li>• Capital grant to cover up-front costs, including:               <ul style="list-style-type: none"> <li>o Mending waste bins</li> <li>o Waste truck collection fees for six months</li> <li>o Waste worker wages for six months</li> <li>o Materials for the development of waste reprocessing</li> </ul> </li> <li>• Market research to pitch the price of plastic flooring / charcoal briquettes appropriately</li> </ul> Begin collecting and stock-piling plastic bottles	<ul style="list-style-type: none"> <li>• Outline job description and employee benefit package for administrative assistant role</li> <li>• Begin the search for an administration assistant</li> </ul>	<ul style="list-style-type: none"> <li>• Begin engaging local landowners to investigate the possibility of obtaining space for waste reprocessing activities (collection and storage of plastic LDPE, creation of plastic flooring)</li> </ul>
<b>Medium Term (6-12 months)</b>	<ul style="list-style-type: none"> <li>• Creation of mandate from local government, authorizing KMEG to collect dues from plot owners.</li> <li>• Obtain monthly contributions from plot owners</li> </ul>	<ul style="list-style-type: none"> <li>• Employ assistant to take over the day-to-day management of KMEG's waste strategy</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate financial feasibility of moving to a larger office</li> </ul>
YEAR REVIEW			
<b>Long Term (12-24 months)</b>	<ul style="list-style-type: none"> <li>• Sell plastic flooring and charcoal briquettes to supplement income</li> <li>• Provide clean-up function for local hotels</li> </ul>	<ul style="list-style-type: none"> <li>• Develop skills of committee through training programmes</li> </ul>	<ul style="list-style-type: none"> <li>• Move into new space</li> </ul>

### Generating a Sustainable Income Stream

The lack of reliable income has undermined the waste management system and prohibits the scaling-up of the scheme to manage waste in a more sustainable manner. Whilst the Group can generally secure the funds to pay for the weekly refuse-collection, creating a financially self-sustaining model is the key to a successful system in the long-term.

Financial sustainability can be achieved reducing the Group's primary overhead – the waste collection service – whilst generating an income from reprocessing some of the more valuable waste that is commonly thrown away into landfill and persuading plot owners to contribute to the maintenance of the scheme.

In the short term (six – nine months), KMEG require up-front capital funding in order to kick-start the implementation of the up-scaled scheme. Money is needed to repair refuse bins (which have been damaged by collection trucks) secure the weekly collection of waste and employ an administration assistant. KMEG and the support staff in the UK are currently investigating where sources for additional funding might come from. Potential partnerships with local organisations were discussed during the stakeholder meeting, although these centered on offers of “soft assistance” (i.e. tools and transportation).

Over the longer term, the two-year strategy places the largest emphasis on the collection of contributions from plot owners on a monthly basis. The group estimates that, in order to fund weekly waste collections and two full-time sorters, each of the 64 plot owners will need to contribute 867 shillings per month (as a comparison, the average rent for a plot in Kwa Muhia is 3,000 shillings per month). The last four years have shown the simply relying on the “goodwill” of plot owners will not secure a consistent collection. Interviews with members of KEMG’s committee revealed that waste management is simply not a top priority for all the plot owners; competing concerns include noise pollution from church services and a lack of toilet facilities. A more institutional issue stems from the lack of diversity in the KMEG committee. It is likely plot owners who are not on the committee feel disengaged with the scheme, a difficulty which is exasperated during periods when the waste collection service truck does not appear. KMEG might benefit from recruiting regular (non plot-owning) community members onto the committee, in order to solicit more popular appeal for the scheme. In this way, more of the plot owners may feel accountable for providing regular contributions.

Between the beginning of March and the end of April 2016, five waste collections had been made, costing 6,5000 KSH per visit (5,000 for the truck, 1,500 for labor). The Chairman of KMEG reported the development of a more positive relationship with the truck operators during this period, although a small hike in prices made finding the appropriate funds very difficult.

Through a discussion with the key members of the KEMG committee, guided by the specific knowledge of waste-expert Mike Webster, three key reprocessing strategies were identified: the creation of charcoal briquettes from organic materials, the creation of plastic paving from Low Density Polyethylene (LDPE) plastic bags and the collection and sorting of plastic bottles. Each of the options require low-capital expenditure, do not need specific or highly-trained laborers and make use of abundant materials. The waste survey, although undertaken in Kamere, provided an invaluable insight into the type and relative quantities of waste produced by the community on a daily basis. After an additional inspection

of the waste lying around the village, it became clear that opportunities for re-processing waste were abundant. The options were pitched before a full meeting of the KMEG committee and agreed upon. A third option – that of creating bags and jewelry out of LDPE to sell to tourists – was abandoned. Despite the fact that this would help encourage the involvement of more women, it was decided that the village would not produce enough of similar LDPE waste to make the exercise economically worthwhile.

A rough guide to the financial viability of the scheme (appendix one) makes good reading. In the short / medium term, the collection and sorting of plastic bottles presents the best return and requires the least up-front capital. It was suggested that KMEG could team up with the Elsemere Educational Trust (located 2Km away) to share the cost of renting a truck to transport plastic bottles to Nairobi for sale. This partnership is currently under investigation.

The potential to re-process waste into a commodity that can finance a sustainable strategy is very promising; the calculated income per day from plastic bottle re-processing alone is predicted to be within the region of 4,625Ksh. Of course, there are limitations to these calculations. For example the waste collection figures, whilst derived from the September 2015 survey in Kamere, only represent a snapshot in time of that week; there is no guarantee that the same volume and composition of waste will be produced all year round. In addition, the calculations make little room for the development of unforeseen eventualities (e.g. fluctuations in the market price of plastic or a sudden drop in supply). Whilst more market research needs to be done to crystalize the business case, the opportunity appears financially viable. This income stream will incentivize waste separation at source and therefore reduce the gross amount and associated cost of sending waste to landfill. The net impact, of course, will be to reduce the amount of waste which finds its way onto the streets of Kwa Muhia, causing damage to the environment, to livestock and to human health. It is thought that in the long term, this model could be used to found a training center for other village community groups, with the potential to bring in significant revenue.

The practicalities of creating briquettes and plastic paving present some challenges. Whilst the technologies required a very basic (see figure three for the plastic tile “recipe”) KMEG do not currently have access to the space needed to create and store equipment and end products. The burning of LDPE and biodegradables, whilst non-toxic, does create noxious fumes which need to be kept away from places of residence. Small up-front capital costs are needed to purchase oil drums and tools and some training will need to be given to waste laborers (once a pilot scheme has successfully established a

consistent method). These issues are dealt with in the two-year strategy within which the reprocessing of waste into consumables is an integral part.

In the long term, it was decided that KMEG should investigate the possibility of offering a waste clearing service to local hotels. This could provide an additional income stream and more materials to be directed towards the Group's reprocessing activities.

### **Administrative support**

To relieve the burden on Group Chairman, Duncan Oloo, and to allow the KMEG to become a more efficient operating body as the waste management system is up-scaled, additional administrative support is a key facet of the new strategy.

In the short-term, it was agreed that KMEG should look to employ a full-time administration assistant to look after the day-to-day running of the project. Their overall objective would be to oversee the effective implementation of the waste strategy. Day-to-day activities would include engaging with the community to deal with stakeholder concerns and viewpoints, to identify and manage new sources of funding, to build relationships with waste stakeholder groups, to ensure the Group meet legislative requirements (especially important during up-scaling) and to manage the weekly collection of refuse bins. The assistant would have a leading role in moving the strategy forward, taking responsibility for each of the short, medium and long-term facets of the strategy. It is expected that the candidate would need to be educated to degree level, and be prepared to accept the position for at least the next two years.

The employment of an administration assistant would require up-front capital, but it was decided that the position would be a pre-requisite for the development of the scheme past the current point and to secure the legitimacy of the Group within the community itself.

In addition, it was decided that relevant members of the committee should be empowered to undertake their respective roles effectively through undertaking training courses in basic administrative tasks, to support the development of financial and written literacy skills. Investing in the skills of committee members will help support the long-term maintenance of the scheme beyond the remit of the administration assistant and enhance the community-based ownership of decision making and implementation.

Local organisations (table one) are key stakeholders in Kwa Muhia’s waste management system, with the resources to help increase the effectiveness of waste management and assist other communities in emulating what KMEG have achieved. During a lengthy meeting with key stakeholder groups, held at local government offices, KMEG had the opportunity to introduce their scheme formally to a wide audience and secure buy-in. Networking in this manner provides KMEG with the opportunity to access skills, expertise and resources that might be otherwise unavailable. The feedback was overwhelmingly positive, with all groups voicing support for KMEG’s project. Potential partnerships were identified with groups offering soft support and, significantly, the Lake Naivasha Growers Group (which collectively controls 70% of agricultural production) conceded some responsibility for causing the waste menace through incentivizing mass inward-migration to the region. A follow-up visit to the Elsamere Centre for Education in Sustainability (a local non-profit group offering conservation education programmes) revealed the potential for a partnership based on jointly-hiring a truck to deliver plastic bottles to Nairobi for recycling.

**Table 1: Local organisation present at the meeting of stakeholders, held during the visit.**

<b>Name</b>	<b>Function</b>	<b>Potential Link</b>
Imarisha Naivasha	Public / private sector community-driven initiative to promote the environmentally sustainable development of the Naivasha catchment.	Good source of practical knowledge and funding partnerships (Imarisha Naivasha provided the original capital for the refuse bins).
Lake Naivasha Riparian Association (LNRA)	Operates management plans to maintain Lake Naivasha’s quality.	Good source of soft support (have lent KMEG vehicles in the past). Have voiced support for the waste management system as a way of prohibiting lake pollution.
Elsamere Conservation Centre	Operates a wildlife retreat and conservation education center for national and international parties.	Potential partner for long-term education initiatives and for sharing a truck to transport recycled bottles to Nairobi. The center also has a large plot of land, which could be used to practice melting LDPE bags for tiling.

Lake Naivasha Growers Group (LNGG)	An organisation which represents 70% of flower growers in the Naivasha basin.	Voiced support for KMEG's initiative, and partial responsibility for creating the waste problem through attracting inward migration to the region. Could be a potential source of land and significant funds (more likely just soft support however).
Public Health Officer	Present at the meeting in recognition of the fact that waste management is a public health issue	Voiced support for KMEG's initiative. A good source of knowledge, with good governmental links.
Deputy County Commissioner	Oversees the governing of the county district within which Naivasha is located.	Voiced support for KMEG's initiative. An excellent source of government connections.

## Space

The up-scaling of the current scheme is limited by the lack of available space to securely store waste management equipment, to undertake briquette and plastic tile processing and to store bottles of leachate that have been ciphred from the refuse bins. A number of factors place restraints on the nature of a suitable site. Firstly the site must be large enough to provide secure storage for tools (including oil drums for melting plastics and burning briquettes, as well as wheel barrows etc.) and storage for the collected plastics and biodegradables. In addition the site must also be close enough to Kwa Muhia village so as to reduce transport costs as much as possible, yet positioned well enough so the burning of materials does not cause a nuisance to village residents.

The land around Kwa Muhia village is owned by a variety of private people and organisations. The likelihood is that KMEG will need to approach one of these landowners and solicit land, if possible, on a rent free basis so as not to cause an additional financial burden. Privately held land on the southwestern side of the settlement has been provisionally specified, as has land owned by a neighboring flower producer.

Hopes that the neighboring multinational flower producer (Findlays) might donate some of their land through a CSR initiative were scuppered when the plant closed down in March 2016. KMEG have subsequently lost their contact at the firm, and are currently investigating whether the replacement company might be equally as approachable. A second option – that of approaching neighboring private landowners – is currently being investigated. However, in assessing the legal implications of burning

LDPE to produce plastic tiling, KMEG have found that a variety of Environmental Impact Assessments must be undertaken (and paid for) before the commencement of any activities. This will set the production of plastic flooring back somewhat, making the bottle collection scheme even more favorable as a source of revenue in the short / medium term.

Less immediate is KMEG's need for a new office site, in order to cater as a meeting space for larger groups of people and to act as a showroom for the Group's products. Currently, KMEG operate out of a small office (roughly 15 x 15 feet) which is inadequate for both functions. The current office is rented at a cost of 3,000 shillings (roughly £20) per month. A new larger office could cost up to 5,000 per month.

## CONCLUSION: LESSONS LEARNT

**Lesson 1 – Survey the waste.** Carry out a survey of the waste people generate in their village. There is a standard methodology for this, Waste Aid can advise. The data on the amount and composition of the waste is invaluable for planning and designing solutions. Another benefit is that it makes residents aware of the rubbish they generate each day.

**Lesson 2 – Compost bio-degradable/compostable waste.** Bio-degradable waste is likely to be the greatest proportion of waste PRODUCED (two thirds of waste in Kwa Muhia and Kamere). Bio-degradable waste should be composted because compost and leachate are valuable resources as soil conditioner and substitute for fertiliser. In addition, composting significantly reduces the amount of waste that needs to be transported to a rubbish tip – saving fuel/money and CO<sub>2</sub>. However composting on a village scale is not straightforward, and advice should be taken on the most appropriate technique. In Kwa Muhia the village lack of space for composting was the largest issue.

**Lesson 3 – Consider options for non-biodegradable waste .** Mike from Waste Aid showed KMEG several ways to reduce the amount of non-compostable waste by turning ‘waste into wealth’, thus reducing still further the cost of transporting waste to the tip.

- 1) The survey showed that more than 20% of the waste is plastic. A visit to the Naivasha rubbish tip with Mike from Waste Aid showed KMEG that certain types of plastic e.g. plastic bottles or gallon containers can be collected and sold them to wholesalers in Nairobi for recycling; the pickers on the tip also provided information on market prices and wholesalers. This could provide an income stream for KMEG. But KMEG need space/land to store such plastic waste before it can be transported to market; KMEG also need a permit is to store waste.
- 2) Mike from Waste Aid also showed KMEG how to turn certain types of plastic into other products. He showed KMEG how to melt plastic bags with sand to make plastic-crete pavers. Selling pavers could provide KMEG with another income stream, but KMEG must first obtain the legal permits for the manufacturing process, find space/land for the manufacturing process, validate there is a market for the plastic-crete pavers and streamline the production process to make a profit.

- 3) Mike showed KMEG how to make charcoal briquettes by mixing waste charcoal dust with starchy paste. The manufacture and sale of the briquettes could be another income stream for KMEG.
- 4) Mike also showed examples of waste paper and rubber turned into jewelry. Another business opportunity.

Mike emphasized that every effort should be made to minimize the transport costs of waste, the profit margins from waste are small and these small margins can easily be eroded by transport. This advice does fit with the processing of waste locally in a community rather than transporting it vast distances to a tip.

Initial attempts at business plans showed that KMEG would need external funding to start up these enterprises – to find land, obtain the necessary legal permits and licenses, test and refine the manufacturing process, market test the products and simply run the business. This workload is not possible for KMEG who are all volunteers and have to turn an income to support themselves and their families. In addition, KMEG need to decide if their community group is the best structure to run a business; another business model maybe required.

**Lesson 4 – Provide a good waste collection service.** Mike explained that KMEG were providing a waste collection service to the village of Kwa Muhia. Essentially KMEG fund this service using the contribution per plot made by landlords; KMEG use this income to pay the wages of the laborers. Initially KMEG had enough income to provide a high quality waste collection service and keep the village very clean. Residents quickly learned to use the new waste bins and appreciated the village being cleaner. However factors out with KMEG's control e.g. the local authority unexpectedly withdrawing the use of a truck to collect and transport the non-biodegradable waste to the tip requiring KMEG to find and pay for an alternative truck (proven very unreliable) has caused problems. Landlords are unwilling to pay KMEG for a service that does not keep the village clean and unless KMEG have sufficient funds from the landlords they cannot pay the laborers or pay for the truck; landlords are unwilling to increase their contributions unless KMEG can prove they can provide a reliable service. This is a challenge for KMEG to resolve, but there is a danger it could spiral downward and out of control leaving the waste in the village completely unmanaged once again.

Mike pointed out that if KMEG can resolve these difficulties then KMEG could offer clean up services to the local hotels or events to provide another income stream.

In the long run Mike also suggested KMEG could charge other communities to help them set up workable solid waste management systems in their own villages, much as they were asked to help in Kamere.

**Lesson 5 – Financial sustainability – the challenge.** Since its formation KMEG has been determined to find ways to provide a long-term sustainable income to pay for the solid waste management system in their village; local people are very aware of externally funded projects which come to an abrupt end when funding finishes and the funder moves funds onto a new project. KMEG are finding it difficult solve this challenge because they have no power to enforce the landlords to pay.

If we compare Kwa Muhia with waste management in the UK, it is clear that KMEG are providing a community-run and funded service which in the UK is provided by the local authority and funded by taxes. Here waste management companies tend to be contracted by the local authority. KMEG's financial challenge is going to be replicated throughout the developing world. Waste is a growing menace everywhere, but highly complex waste management systems like we have in the UK are expensive to run and are already having to adapt to new EU restrictions on the amount waste sent to landfill. We all need to find new ways to manage our waste, because we can't reduce, reuse and recycle 100% our waste (zero-waste) out of existence in the immediate future.

It seems likely that new models for managing solid waste will be developed in different places, because it seems unlikely to be a one-size-fits-all model for solid waste management will be developed that suits the whole world. The journey upon which KMEG has embarked is therefore very important, because it will take groups with their stoical determination to find genuinely sustainable solutions to the local problems of solid waste management in developing countries. Finding better ways to manage solid waste is important for people's health, for their livestock for wildlife and for the environment, so KMEG will continue to need support and encouragement on their travels in the hope they will be able to help others shorten their journey.

**General lessons for development projects:**

- Systems should be first and foremost financially sustainable.
- Work hard to involve the whole community - part of the reason KMEG's solution has been a success to this point is because the community have taken responsibility for their own rubbish. Through involving institutions such as schools, the church and the villages women (who hold prominent committee positions) the scheme has been inclusive and universally relevant.

- The importance of sharing the workload - people must understand that building a waste strategy is a team effort. If a community relies only on a few people, then scaling up becomes an issue.
- Research the technologies which might be appropriate to your community – in Kwa Muhia, collecting plastic bottles, briquetting and plastic flooring look like they might be a success.
- Look to involve stakeholders from outside the community (e.g. local organisations). These groups have the resources to enhance the impact of community-based schemes (e.g. Imarisha Naivasha and the bins / cars)
- Network! Use social media and trade fairs to promote the scheme and make linkages with other groups both nationally and internationally (e.g. finding Mike!)

## Appendix

### 1) Estimated waste income per day in Kwa Muhia

ASSUMPTIONS	UNIT	
Household in Kwa Muhia	Number of households	2,500.00
Waste produced per household per day	Kg	1.00
Compostable waste	%	67.00
% LDP -low density plastic = plastic bags	%	16.00
% PET = Plastic bottles in waste	%	5.00
% HDP = high density polyethylene	%	3.00
Cardboard	%	10.00
Price of PET (plastic bottles) per kg	KSh	17.00
Price of HDP high density polyethylene (gallon cans) per kg	KSh	10.00
Price of cardboard per kg	KSh	7.00
WASTE VALUE CALCULATIONS		
Potential income from PET = plastic bottles in Kwa Muhia per day	KSh	2,125.00
Potential income from HDP (high density polyethylene i.e. gallon cans) Kwa Muhia per day	KSh	750.00
Potential income from cardboard in Kwa Muhia per day	KSh	1,750.00
<b>TOTAL INCOME PER DAY</b>	<b>KSh</b>	<b>4,625.00</b>

### 2) Estimated briquette production costs

		No of units	Unit price	Total price (KSh)
EQUIPMENT COSTS				
Table		1	5000	5,000.00
Sufuria		1	600	600.00
Drum		1	1200	1,200.00
Mould		1	600	600.00
Hammer		2	750	1,500.00
PPE - dust coat		2	850	1,700.00
PPE- facemask		400	5	2,000.00
PPE - gloves		4	250	1,000.00
Total equipment				13,600.00
25% contingency				3,400.00
Total equipment plus contingency				17,000.00
MATERIAL COSTS				
Charcoal dust	kg	150	2.67	400.50
Maize flour	kg	50	5	250.00

Water	litre	50	0.2	10.00
Fuel (to cook flour)				25.00
Total materials for 200kg i.e. 2000 briquettes				685.50
Total materials for 100kg i.e. 1000 briquettes				342.75
<b>PRODUCITON COSTS</b>				
Labour/day		2	300	600.00
Production costs of (000s briquettes)				
Material				342.75
Labour				1,200.00
% of capital costs - total/200 working days per year				68.00
<b>OVERALL COSTS</b>				
Total per 1000 briquettes in KSh				1,610.75
Cost per briquette in KSh				1.61

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