U.S. Agency for International Development (USAID) and
Higher Education for Development (HED)

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"Support for Two African Partnerships Promoting Clean Drinking Water and/or Hygiene"

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Executive Summary

The American Council on Education Office of Higher Education for Development (ACE/HED) signed an Associate Award with the United States Agency for International Development (USAID) Washington on September 22, 2009, establishing collaboration between the ACE/HED and USAID's Economic Growth, Agriculture and Trade/Economic Development's Water Team (USAID/EGAT/NRM). The purpose of the award was to provide funding for two partnerships between higher education institutions in the United States and Africa to address issues of clean drinking water and water management related to improved sanitation and hygiene outcomes. The two partnerships, described below, had been awarded prior funding from HED through merit-based, open competitions in 2000 and 2003 and had demonstrated success in achieving their objectives. At USAID's request, HED invited both of these partnerships to submit an implementation and budget plan for a three-year follow-on award of up to $300,000 to continue working in these areas.

The "*Support for Two African Partnerships Promoting Clean Drinking Water and/or Hygiene*" Associate Award included two partnerships:

1. The partnership between ***Cornell University***, ***Tompkins Cortland Community College***, and ***Bahir Dar University*** in Ethiopia collaborated to enhance both human and institutional capacity at Bahir Dar University to address water and sanitation issues in local communities. The partnership was designed to strengthen the capacity of students and university faculty in planning and designing safe drinking water systems that are appropriate for the social context in which the systems are placed. The partnership sought to support students to complete a Master's program in which participatory skills, watershed management, water supply and interdisciplinary implementation are taught and offer summer/thesis program during each of the three years covering practical hands-on field research during which students can gain experience in several aspects of providing safe and clean potable water in rural communities.

2. The partnership between ***State University of New York, Albany***, ***Tuskegee University***, and ***Makerere University*** in Uganda collaborated to enhance both human and institutional capacity at Makerere University to address safe drinking water issues in two selected communities in Kamapala City and the Mukono Municipality in Uganda. Specifically, the partnership focused on enhancing human capacity at Makerere by increasing formal training on issues related to drinking water quality and sanitation and by strengthening Makerere's faculty teaching capacity in the areas of drinking water and sanitation. Additionally, the partnership focused on developing greater capacity of community members in the two target communities to identify and sustainably address water and sanitation issues by themselves.

Under the Associate Award, both partnerships received approval from USAID for a one-year no-cost extension in August 2012. The partnership between Cornell University, Tompkins Cortland Community College, and Bahir Dar University in Ethiopia was envisioned to end on August 31, 2012 but the sub-cooperative agreement was extended until August 31, 2013. The partnership between State University of New York, Albany, Tuskegee University, and Makerere University in Uganda was envisioned to end on September 30, 2012 but the sub-cooperative agreement was extended until September 30, 2013. Accordingly, the Associate Award was extended as well for an additional year from December 31, 2012 to December 31, 2013.

Key highlights of results for each partnership are:

Cornell University, ***Tompkins Cortland Community College***, and ***Bahir Dar University*** in Ethiopia:

- The partnership was successful in significantly enhancing a pre-existing Master's program and fully institutionalizing it at Bahir Dar University. The partnership also established a new Doctor of Philosophy (PhD) program in Integrated Water Management at Bahir Dar University, which had not been originally envisioned in the partnership's scope of work;
- The partnership incorporated a client-centered approach into the design of both the Master's and PhD graduate programs in integrated water management and water supply. This approach emphasizes direct engagement with community members who will benefit from the water supply systems;
- The client-centered approach of these two academic programs has been replicated in other Universities in Ethiopia, thereby expanding the partnership's impact; and
- Field research conducted by students and faculty of the Master's and PhD programs directly increased the knowledge base in soil and water management and water supply in the Ethiopian highlands and was utilized and applied by key stakeholders in Ethiopia.

State University of New York, Albany, ***Tuskegee University***, and ***Makerere University*** in Uganda:

- Makerere University's institutional capacity to offer relevant educational offerings was strengthened by developing the curriculum for an eight-week certificate course in Water, Sanitation and Hygiene (WASH) that will be new educational offering by the School of Public Health after partnership closeout. The course will respond to a pressing need for training in the WASH sector in Uganda and will run during the summer breaks of the university;
- Field research conducted by the partnership to assess the WASH status of the two target communities; examine the socio-economic and cultural factors and practices that result into the current environment and community health status; and understand the communities' attitudes and practices on solid waste management helped raise awareness among community members regarding WASH practices and led to tangible improvements in these practices at the two project sites; and
- The partnership estimates that approximately 300 host-country individuals directly benefited from outreach activities including clean-up campaigns, research efforts, demonstrations, promotion of chlorination of household water, and home improvement campaigns.

Background

At the beginning of FY 2009, USAID approached HED to discuss successful partnerships that were addressing safe drinking water and sanitation. USAID was formulating a response to an earmark [1] ***"…****to increase sustainable access to safe drinking water and sanitation and improve hygiene. Eligible*

[1] The FY 2008 Omnibus Appropriations Act language states that *"not less than $300,000,000 shall be made available for safe drinking water and sanitation supply projects, including water management related to safe drinking water and sanitation, only to implement the Senator Paul Simon Water for the Poor Act of 2005 (Public Law 109-121)."*

activities must have a stated intent to address these goals as a primary or secondary objective, and demonstrate that intent through objectively verifiable indicators linked to these goals."

The "*Support for Two African Partnerships Promoting Clean Drinking Water and/or Hygiene*" Associate Award enabled HED to continue to support two partnerships that had focused on the ability of higher education in African countries (Ethiopia and Uganda) to address the issues of clean drinking water and water management as it relates to improved sanitation and hygiene outcomes. At USAID's request, HED invited these partnerships to submit an implementation plan and budget for a follow-on award of up to $300,000 for a three-year period. The partnership implementation plans included partnership activities focused on increased access to drinking water supply or sanitation services, better quality of those services, and/or hygiene promotion.

HED required that the original U.S. partners, the State University of New York at Albany and Cornell University, broaden the scope of the partnership to include an additional U.S. higher education institution or institutions, providing access for Bahir Dar and Makerere to a wider spectrum of U.S. partners in related disciplines. As a result, Tompkins Cortland Community College and Tuskegee University were incorporated into the Ethiopia and Uganda partnerships, respectively.

During the period of performance of the two follow-on awards to Cornell University and SUNY (2010 through 2013), USAID revised its definitions of standard indicators for higher education (2010 and 2012) and issued a new Evaluation Policy (2011). HED responded to new requirements triggered by these changes by establishing new systems for results-based management and partnership reporting. As a result, the two partnerships supported by this Associate Award and ACE/HED's subaward agreements with the partners predate the updated systems. While these partnerships were not able to fully utilize HED's new reporting system and benefit from HED's updated and rigorous results-based management approach, they nonetheless achieved significant results and sustainable impact.

Section 1: Partnership Performance

A. *Cornell University*[2]*, Tompkins Cortland Community College, and Bahir Dar University:* *"Improved Drinking Water Utilization through Integrated University Research, Planning, and Training Initiatives in the Lake Tana Region, Ethiopia"*

Implementation period	Subaward Funding Amount	Subaward Cost-share Amount
01/04/2010-08/31/2013	**$295,246**	**$70,077**

I. Summary

Access to safe drinking water services in the Ethiopian Highlands is one of the lowest worldwide. Water harvesting structures fail, soil and water conservation structures are not maintained, and access to safe drinking water supplies and sanitation services is among the lowest in Sub-Saharan Africa. Responding to the lack of appropriate integrated programs at the university level to train future graduates in participatory methods in water management and water supply, the partnership between

[2] The sub cooperative agreement with ACE/HED was fully executed on January 4, 2010.

Cornell University (CU), Tompkins Cortland Community College, and Bahir Dar University (BDU) was designed to incorporate a participatory approach to this discipline for students in the Ethiopian highlands[3].

Through its activities, the partnership was successful in:

- Training students in integrated watershed management and participatory design of improved and safer water supply systems;
- Helping students understand the intricacies and importance of providing safe drinking water; increasing the general understanding of the technical requirements for small-scale water development in Ethiopia; and
- Increasing the general understanding of the sources and transport processes for pathogens, sediments, and other pollutants that degrade the water supply systems

More specifically, the partnership was successful in enhancing a pre-existing Master's program and fully institutionalizing it as a Bahir Dar degree. The partnership also established a new Doctor of Philosophy (PhD) program in Integrated Water Management at Bahir Dar University, which had not been originally envisioned in the partnership's scope of work. These two academic programs graduated 30 Master's students and two PhD students with partnership support as of partnership closeout. Two additional Master's students and 14 additional PhD students also enrolled toward the end of partnership implementation and will receive their degree in the future.

The Master's program was designed to train future professionals who can help to institute more effective and sustainable watershed management practices. The program offers students a blend of theoretical and practical studies to build their expertise in watershed management and hydrological sciences. The Master's courses covered several disciplines: civil and agricultural engineering; crop, soil, and animal sciences; natural resource management; economics and other social sciences; and communication. The PhD program, in turn, sought to fulfill a need for additional specialized training in this area, with a focus on preparing future faculty members to fill essential roles at Ethiopian higher education institutions. The programs helped to fortify the institutional relationship between BDU and Cornell, and both emphasized opportunities for students to engage community members by using participatory methods to design potable water supply systems[4].

The CU-BDU partnership performance objectives were to:

1. Enhance both human and institutional capacity at Bahir Dar University in dealing with water and sanitation issues in local communities.

[3] BDU's location, adjacent to Lake Tana, in Amhara Region in the northwestern Ethiopian Highlands, makes it ideal for a program in watershed management. Lake Tana contains more than 50 percent of the stored fresh water in Ethiopia and is the source of the Blue Nile River. Excessive siltation due to inappropriate water and vegetation management in the surrounding highlands is damaging the lake.

[4] Research conducted by the partnership reiterated the importance of both selecting appropriate design practices attuned to local conditions prevailing in the Ethiopian highlands and decision-making at the local level in contrast to the central authority.

2. Produce a client-centered approach when designing small-scale water development by training students to work together as practitioners using participatory methods to design potable water supply systems.
3. Engender the sustainable development of water resources by training students in the sustainable use and development of water resources.
4. Promote the use of safe drinking water by training students to design systems that prevent the consequences of water borne illnesses among the population being served and by providing students with training in simple methods for pathogen detection.
5. Improve water supply systems through field-based research and design projects that allow students to work directly with the community on various aspects of water supply systems including the promotion of sustainable practices in the surrounding watershed.

II. Partnership Achievements

Major partnership achievements based on progress reports and the final partnership report submitted by Cornell University are presented below by performance objective.

Objective 1: *Enhance the human and institutional capacity at Bahir Dar University in dealing with water and sanitation issues in local communities*

The partnership enhanced the institutional capacity of BDU to offer graduate-level degree programs that are designed to better equip students with the knowledge and skills necessary to address water and sanitation issues in local communities. Precisely, the partnership helped fully institutionalize the Master's program as a BDU offering and create a new PhD program in Integrated Water Management.

The Cornell University/Bahir Dar University (CU/BDU) Master of Professional Studies (MPS) program in International Agriculture and Rural Development had been developed in 2007 as part of the initial subaward provided by HED/USAID. The Cornell-Bahir Dar program aims at preparing professionals who will engage communities in water resource system design, development, and operation. With support from the partnership funded through this Associate Award, this Master's program was transferred over and fully institutionalized at BDU in 2011. The program, independent within BDU at the beginning, now has an academic home within the Faculty of Agriculture. This will allow the program to obtain funding through the regular university budget allocated by the Ethiopian government as part of their national education budget. As of September 2011, the MPS program began to be taught as a Bahir Dar University program with students receiving a Master of Sciences degree from BDU.

Human capacity was enhanced by supporting students to complete the Master's program. The partnership funded under this Associate Award supported the final stages of research activity for a first cohort of 19 Master's students and funded entirely a second cohort of 13 Master's students. The list of Master's students from both cohorts is included in Appendix A. As of December 2013, the Master's program had graduated all 19 students of Cohort I and 11 of 13 Cohort II students had obtained their Master's degree. One student from Cohort II had completed all requirements and will receive their degree in May 2014, and the last student had a third draft thesis under review.

Table 1. Total Number of Master's Students

Cohort	Students Who Enrolled (Number)	Students Who Completed (Number)
Master's Program Cohort I	20*	19
Master's Program Cohort II	14*	11
Total	34	30

*While 20 students had enrolled in Cohort 1, a student, Emebet Negash was killed in a vehicle accident. Cohort II began with 14 students, yet one of them left to begin studies at the University of Delft.

As it became clear that there was a need for study beyond the Master's level to continue to deepen human capacity in the area of water resources management, the partners began discussing the possibility of creating a PhD program within BDU building on the CU/BDU Master's program that was the focus of the first two years of the partnership. The partners worked collaboratively in developing the curriculum for the PhD program, which mirrors key features of the graduate program at Cornell, such as the fact that graduate student committees with chairpersons are chosen by the students. The BDU Senate officially approved the PhD degree program in Integrated Water Management (IWM) at the School of Civil and Environmental Engineering of the Institute of Technology at BDU in April 2012. The PhD program recognized that natural resources (including water) can only be managed successfully with an interdisciplinary approach. The partnership developed a new admissions process for this new program, which includes an entrance exam, candidate interviews, and a final selection process based on academic potential.

On August 31, 2012, HED executed a modification of the subaward agreement with Cornell University to ensure that partners had adequate time to fully incorporate the establishment of this program within BDU by extending the subaward implementation period by one year.

Prior to the beginning of the partnership funded under this Associate Award, six Ethiopian individuals – including three BDU faculty members – had enrolled in the PhD program in Biological and Environmental Engineering (BEE) at Cornell University, which enabled this first group of BDU faculty to improve their credentials beyond the Master's level. All six PhD students conducted fieldwork in Ethiopia with some partnership support provided in the final stages of these fieldwork activities. As of December 2013, two BDU faculty members and partnership principals, Seifu Admassu and Essayas Kaba, had completed all Cornell PhD requirements and received their doctoral degrees. A third student, BDU faculty member Abeyou Wale, is scheduled to be granted his PhD degree by Cornell University in 2015. The three remaining individuals were Cohort I Master's students Tigist Yazie, Haimanote Bayabil, and Assefa Zegeye. All three have

The IWM PhD Program

The IWM PhD program is unique in that it is the first PhD program in the BDU Institute of Technology and the only PhD program in Natural Resources in Ethiopia. Cornell faculty support this program by teaching and advising students (including several from other BDU programs) in their research, even after partnership closeout. The IWM PhD program is coordinated by Dr. Seifu Tilahun, who is a graduate of the partnership PhD program currently serving as assistant professor in the Department of Water Resources Engineering and currently the director of the School of Civil and Water Resources Engineering. He received his doctorate in the Biological and Environmental Engineering at Cornell University in January 2012.

completed their course requirements, and as of late 2013 were conducting their field research within Ethiopia.

In July 2012, twelve students applied to the newly- established PhD program at BDU, with five students (all male) admitted in September 2012. The partnership supported the first year of these five Ethiopian PhD students and the beginning of their research activities. The research of the first PhD cohort of students is taking place in three watersheds in the Lake Tana basin with the main goal of finding better ways to reduce sediment losses and increase food production. A second cohort of five students was admitted shortly after partnership closeout in September 2013 and consists of four males and one female.

Table 2. Total Number of PhD Students

PhD Program	**Students Who Enrolled (Number)**	**Students Who Completed (Number)**
PhD Program at Cornell University	6	2
PhD Program at BDU (Cohorts I and II)	10	0
Total	16	2

Both programs admitted students from a wide variety of backgrounds (natural resource management, economics, mathematics, soil science and various disciplines in Engineering), in keeping with the programs' interdisciplinary approach. Courses taught included field survey methods, economics, watershed management, modeling and water supply. For a detailed description of the course schedule, please refer to Appendix B.

Notably, these were the first programs of their kind in Ethiopia, and the partners have highlighted the fact that some components of these programs have been replicated in other Universities in Ethiopia. At Woreta College – which belongs to the University of Tabor – an integrated watershed program was started by one of the Master's students who became Director of the Agricultural Economics program after graduating. Two other Master's program graduates are currently instructors at the University of Wollo and have incorporated several components of the program's approach into their pedagogy.

Objective 2: *Produce a client-centered approach when designing small-scale water development by training students to work together as practitioners using participatory methods to design potable water supply systems*

The partnership incorporated a client-centered approach into the design of both the Master's and PhD graduate programs in integrated water management and water supply. Students learned important context by visiting nearby watersheds, and these visits highlighted the importance of taking into account the perceptions of community members in regards to the utilization and maintenance of the water systems. A dedicated course on participatory methods helped prepare the students to interact with the community. As part of this course, students learned to develop and apply the following methods:

- Key informant interviews: these interviews consist on a series of questions that are asked to a community leader, one on one. A number of interviews are conducted of different people representing a community cross section using the same set of questions and a consistent (ideally the same) interviewer. The interviewer then records the answers, compiles the results, and analyzes the data to determine the range of opinion and understanding among the surveyed leaders. The interviewers-in-training learn how to identify good interviewees, compose and order questions, get interviewees to be open, avoid biasing results, create a composite of results, and other analytical skills.

- Focus groups: focus groups are designed to elicit opinion and understanding levels within a specific group of individuals. They do not necessarily involve only community leaders. The focus group discussion is recorded and transcribed for qualitative analysis afterward.

- Watershed transect: transects are observatory walks or treks across the countryside and fields in any given area, village or watershed. Transects serve to help observers see at close range several items of interest and relevance which they would otherwise miss. A leader walks with others, someone records observations (photos, annotations on maps), and they stop to talk to people they encounter. The itinerary is selected to include land features and people to stimulate discussion.

The partnership observed an important shift in the students' approach to including community members. Indeed, while only one of the students of Cohort I was willing to ask the farmers for information during a fieldtrip early in the program, in the end 90% of the students included data in their thesis obtained either by formal survey, transect walk or focus groups.

Objective 3: *Engender the sustainable development of water resources by training students in the sustainable use and development of water resources.*

The partnership found that sustainable development of water resources often fails because key underlying problems are not well understood. Many approaches in providing potable water do not result in sustainable systems because the stakeholders did not have any input in the design and establishment of these systems. The partnership also found that, when training was provided to the community members after the installation, the life of the systems was longer. These improved methods for sustainable installation of water supply systems and water conservation practices are now being taught as part of the new programs at BDU, at other Ethiopian universities, and are being discussed at NGO's and local governments for possible replication. In the PhD program the partnership continues to study design practices that are more sustainable.

The Master's students examined the issues surrounding sustainable development of water resources in depth through their research work. Students' theses have been published in the Cornell Library and in some cases outside of the university, including 11 peer-reviewed, international publications. These theses covered topics related to sustainable development of water resources such as: modeling groundwater in the Lake Ziway, Rift Valley Ethiopia; assessment of gully formation and development in the highlands of Blue Nile Basin, Ethiopia; organization and management of traditional irrigation schemes In Eastern Amhara, Ethiopia; and assessment of water supply sources and determinants of household water consumption in Simada Woreda, Ethiopia, among many others. A list of students' Master's projects reports and PhD theses is included as Appendix C.

Objective 4: *Promote the use of safe drinking water by training students to design systems that prevent the consequences of water borne illnesses among the population being served and by providing students with training in simple methods for pathogen detection.*

The partnership promoted safe drinking water through community outreach, workshop presentations, policy briefs and publications. Partnership personnel and Master's students at BDU conducted a "Learning and Communication in WASH in Amhara Region" project that reached 32 communities in its water supply surveying, or over 500 families in 2010 and 2011. The BDU School of Civil and Water Resources Engineering held a workshop at BDU to disseminate research findings from this activity that reached 27 people, 17 from BDU and 10 from other organizations. Based on the research of the Master's students and available literature, and with a supplementary grant from WaterAid Ethiopia, a set of six briefing notes was prepared around this topic. These were:

1. Bottlenecks of operation and maintenance
2. Wisdom at the source of the Blue Nile – MUS
3. Sanitation promotion and household latrine
4. Sanitation promotion
5. Can communities manage complex technologies?
6. The role of users at the different levels of WASH projects

Results were also published in the peer reviewed journal "Water Policy" (see Tigabu et al in 2013). The full text of these publications and other partnership research products are available in the above-mentioned partnership website. Presentations of key findings were made at the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods in Addis Ababa in June 2013 and at the International Conference on Science and Technology towards the Development of East Africa (ICST) in Bahir Dar in May 2013.

Objective 5: *Improve water supply systems through field-based research and design projects that allow students to work directly with the community on various aspects of water supply systems including the promotion of sustainable practices in the surrounding watershed.*

Field research conducted by students and faculty of the Master's and PhD programs directly increased the knowledge base in soil and water management and water supply in the Ethiopian highlands. As part of this work, the partnership estimates that more than one hundred water supply systems were surveyed to find the underlying causes of failure and poor performance of these systems throughout the Ethiopia highlands in Amhara Regional State. Among other findings, research showed that:

- Systems with decision-making power at the community level during design and construction remained working longer than when the decisions were made by a central authority with no input from the local community;
- Most runoff is generated from the periodically saturated bottomlands and from degraded areas (eroded nearly to the subsoil from intensive land management) instead of the steep hill slopes. This is of great practical value since it means that the practice of installing stone bunds randomly on the hillsides carried out under the various food for work programs might not be as effective as placing practices on the degraded and bare areas; and
- Major gullies start in the saturated areas at the bottom of the watersheds and move upstream. The slumping of the gully walls is a direct result of pressure from the high water table. The partnership initiated efforts to arrest the advance of the gullies in the PhD program, though further experimentation and theoretical development is required.

Students and faculty also contributed to the promotion of sustainable practices by presenting the findings of their research projects to local communities in the watersheds where the students carried out their work; at meetings of local chapters and international annual conferences of various professional organizations (such as the Soil Science Society, American Geophysical Union and the European Geoscience Union); and at other universities in Africa, Europe and the United States. The results were also published in International and Ethiopian proceedings and International Journals.

Notably, the students' research findings were utilized and applied by key stakeholders in Ethiopia. For example, the International Water Management Institute (IWMI) in Addis Ababa based a large project of capturing rainwater harvesting on the findings of the Master's students that the hillside acts as source of the baseflow and the degraded and bottom lands as sources for direct overland flow. IWMI distributed this information widely among various stakeholders in Ethiopia. In addition, the partnership also worked closely with the Amhara Regional Agricultural Research Institute (ARARI) on improving the effectiveness of soil and water conservation and gully control mechanisms based on their research.

Overall, publications developed with partnership support through the fall of 2013 included 16 refereed articles, seven book chapters, and 22 conference papers. All research products resulting from this fruitful collaboration are available in the partnership's dedicated website: http://soilandwater.bee.cornell.edu/Research/international/eth_pubs.htm.

III. Partnership Collaborating Stakeholders

The partnership worked closely with a number of governmental, academic, and nongovernmental organizations listed below.

Table 3. Collaborating Stakeholders

Organization	Type of collaboration
ARARI (Amhara Agricultural Research Institute)	Cooperatively performed research in four watersheds: Andit Tid, Anjeni, Debre Mawi and Maybar. The partnership analyzed long-term discharge and sediment data provided by ARARI. Published refereed papers together with ARARI. The partnership provided input on long-term policies on soil conservation.
TaSBO (Tana Sub Basin Organization) and BeSBO (Beles Sub Basin Organization)	The partnership offered a six week course on watershed modeling to enhance staff skills of both offices. In addition, the partnership provided hands-on training for discharge, sediment and phosphorus modeling of watersheds.
BoA (Bureau of Agriculture) Bahir Dar	The partnership enhanced staff skills and advised on water supply systems.
Water and Land Resource Center-Addis Ababa Ethiopia	The partnership cooperated in research in the Debre Mawi watershed and Anjeni Watershed
Jimma University	The partnership conducted a seminar for faculty and discussed possible cooperation.
Addis Ababa University	Interaction on water management and exchange

	of instructors.
University of Debre Tabor	Cooperated together with Bahir Dar University on writing a grant proposal to USAID.
Woreta College of Agriculture	The partnership advised on establishing a program in Integrated Watershed Management in their Department of Economics.
SWISHA (Sustainable Water Harvesting and Institutional Strengthening in Amhara)	The partnership provided training to the staff on computer simulations. SWISHA aided the partners with logistic support in the Debra Mawi watershed and making connections with the various governmental organization in Bahir Dar
CGIAR's IWMI (International Water Management Institute) and ILRI (International Livestock Research Institute)	Cooperated closely with IWMI on research on rain water management in the Nilebasin II project and in adapting the SWAT water simulation model for the Ethiopian highlands. Participated in research and dissemination activities. Provided two chapters for a book on the Nile.
iDE, International Development Enterprises	Leveraged funding for one of the students to work on irrigation project in the Rift Valley.
WaterAid of Ethiopia	Provided funding to the partnership and cooperated on publishing a set of six factsheets on Water Supply and Sanitation and its dissemination.
UNICEF	As leader of the international WASH (Water Sanitation and Hygiene) initiative it was a partner in the partnership's outreach work with WaterAid Ethiopia.

IV. Sharing Learning: Challenges and Lessons Learned

The partnership faced the following challenges during implementation:

- While the partnership had originally included Tompkins Cortland Community College (TC3) in Dryden, NY as a secondary U.S. partner, TC3 faculty involvement in the partnership was not ultimately viable despite efforts by Cornell University to include TC3 faculty expertise in several program components. This was largely due to the high teaching load of TC3 instructors, which precluded instructors from traveling to Ethiopia to achieve the partnership goals. Any future project involving community colleges should include funds to hire substitute teachers to free time for the primary ones to engage in overseas activity.

- The Cornell admissions panel's merit-based selection criteria caused some misunderstandings with potential Ethiopian institutional sponsors, who had their own system of selection criteria for graduate studies. Indeed, some institutions did not provide leave to the students; eleven students in Cohort I had to resign their jobs to enter the program, leaving them without income.

Funds for support of students' research were later leveraged by Cornell University from the International Water Management Institute (IWMI) and three U.S. donors.

- Despite the relatively good Internet accessibility at Bahir Dar University, power outages – particularly during the end of the dry season – affected the use of Internet-based courses during the first years of the partnership. The partnership worked to enable CU-BDU students to access the Cornell library system including electronic journal subscriptions thanks to modifications made by the Mann Library staff at Cornell.

- At the beginning of the program, there were misunderstandings among the students given the marked differences between the Ethiopian and American educational systems. These issues were fully resolved by communicating with the students more effectively.

The following lessons learned were communicated to HED by the partners:

- Managing cultural differences: Students found it challenging – yet rewarding – to adjust to the less formal and more practical style of American higher education in engineering curricula (including social sciences tailored for engineers). Instead of teaching theoretical principles, the program taught practical application of theoretical principles directly related to Ethiopian conditions. The relatively informal student-faculty interactions with Cornell faculty differ from those that they experienced as undergraduates. While the less formal atmosphere encourages exploration and application of new ideas, students were not always certain about what was permissible and what was not.

- Time investment required: Good working relationships with partner institutions take years to develop and require a mutual trust that can only be achieved by significant face-to-face interactions in the U.S. and Ethiopia. The partnership developed trust by a visit of the Bahir Dar University President to the Cornell campus and by project personnel teaching at the Bahir Dar campus and advising students regularly.

V. Sustainability

Skilled human resource: Training several faculty and practitioners at Master's and PhD levels have contributed to building the capacity of BDU and local organizations employing the program graduates to address safe water and water resource management issues in the region. These faculty and practitioners will form the core human resource able to conduct research that can be applied to resolve societal problems while engaging communities with innovative and problem-solving interventions. Further, the approaches utilized by the programs were fairly visible in Ethiopia and resulted in some components of these programs being replicated in other Universities. At Woreta College – which belongs to the University of Tabor – an integrated watershed program was started by one of the Master's students who became Director of the Agricultural Economics program after graduating. Two other Master's program graduates are currently instructors at the University of Wollo and have incorporated several components of the program's approach into their pedagogy. These results will continue to build on the body of knowledge and human capacity contributed by the partnership in this area.

Relevant academic programs at BDU: The two academic programs in integrated water management, institutionalized at BDU through this partnership, reflect BDU's enhanced capacity to offer academic programs more in line with the needs of the Amhara region and more inclusive of community involvement during planning, design, and construction of water systems intended for their usage. These results will ensure that future graduates will be better equipped to contribute solutions to the issues of water resources and better positioned to spearhead similar changes when in leading positions at other academic or government institutions in Ethiopia. Such contributions are already occurring based on the career paths followed by Master's graduates outlined in Table 4 below.

Table 4. Subsequent Employment of Master's students of Cohorts I and II.

Next role	Cohort I	Cohort II
PhD or second MS studies	10	4
College level teaching or extension	4	2
NGO International	1	1
NGO Ethiopia	1	1
Private	1	0
Government - Ethiopia	2	2
Government - International	0	1

Source: Cornell University's Final Partnership Report

Strengthened relationships between BDU and U.S. higher education institutions: Faculty collaboration, extended visits, and the myriad of joint research initiatives undertaken by the partnership were also key in strengthening the professional bonds among Ethiopian and U.S. faculty, one of which is formally an adjunct faculty at BDU (Dr. Tammo Steenhius). These collaborative relationships are likely to continue in the future through ongoing initiatives (Dr. Steenhius still visits Ethiopia regularly to advise PhD students), co-teaching of classes, and new research efforts. Notably, among the latter, a proposal was developed for submission to a United Kingdom national funding consortium entitled "Adaptive governance of mountain ecosystem services for poverty alleviation enabled by environmental virtual observatories (MOUNTAIN-EVO)". Funding was approved in mid-2013 and will allow BDU to work with the Imperial College of London, the University of Central Asia in Kyrgyzstan, the Society of Hydrologists and Meteorologists (SOHAM) of Nepal, the Consortium for Sustainable Development of the Andean Ecoregion (CONDESAN), and other local and international organizations. The central research question is how recent conceptual and technological innovations in environmental sensing, data processing, interactive visualization and participatory knowledge generation can be leveraged to implement demand-driven, interactive and multidirectional approaches to knowledge generation about Eco-System Services (ESS). The consortium will implement a process of participatory data collection and processing on the ESS and their trade-offs, embedded in the local NGO and educational setting.

VI. Conclusions

The partnership supported under this Associate Award helped further cement the already strong relationship between BDU and Cornell University. A visit to Cornell by Dr. Baylie Damtie, President of Bahir Dar University in November 2011, underscored the depth of the relationship. His visit included extensive consultations with senior administrators and interested faculty at Cornell, and additional consultations with the University of Massachusetts, Boston University, and the University of Michigan (Ann Arbor). While at Cornell, Dr. Damtie spoke at an international water conference focused on the Mediterranean region, highlighting the role BDU plays in providing scientific knowledge and student training in Ethiopia and how the partnership between his University and Cornell has contributed to these efforts. A visit to Bahir Dar by U.S. Ambassador to Ethiopia, Donald E. Booth, in the summer of 2010 had also highlighted the importance of U.S. – Ethiopia collaboration in the Amhara region. A press release with additional details on this visit is included as Appendix D.

The Master's students research findings contributed new knowledge to the understanding of watersheds' hydrologic behavior. Students' surveys on water supply and irrigation confirmed that systems in which people had a say in the design from initiation of the project were most successful. Another student's work consisted in comparing management systems in three watersheds, and his findings underscored that their management succeeded when the farmers could make choices in what measures should be implemented. Students were also highly productive scientifically. A total of 16 refereed manuscripts in international journals, seven book chapters and twenty two proceedings papers have been published through fall 2013. Faculty capacity at BDU was also enhanced by their participation in collaborative research initiatives – the partnership noted that working with faculty members on research projects helped them broaden their expertise and deepen their knowledge base, and in several instances resulted in their professional advancement within BDU. Additional details are provided in greater depth in Cornell University's final partnership report included as Appendix E.

The partnership also benefited Cornell University in several ways. Graduate students at Cornell gained experience in teaching courses at the graduate level in Ethiopia. At the Ithaca campus, using Ethiopian case studies diversified the geographic and cultural coverage of Cornell's research, allowing the University's work to have broader application. The campus community was enriched by the Ethiopian resident students' and exchange visitors' presence. Two U.S.-based graduate students funded by another program worked on research projects in Ethiopia, from a base at Bahir Dar University. These were PhD projects of approximately two years of duration. The U.S. students worked under guidance of BDU and Cornell faculty, they had access to BDU facilities and equipment, and they worked through local community relationships previously established by the partnership. Like the earlier MPS students research projects, these students are motivated to improve the scientific foundations of local planning and management related to water quality and to involve the community in their research.

B. *State University of New York, Albany*[5]*, Tuskegee University, and Makerere University:* *"Drinking Water Supply, Sanitation and Hygiene Promotion Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda".*

Implementation period	Subaward Funding Amount	Subaward Cost-share Amount
02/09/2010-09/30/2013	**$299,736**	**$172,349**

I. Summary

Sanitation and personal hygiene are major problems in Uganda, and the situation is particularly serious in urban slum communities where lack of funds and infrastructure restrict access to clean drinking water, leading people to collect drinking water from surface sources or superficial pipes containing drainage water from superficial soils. Compounding this issue, local homes traditionally have an attached outhouse which results in easy transport of infectious and other contaminants into superficial water sources. In addition, there is a lack of facilities for washing hands after use of the toilets.

In response to this challenge, the partnership between State University of New York (SUNY), Tuskegee University, and Makerere University focused on addressing safe drinking water issues in two communities of Kampala City and Mukono municipality by engaging in several areas. On one hand, the partnership sought to strengthen Makerere's human and institutional capacity to address these issues by involving faculty and students in outreach activities conducted in the two target communities, including fieldwork. These activities enabled faculty and students to enhance their understanding of the constraints limiting access and proper utilization of water and sanitation in these communities. Further, the partnership developed the curriculum for a short course on Water, Sanitation and Hygiene (WASH) that will be offered by Makerere going forward.

On the other hand, the partnership greatly emphasized education and training to residents of the two target communities to enable them to identify and deal sustainably with water and sanitation issues. The partnership's approach to achieving this objective consisted on promoting WASH practices through a variety of activities involving health workers, community residents, and youth. Offices were established in both communities, employing community members as field coordinators trained to assist with a wide range of partnership activities. Partnership strategies to improve access to safe drinking water and sanitation facilities included awareness-raising campaigns to educate the communities on WASH; design, construction and placement of "tippy-tap" devices to enable residents to wash their hands regularly[6]; distribution of chlorine tablets; and engaging both community youth and Makerere University students in key educational activities including home improvement campaigns, water quality testing, and clean-up campaigns in common community areas.

Overall, the partnership was successful in identifying the most pressing water and sanitation issues affecting these two communities; helping community members understand the importance of addressing these issues by widely disseminating research findings; and establishing improved WASH practices among community residents through awareness-raising, training, and small community

[5] The sub cooperative agreement with ACE/HED was fully executed on February 9, 2010.
[6] The *tippy tap* uses a 3-5 litre jerrycan, a string and pedal to provide a simple but effective means of hand washing after toilet use.

projects t improve the overall health status of these communities. Key informant interviews and focus group discussions conducted towards the end of the partnership by the partnership team in Uganda indicate that these activities contributed to a reduction in water-borne diseases in the community, hence directly improving the community health status[7]. Partnership achievements are described in greater detail below and in SUNY's final partnership report attached as Appendix F.

II. Partnership Achievements

The State University of New York, Albany, Tuskegee University, and Makerere University collaborated to encourage the mobilization of resources (both national and international) to promote WASH in Uganda. The partnership enabled Makerere University to promote Ugandan government policies to address the infrastructural and educational issues facing water sanitation and access to water in two particular communities of Kampala City and Mukono municipality. The partnership performance objectives were to:

1. Enhance both human and institutional capacity at Makerere University to address safe drinking water issues in two selected communities so that the University and its faculty have the skills and knowledge to promote safe drinking water throughout Uganda.
2. Conduct a survey of water sources and sanitation facilities available in the selected study areas that provides quality data on the incidence of water-borne and excreta diseases so that the scope of the problem at both the local and national level is better understood.
3. Conduct a desk survey of government and other available medical information, with an emphasis on children, to provide an estimate of the current incidence of selected water-borne and excreta diseases in the populations of the selected study areas.
4. Train Makerere University students to identify risk factors associated with identified water and excreta related diseases in the selected study areas so that the students are better equipped to work effectively with communities as full partners.
5. Determine the constraints limiting access and proper utilization of water and sanitation facilities that impede hygiene conditions in the study areas so that the problem-solving skills of Makerere University students are strengthened and the differences in constraints between the study sites are better understood.
6. Develop greater capacity within the study communities to identify and deal sustainably with water and sanitation issues so that the community members are enabled to address them and empowered to transfer their knowledge to other communities.

Objective 1: *Enhance both human and institutional capacity at Makerere University to address safe drinking water issues in two selected communities so that the University and its faculty have the skills and knowledge to promote safe drinking water throughout Uganda.*

Makerere University's institutional capacity to offer relevant educational offerings was strengthened by developing the curriculum for an eight-week certificate course in WASH that will be offered by the School of Public Health after partnership closeout. The course will respond to a pressing need for training in the WASH sector in Uganda and will run during the summer breaks of the university. Course participants will spend four weeks (full-time) at MakSPH and four weeks at suitable work places or field sites. The first course will run from June 16 to August 8, 2014.The course promotional

[7] The partners are finalizing the evaluation report describing these findings. The report will be shared with USAID in the coming weeks.

brochure is included as Appendix G. The course is intended to strengthen the capacity of practicing workers to successfully identify and address WASH opportunities and challenges by enhancing their knowledge, skills and attitudes to understand and apply the six essential services of WASH:

1. Monitor WASH status to identify and solve community environmental health problems
2. Diagnose and investigate WASH problems and health hazards in the community
3. Inform, educate and empower people about WASH issues
4. Mobilize community partnerships and actions to identify and solve WASH problems
5. Evaluate effectiveness, accessibility and quality of personal and population based WASH services
6. Research for new insights and innovative solutions to WASH problems

Makerere's ability to conduct research was also enhanced by procuring much-needed laboratory equipment – including three microscopes and three bacteriological water-testing kits –, which are now used by students of Environmental Sciences to conduct practical sessions and by faculty during their research activities.

The partnership also supported a Ugandan student, Mr. Shedrack Nayebare, to pursue a Master's degree at University at Albany, which he completed in 2012. Mr. Nayebare conducted part of his training at Tuskegee University. His supervisors noted that he was a committed and outstanding student during his time in the US. Mr. Nayebare was later admitted to the PhD program in the Department of Environmental Health Sciences where his current project involves health effects of air pollution in developing countries.

The partnership contributed to enhancing Makerere's outreach capacity by involving faculty and students in partnership activities conducted in the target communities. Overall, the partnership estimates that approximately 25 members of the Department of Disease Control and Environmental Health at the School of Public Health were involved in various activities throughout the life of the program. Such activities included health education, community training, school training, research and advising the community in WASH. These activities enabled faculty and students to interact with the target communities and learn more about the challenges faced by urban slums in Uganda in the area of water and sanitation. This type of exposure also tends to broaden the faculty perspective and provide real-life examples of water and sanitation issues that can be incorporated into their teaching methodology to better prepare students on this area.

Additional outreach was conducted by the partnership team by presenting their work at two conferences: the 3rd All Africa Congress on Environmental Health held in Durban, South Africa in November 2012; and the 10th Makerere University Environmental Health Students' Association (MUEHSA) conference held in Kampala in April 2013. The partnership also exhibited materials reflecting their activities at several forums in Uganda, including during the national Independence Day celebrations in Mukono district, at the third Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) in Entebbe, and the Uganda National Council for Higher Education Inter-University Exhibition, in Kampala, all in 2012.

Further, the partnership supported three Makerere University Environmental Health Students' Association (MUEHSA) annual conferences in 2011, 2012 and 2013. These two-day conferences reached several students and practitioners from across the country from environmental health and other professions. The 2013 conference reached an estimated 120 participants. These conferences were crucial in sharing research findings as well as discussing and addressing emerging environmental

health issues. In 2013, the project supported the Joint Annual Health Scientific Conference organized by Makerere University College of Health Sciences (MakCHS) which included MakCHS' 9th annual conference. This conference, held in Kampala in September 2013, was well attended with an estimated 400 participants.

Objective 2: *Conduct a survey of water sources and sanitation facilities available in the selected study areas that provides quality data on the incidence of water-borne and excreta diseases so that the scope of the problem at both the local and national level is better understood.*

A baseline survey to assess the WASH status of the two target communities designed to examine the socio-economic and cultural factors and practices that result into the current environment and community health status was conducted in early March 2011. The partnership developed a cross-sectorial survey involving both qualitative and quantitative data collection methods that was applied during this process.

The baseline process included 102 households in Kampala and 111 households in Mukono. It consisted of household surveys (questionnaire and checklists), four focus group discussions, 12 key informant interviews, bacteriological analysis of drinking water, stool analysis from children under five with diarrhea, and soil analysis (from all households involved) at each of the two communities. The baseline survey underscored the poor WASH status of the community, further validating the selection of the two sites where the partnership would work. Detailed baseline results are provided in the Baseline Survey Report for both communities included as Appendix H.

To ensure that community inhabitants reached a better understanding of the water and sanitation status of their communities, the partnership conducted six meetings in the two communities during June and July 2011to disseminate baseline findings. During these outreach activities, the team provided health education, including drinking water safety, hand washing, waste management, excreta disposal and personal hygiene. The partnership estimates that over 200 community members attended these meetings. The findings were also used while designing health education messages that were later located at the primary schools involved in this initiative.

Uganda: Key Baseline Findings

- Public taps were the most used water sources among the households (67.6%)
- Almost all of the households (96%) boiled their water for drinking purposes. The majority of households (69.9%) stored their drinking water in plastic jerrycans with covers.
- About a quarter of the households (27.5%) had drinking water with no coliforms, therefore making it safe for consumption. However, almost a third of the households (39.4%) had drinking water with "too numerous to count" colony forming units.
- The majority of households (73.5%) owned latrines. Most of the households which did not have latrines used the community ones which they shared among 1-5 households. Large proportions (82.3% and 85.3%) of the latrines lacked hole covers and vent pipes respectively.
- There was poor solid waste management noted in the area with a significant number of households (47.1%) disposing of refuse in open pits where it eventually got burned. No skip was available in the community for storage of waste.
- Private clinics were the first choice health facility for households seeking healthcare. The prevalence of diarrheal diseases and fever among children was low. A significant number of children (41.4%) did not have their immunization cards available.

Objective 3: *Conduct a desk survey of government and other available medical information, with an emphasis on children, to provide an estimate of the current incidence of selected water-borne and excreta diseases in the populations of the selected study areas.*

The partnership conducted a review of all available literature from the Ministry of Health and relevant local authorities to inform the design of the surveys and other data collection instruments used during the initial partnership stage. However, the partnership found the data reviewed to be inadequate and not as useful to their objective as expected.

Objective 4: *Train Makerere University students to identify risk factors associated with identified water and excreta related diseases in the selected study areas so that the students are better equipped to work effectively with communities as full partners.*

The partnership engaged Environmental Health Science students at Makerere University in project activities such as household visits, sanitary inspection of water sources, and promotion of hand washing using *tippy taps*. The partnership estimates that approximately 100 students benefited from practical field exposure through these activities and utilized their experience to supplement the theoretical knowledge acquired in the classroom.

In addition, 12 students of Environmental Health Sciences at Makerere University worked at the two partnership field sites throughout the duration of the award as part of their university mandatory requirement of carrying out six-week internships. These students were not only learning from the project team but also actively taking part in ongoing activities. Specifically, these students were involved in the home improvement campaign, community health education, school training, community demonstrations, inspection of water sources, clean-up exercises and research activities. These activities have enhanced knowledge, experience and skills of students in identifying WASH risk factors, understanding community challenges and working effectively with communities to identify creative solutions to their most pressing challenges.

Objective 5: *Determine the constraints limiting access and proper utilization of water and sanitation facilities that impede hygiene conditions in the study areas so that the problem-solving skills of Makerere University students are strengthened and the differences in constraints between the study sites are better understood.*

The partnership conducted several research activities to determine the constraints limiting access and proper utilization of water and sanitation facilities in the target communities. These research activities often involved Makerere University students. For example, research was conducted to assess the quality of water from sources in the communities. This involved carrying out water sampling and analysis from communal and household sources. Results showed that some of the water sources were contaminated. The findings were disseminated to the community during awareness-raising sessions on water quality and households whose water was contaminated were advised to treat it before drinking by either boiling it or using Aquasafe chlorine tablets.

In addition, research to assess the community knowledge, attitudes and practices on solid waste management was conducted in June 2013. The initial results from the research on solid waste management in the project sites were disseminated to the communities, which later facilitated the process of advising the community on how to improve current waste management practices in their area. Notably, the partnership remarked that, based on the results of the baseline survey and the solid

waste research, one of the study sites (Kampala) initiated a plastics project that collects solid waste from their area and takes them to a recycling site in Kampala. A preliminary report describing main research findings regarding solid waste management is included as Appendix I, with the final report forthcoming. The partners are also working on an article describing this work to be published in a peer reviewed journal.

Objective 6: *Develop greater capacity within the study communities to identify and deal sustainably with water and sanitation issues so that the community members are enabled to address them and empowered to transfer their knowledge to other communities.*

The partnership conducted a wide variety of activities to engage the communities at the two project sites and relied on community health workers and local youth to further promote WASH practices and conduct awareness-raising activities among community members. Overall, the partnership estimates that approximately 300 individuals participated in activities including clean-up campaigns, research efforts, demonstrations, promotion of chlorination of household water, and home improvement campaigns.

The partnership also organized visits between members of the two communities to facilitate the exchange of experiences and lessons learned. Two exchange visits were organized in October 2012 and involved 20 community members. The visits were crucial for each group to appreciate the challenges faced by the other as well as to understand how WASH practices were being promoted in their communities. These exchange visits also provided an opportunity to learn of the specific nuances of each project intervention.

An overview of the outreach activities conducted in the two communities to develop greater capacity to identify and address water and sanitation issues is included below.

Table 5. Partnership Outreach Activities

Activity	Description	Results
Awareness-raising activities on WASH	The partnership team and community health workers implemented a home improvement campaign in the area. This involved carrying out house to house visits to ascertain the WASH status of the households. Based on the findings of the inspection, the team would educate household members on the ideal health requirements in a home.	This activity helped community members to identify WASH shortfalls in their homesteads and provided them with appropriate measures to improve this situation. An estimated 500 households were reached by the partnership through these activities.
Promotion of hand washing using the *tippy tap* technology	The partnership promoted hand washing at critical times, particularly after visiting the toilet. Special trainings on hand washing, specifically the use of the *tippy tap* technology, were conducted.	As a result of these activities, the partnership estimates that over 200 households in the study areas constructed these hand washing facilities at their latrines with partnership support. The introduction of the *tippy tap* technology greatly

		improved the hand washing practices of the general community including among children who enjoyed using the facility after latrine use.
Support clean-up exercises in the community	The partnership team supported the communities in routine clean-up exercises of common areas to improve sanitation.	These exercises improved the aesthetic appearance of the areas and reduced waste in the community.
Providing advice in WASH	The project provided advice in WASH to the communities throughout its duration. This included routine visits to the communities where meetings were held to discuss WASH issues faced by residents.	This ongoing support ensured that WASH information continued to be provided to the community to promote better heath practices, especially given the high mobility of community dwellers.
Supporting health clubs in primary schools	The partnership supported students' health clubs in two primary schools in the project communities. These schools were Kikulu primary school (Kampala) and Lweza primary school (Mukono). The project conducted several activities in WASH among the health club members, including training, health education, demonstrations, and drawing competitions. To promote appropriate WASH practices in the two schools, the partnership also supported the development of 'talking compound' messages which were displayed in appropriate places in the school compounds[8].	Educating school children helped raise awareness of WASH issues in these two schools. At the end of the partnership, approximately 200 health club pupils received educational materials with different health promotional messages to keep and to continue promoting WASH practices among their classmates, within their families, and elsewhere. The compound messages were greatly appreciated by the schools as they helped promote sanitation and hygiene across the entire school population.
WASH Short Course	The project trained 41 community members in a short course in WASH. The short course was offered twice: in March 2012 and August 2013. Participants included village health	Participants are better equipped to continue promoting WASH in their respective communities through health education, house-to-house visits, clean-up

[8] The messages were 'Wash hands after visiting the toilet', 'Sleep under a mosquito net', 'Wash your hands before eating food' 'Remove stagnant water from your compound' and 'Keep the environment clean'.

	team members, local leaders or individuals involved in community work in the area.	exercises and improving solid waste management.
Capacity building of youth in WASH	An estimated 20 youth in the two communities were trained in several WASH techniques including inspection of households and water sources, use of water testing equipment and research.	These youth are now more knowledgeable of WASH techniques that can continue to be applied in their communities.
Promoting drinking safe water through household chlorination	The project conducted training sessions on the use of Aquasafe chlorine tablets to ensure safe drinking water for community members and subsequently promoting its use on the community.	The partnership found that many community members were not aware of the existence of chlorine tablets, and so they greatly appreciated this option to ensure they have safe water for drinking. Other families had negative perceptions about the tablets, which the project personnel worked to address.
Improving plastics collection	At the start of the project, the baseline survey had identified challenges in solid waste management in the two target communities. The partnership subsequently educated community members on the preferred options of waste management, including recycling.	This activity greatly improved the management of solid waste as fewer plastics were available in the general waste stream. The plastics were later taken by the youth for recycling at a recycling plant in Kampala.

III. Partnership Collaborating Stakeholders

Table 6. Collaborating Stakeholders

Organization	Type of collaboration
Youth Centre Support Network (YSCN)	The partnership supported this youth organization to reduce waste in the Kikulu zone through the collection of plastics. This was done through sensitizing the community during the various sessions on the importance of recycling waste, particularly in urban slums. The youth involved in plastics collection were also trained on the ideal ways of handling the waste.
Uganda Health Marketing Group	The project partnered with this non-Governmental Organization to promote use of chlorine tablets (Aquasafe) as an option of treating drinking water at households.

Mukono District Health Office/Department	Mukono district health personnel were involved in many of the awareness-raising activities conducted by the partnership. The Mukono district health department also assisted in carrying home improvement campaigns in the communities – including house to house visits, identifying issues to be addressed, and making recommendations for improvement.
Local Government Councils	The partnership was involved in clean-up exercises in the project communities in collaboration with the local authorities. This activity helped improve the sanitation and hygiene status in the area.
Uganda Institute of Allied Health and Management Sciences (UIAHMS)	The project involved UIAHMS in the development of a curriculum for the short course in Water, Sanitation and Hygiene to be offered by Makerere University School of Public Health.

IV. Sharing Learning: Challenges and Lessons Learned

The partnership experienced the following challenges:

- Given that Ugandan Government approval needs to be obtained (specifically from the Uganda National Council for Science and Technology) to undertake research activities such as the ones included in the partnership, the partnership experienced some delays in obtaining this approval to be able to begin implementation. This delay resulted in the partnership's request for a No-cost extension of one year, which was approved by HED and USAID and executed on September 26, 2012.

- Obtaining human subject approval, even though activities to be undertaken were classified as an educational study, was also required. SUNY's Institutional Review Board requested that every person involved in training activities took the Collaborative Institutional Training Initiative (CITI) training tests, which were unfamiliar to most of the participants and resulted in additional delays in getting the project started.

- The lag in disbursement of funds from SUNY to Makerere University also presented challenges and in multiple occasions slowed partnership progress. Given that the partnership was to be implemented on a reimbursement basis, cash flow constraints presented difficulties to Makerere partnership staff implementing day-to-day activities.

- One of the major challenges the project faced was the frequent migration of people in and out of the two communities. Slum community populations are typically not permanent residents and hence move to other areas whenever there is need, such as in search of jobs. This negatively affected the project's goal of developing greater capacity within the study communities to address WASH issues as some of the members who had been trained left the community. This challenge was mainly addressed by selecting members who had strong ties to

the community and were expected to stay there for a long enough time to participate in major partnership activities.

- In some cases, the partnership experienced challenges convening some community members, despite extensive mobilization, to attend health education sessions. The partners perceived that this was due to the fact that some inhabitants do not consider these communities their permanent residence and are less concerned about community activities overall. There were also some instances of community members stealing the *tippy taps* from some toilets in the area, which prompted some community members to lock the jerrycan in the toilet as opposed to having it installed outside the facility. Although the community was extensively sensitized on the importance of these hand-washing facilities, some members still continued with this negative practice.

- Throughout partnership implementation, Makerere University was closed on a number of occasions—most recently in August 2013 – either due to strikes by students and/or staff. Implementation of partnership activities during these periods was affected as in some instances certain offices could not be accessed.

The following lessons learned were communicated to HED by the partners:

- Selecting and training community members who have strong ties to the community was found to be more effective in terms of disseminating and exchanging WASH related information and skills in the two communities – and increasing the prospects of long-term impact.

- Exchange visits between members of the two communities facilitated the exchange of experiences and lessons learned, and also provided an opportunity to learn of the specific nuances of each project intervention.

- In the first year of the project, continuous stool sample collection and examination from children under 5 years old with diarrhea was conducted. Based on the results, children were referred to nearest health facilities for treatment. However, this activity was not sustainable as the community's expectations of providing medicine to the sick children could not be met by the project. Managing community expectations with respect to partnership activities and expected services to be received is therefore important to address from the beginning.

- Although the project focused primarily on WASH, field work with the communities underscored many other problems faced by these populations, including diseases (such as HIV/AIDS, malaria, tuberculosis), nutrition, poverty, illiteracy, ignorance and health system challenges (few health facilities, regular stock-out of drugs, poor state of health facilities, insufficient health workers and poor health worker attitude).

V. Sustainability

Strong professional and institutional linkages developed between SUNY, Makerere and Tuskegee University through this partnership, both at the faculty and at the student level. Collaborative initiatives will continue to be explored going forward as there is potential for more research and

development projects to assist various communities in Uganda. In the case of this partnership, the inclusion of a secondary U.S. partner, Tuskegee University, added value to the partners' institutional relationships. Tuskegee faculty provided input in the development of research protocols during the partnership initial stage, as well as for other project reports. The investigators from Tuskegee are also playing a role in the writing of various research products that resulted from this collaboration. Other future opportunities for the partnerships include but are not limited to faculty and student exchange visits, joint academic programs, collaborative initiatives, joint projects and conferences.

The partnership provided valuable opportunities for Makerere staff to enhance their skills, thereby contributing to developing capacities within the university to address challenges related to WASH. The substantive engagement of Environmental Health science students and the Students' Association at Makerere in project activities, including in community outreach, helped increase their knowledge and hone their skills as future leaders and practitioners.

The partnership's work in engaging community health workers, youth, and other community members ensured that individuals already involved in health promotion are better equipped to improve the health and wellbeing of their respective communities. Youths involved in awareness-raising activities including demonstrating and installing *tippy taps* for community members will continue doing so to ensure that these practices continue even beyond after program closeout. Many of the community activities, such as clean-up campaigns, were conducted by the community members themselves with only limited support from the partnership, which leads to greater ownership of these efforts and will make the continuation of these activities after partnership closeout more likely.

VI. Conclusions

The partnership demonstrated that meaningful improvements in the lives of residents in urban slums are possible by promoting improved water, sanitation and hygiene practices in collaboration with the community members themselves. The training of WASH community volunteers, local leaders and youth in the communities was crucial in the success of the project as it helped empower residents and create increased capacity within the communities. The involvement of Makerere University students served two purposes: provide experiential learning opportunities for students to supplement their classroom training, and support partnership activities aimed at assisting the communities to improve their overall health status. The students were eager to learn about project activities in the field as well as taking part in planned activities.

The partners' strategy to conduct field research, analyze findings and communicate these to the communities in a straightforward way to ensure that they were well understood paid dividends as it helped enhance the community members' understanding of the major WASH issues affecting their households and the linkages between poor WASH practices and the incidence of water-borne diseases.

Although the partnership focused on capacity building (training, awareness-raising and health education), the communities also had challenges in WASH infrastructure including few and unprotected water sources, dilapidating housing, poor state of human excreta disposal facilities, and insufficient health facilities. Additional support would enable these and other communities with similar challenges to benefit from interventions targeting improvement of health infrastructure.

Section 2: Conclusions and Recommendations

In the case of this Associate Award, HED was able to mobilize partners with a strong track record of collaboration and results to help USAID respond to a Congressional initiative addressing an urgent development challenge in sub Saharan Africa. The pre-existing relationship between the U.S. and Africa partners helped deepen the personal, professional and institutional ties among these institutions. This impact continues after partnership closeout based on ongoing visits by U.S. faculty to the Africa partners, plans for continued collaboration on critical research projects, and the human capacity developed through completion of Graduate programs with support from both partnerships.

At both Bahir Dar University and Makerere University, curriculum was strengthened and faculty skills and pedagogy were upgraded with partnership support. Faculty engagement was broadened through collaboration with national, regional and international stakeholders, presentations in conferences and other academic venues, and peer-to-peer exchanges made possible through the partnerships. In the case of the Cornell-Bahir Dar partnership, joint research will continue with new resources leveraged by the partners, strengthening and deepening a longstanding scientific and institutional collaboration, and there is continued interest in further curriculum development and faculty exchange.

HED's experience with these partnerships shows the importance of engaging higher education in a collaborative way, through partnership, and ensuring that partners directly engage community stakeholders while managing their expectations as applied research and outreach activities are undertaken. HED also learned that the introduction of new partners into longstanding inter-institutional collaboration should be carefully thought through. There was little evidence to determine whether the new partners (Tompkins Cortland Community College and Tuskegee University in this case) were able to significantly expand options for the host country partners.

Regarding partnership management, HED learned that incorporating new requirements well into implementation reduces the chances of successful buy-in and adequate application by the partners. The shift from a set of anticipated outcomes that had been established as part of the partnerships' subaward agreements to a highly structured and more rigorous results-based management approach with different sets of indicators proved challenging to the partners and resulted in sub-standard data reporting to HED. HED has collected and organized the available data for the two partnerships in an effort to reflect this challenge. Performance data is included as Appendix J of this report. Despite these difficulties, noteworthy results were achieved by both partnerships and their reach was expanded well beyond their originally envisioned scope, especially considering the relatively small investment provided to these institutions.

In both Ethiopia and Uganda, a diverse group of stakeholders from NGOs, communities and the government now know that they can access the expertise of their universities to address issues of water quality and sanitation. The modest investment in these partnerships will continue to accrue benefits in the years ahead as students graduate with focused training and community experience that will allow them to contribute solutions to this key development challenge, whether they continue in academe to train future scientists or move into the private sector or government.

Section 3: Financial Data

AMERICAN COUNCIL ON EDUCATION

Higher Education for Development

Higher Education Partnership for Clean Water Associate Award # EPP-A-00-09-00005-00

Interim Final Financial Report

Reporting Period: September 22, 2009 to December 31, 2013

Line Item	Total Project Budget: A	Total cumulative expenses through December 31, 2013 B	Balance on Budget C = A - B
Personnel	$61,853	$48,523	$13,330
Fringe Benefits	$20,430	$15,896	$4,534
Travel	$11,200	$20	$11,180
Partnership Awards	$600,000	$584,149	$15,851
Other Direct Costs	$5,734	$4,195	$1,539
Total Direct Costs	**$699,216**	**$652,782**	**$46,434**
Indirect Costs	$75,784	$64,064	$11,720
Grand Total	**$775,000**	**$716,846**	**$58,154**

NOTES:

Detailed Breakdown on expenses

Personnel & Fringe Benefits

Expenses incurred represent the salary and fringe benefits charges for those individuals providing technical and administrative support to this project. Program staff included Jennifer Sisane, Crystal Morgan, and Diana Paez-Cook.

Travel

While a visit to the region had been envisioned as part of the lessons learned analysis originally planned, there were no travel costs incurred under this Associate Award. The $20 in expenses are taxis and metro fares to attend local meetings with USAID in Washington DC.

Partnership Awards

The Associate Award funded two higher education partnerships: One in Ethiopia, between Cornell University, Bahir Dar University and Tompkins Cortland Community College and one in Uganda, between State University of New York, Tuskegee University, and Makerere University. The partnerships did not use their entire funding as demonstrated in the balance on budget column.

D. Other Direct Costs

Expenses reported under this category include occupancy charges (a direct cost per ACE's NICRA), supplies, materials, photocopying and communications.

E.Indirect Costs

Indirect Costs per ACE NICRA letter. The indirect costs are still subject to final adjustments (the final indirect costs for FY14 expenses will likely to happen during the summer of FY15) and the current expenses are calculated based on the latest provisional rates established by USAID, ACE/HED's cognizant agency for indirect costs.

Appendices

Appendix A. Ethiopia Master's Students List
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Appendix C. Ethiopia Students' Research
Appendix D. U.S. Ambassador's Visit Press Release
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Appendix F. SUNY-Makerere Final Partnership Report
Appendix G. Uganda Baseline Survey Report
Appendix H. Uganda Solid Waste Research Draft Report
Appendix I. Uganda WASH Course Brochure
Appendix J. Partnerships Performance Data

Appendix A. Ethiopia Master's Students List

Cohort I	Cohort II
Abrham M. Edalamaw	Bezawit Adana
Haimanote K. Bayabil	Birara Chekol Tarekign
Aemiro G. Kassa	Dessalegn Chanie Dagnew
Hussien A. Oumer	Dessalew Worku
Anteneh Z. Abiy	Getachew Ewonetu
Tegegne M. Tarekegne	Getahneh Kebebe
Aschalew D. Tigab	Hasbtamu Addis
Tegenu A. Engda	Melisew Misker
Assefa D. Zegeye	Meseret Belachew
Tenagne A. Wondie	Muhammad Elkamil
Biniam B. Ashagre	Tadesse Gasahaw
Tesfaye H. Demeke	Tigist Alumu
Elia S. Leggesse	Tigist Assafa
Tigist Y. Tebebu	Zemenu Awoke
Emebet G. Negash	
Tilashwork C. Alemie	
Fikru A. Mengstie	
Yidnakachew E. Ayalew	
Habtamu T. Kassahun	
Zelalem K. Tesemma	

Appendix B: Ethiopia MPS Course Schedule

Course Schedule 2007-2008, Cohort I

Dates	Course Number	Course Title	Instructors	No. of credits
Nov 1-21, 2007	BEE 694	Watershed design, measurement & planning	Tammo Steenhuis Amy Collick	3
Nov 21-28		Interim period		
Nov 29-Dec 28	BEE 694	Watershed modeling	Tammo Steenhuis, Amy Collick	4
Dec 28-Jan 6, 2008	IARD 694	Technical writing seminar/computer skills	Amy Collick	1
Jan 7-Feb 2		Christmas break (Ethiopian)		
Feb 2-Feb 9		Technical writing	Amy Collick	1
Feb 18-Mar 6	CSS 471	Geographic information systems & remote sensing	Steve de Gloria	3
Mar 10-21	VETMI 783	Management of soil and waterborne pathogens	Dwight Bowman	2
Mar 24-Apr 18	ANSC 694	Livestock in highland farming systems	Bob Blake	3
Apr 20-25		Research preparation/IARD seminar	Tammo Steenhuis, Amy Collick	1
Apr 28-May16	BEE 697	Participatory methods for community watershed and water supply management	Tammo Steenhuis, Angela Neilan, Amy Collick	3
May 18-Jun 6 (two weeks)	CSS477	Nutrient cycling in natural and managed ecosystems	Dawit Solomon, Johannes Lehmann	2
Jun 9-20	AEM 694	Economic analysis of agriculture-based livelihood systems	Chuck Nicholson	2
Throughout	IARD 699	Seminar in international agriculture and rural development	Amy Collick, All	1
July- Nov 2009	IARD599	IARD MPS thesis	IARD faculty	6

Course Schedule 2010, MPS cohort II

Dates	Course Number	Course Title	Instructors	No. of credits
Mar 4-Mar 13, 2010	BEE 694	Hydrology, erosion and watershed management	Steenhuis Seifu Tilahun	2
Mar 14-Mar 26	VETMI 783	Management of soil and waterborne pathogens	Bowman, Liotta	2

Mar 29-Apr 16	BEE 695	Geographic information systems & remote sensing	Fuka, Abeyou, Steenhuis	3
Apr 19-Apr 30	BEE 697	Rural water supply	Steenhuis, Collick	2
May 2-May 21	IARD 699	Technical writing and preparation of research proposals	Collick and Seifu Tilahun	1
May 24-Jun 13		Research period	*	
Jun 15-July 9	AEM 694	Economic analysis of agriculture-based livelihood systems	Nicholson	3
Jul 12-Aug 6		Research period		
Aug 9-Aug 27	CSS 672	Nutrient cycling in natural and managed ecosystems	Solomon and Lehman	3
Sep 6-Sep 24	DSOC 694	Participatory methods for community watershed and water supply management	Neilan and Makki	3
Sep 27-Oct 22	BEE 694	Watershed modeling	Easton, Fuka Steenhuis	4
Throughout	IARD 699	International agriculture and rural development seminar	Steenhuis, Collick, Seifu	1
Oct to Dec 2011	IARD 599	IARD MPS thesis	IARD faculty	6

Appendix C. Ethiopia Students Research

Author	Title	Year
Anteneh Zewdie Abiy	Geological controls in the formations and expansions of gullies over hillslope hydrological processes in the Highlands of Ethiopia, northern Blue Nile region	2009
Meseret Belachew Addisie	Assessment of Drinking Water Quality and Determinants of Household Potable Water Consumption in Simada District, Ethiopia	2012
Zemenu Awoke Alemeyehu	Assessment of Challenges of Sustainable Rural Water Supply: Quarit Woreda, Amhara Region	2012
Tilashwork Chanie Alemie	The effect of Eucalyptus on crop productivity, and soil properties in the Koga watershed, western Amhara region, Ethiopia	2009
Biniam Biruk Ashagre	SWAT to identify watershed management options: (Anjeni watershed, Blue Nile basin, Ethiopia)	2009
Yidnekachew Ewnetu Ayalew	Irrigation, Food Production and Consumption Pattern in Smallholder Rural Households	2009
Essayas Kaba Ayana (PhD)	Remote Sensing Tools for Land and Water Management in Data Scarce Blue Nile Basin	2013
Getaneh Kebede Ayele	The Impact of Selected Small-Scale Irrigation Schemes on Household Income and the Likelihood of Poverty in the Lake Tana Basin of Ethiopia	2011
Haimanote Kebede Bayabil	Modeling rainfall-runoff relationships and assessing impacts of soil conservation research program intervention on soil physical and chemical properties at Maybar research unit, Wollo, Ethiopia	2009
Melisew Misker Belay	Organization and Management of Irrigation Schemes in Eastern Amhara, Ethiopia: In Case of Sanka Traditional and Golina Modern Irrigation Schemes	2012
Habtamu Addis Beyene	Factors Affecting the Sustainability of Rural Water Supply Systems: The Case of Mecha Woreda, Amhara Region, Ethiopia	2012

Author	Title	Year
Dessalegn Chanie Dagnew	Factors Determining Residential Water Demand in North Western Ethiopia, The Case of Merawi	2012
Aschalew Demeke	Determination of household participation in water source management: Achefer, Amhara region, Ethiopia	2009
Tesfaye Habtamu Demeke	Assessment of Sustainable Watershed Management Approach: Case Study Lenche Dima, Tesgur Eyesus and Dijjil Watershed	2011
Bezawit Adane Demisse	Discharge and Sediment Yield Modeling in Enkulal Watershed, Lake Tana Region, Ethiopia	2011
Abrham Melesse Endalamaw	Optimum utilization of ground water in Kobo valley, Eastern Amhara, Ethiopia	2009
Tegenu Ashagrie Engda	Modeling rainfall, runoff and soil loss relationships in the northeastern Highlands of Ethiopia, Andit Tid watershed	2009
Aemiro Gedefaw Kassa	Simulating the Hydrologic Response of Gilgel Abbay Watershed with a Simple Semi-Distributed Water Balance Model	2011
Habtamu Tilahun Kassahun	Payment for environmental service to enhance resource use efficiency and labor force participation in managing and maintaining irrigation infrastructure, the case of the upper Blue Nile basin	2009
Elias Sime Legesse	Modeling Rainfall-Runoff relationships for the Anjeni watershed in the Blue Nile Basin	2009
Getachew Ewonetu Mamo	Identifying Major Constraints of Ground Water Use for Irrigated Crop Production: Fogera Plain, North Western Ethiopia	2013
Fikru Assefa Mengstie	Assessment of adoption behavior of soil ad water conservation practices in the Koga watershed, Highlands of Ethiopia	2009
Hussien Ali Oumer	Land use and land cover change, drivers and its impact: A comparative study from Kuhar Michael and Lenche Dima of Blue Nile and Awash basins of Ethiopia	2009
Birara Chekol Tarekegn	A Case Study of Gully Erosion in the Ethiopian Highlands: The Warke Watershed	2012

Author	Title	Year
Tegegne M. Tarekegne	Sustainability of rural water supply and sanitation services in Ethiopia: A case study of twenty villages in Ethiopia	2009
Tigist Yazie Tebebu	Assessment of hydrological controls on gully formation near Lake Tana, northern Highlands of Ethiopia	2009
Zelalem Kassahun Tesemma	Long term hydrologic trends in the Nile basin	2009
Seifu Admassu Tilahun (PhD)	Observations and Modeling of Erosion from Spatially and Temporally Distributed Sources in the (Semi) Humid Ethiopian Highlands	2012
Tenagne Addisu Wondie	The impact of urban storm water runoff and domestic waste effluent on water quality of Lake Tana and local groundwater near the city of Bahir Dar, Ethiopia	2009
Assefa Derebe Zegeye	Assessment of upland erosion processes and farmer's perception of land conservation in Debre-Mewi watershed, near Lake Tana, Ethiopia	2009

Appendix D. U.S. Ambassador to EthiopiaVisits Bahir Dar

Press Release 2010; US Embassy Ethiopia

U.S. Ambassador Travels to Bahir Dar, Addis Ababa, July 29, 2010

U.S. Ambassador to Ethiopia, Donald E. Booth, and his wife Anita Booth, traveled to Bahir Dar from July 28-29 to meet with regional and local officials, visit U.S. assistance projects and programs, meet with American citizens and learn about economic development issues in the Amhara area. He was accompanied by the Director of the U.S. Centers for Disease Control (CDC) in Ethiopia, Dr. Thomas Kenyon, and other U.S. Embassy staff. During his first visit to the Amhara region, Ambassador Booth paid calls on Regional State President Ayalew Gobeze and the Bahir Dar City Mayor Alemayehu Sewagegne. He also had the opportunity to meet with religious leaders from Bahir Dar's newly launched Interfaith PeaceBuilding Council and hear about their efforts to promote tolerance and interfaith dialogue in the region. Ambassador Booth and Dr. Kenyon visited the National Defense Force of Ethiopia (NDFE) barracks in Bahar Dar to witness the HIV-AIDS peer education and prevention program supported by the U.S. Government through a cooperative agreement with NDFE. They also received a briefing on the NDFE's Modeling and Reinforcement to Combat HIV/AIDS (MARCH) programs. Ambassador Booth and Dr. Kenyon also met with Bahir Dar University (BDU) President Yeshimebrat Mersha, and the directors of two innovative degree programs offered by the university in conjunction with two American universities, Arizona University and Cornell University. BDU partners with Arizona University in offering a disaster risk reduction and sustainable development master's degree program and with Cornell in providing a watershed management and water supply master's degree program. Both of these academic programs have received funding from the U.S. Agency for International Development. Ambassador Booth and seven U.S. Peace Corps Volunteers who are working in the Amhara region visited the Aba Megesha Geneme Public Library and Information Center where there is an American Corner Library supported by the U.S. Embassy. They received a briefing from the Jerusalem Children and Community Development Organization, which manages the library, about its development programs in the region. The Ambassador also had the opportunity to meet with library clients, including high school students who had participated in the Embassy's annual African American History Month essay contest. Mrs. Booth visited the Children's Library located on the same compound and participated in a special story hour with children from Bahir Dar. Ambassador Booth also traveled to the Tana Beles Hydropower Plant, currently Ethiopia's largest power plant. He met with project personnel at the plant and received a plant tour. Mrs. Booth visited the Tana Medhanealem Integrated Development Association to view U.S.-supported poultry farming and beekeeping projects, and meet with program beneficiaries.

Improved Drinking Water Utilization through Integrated University Research, Planning, and Training Initiatives in the Lake Tana Region, Ethiopia

Participating Institutions:

Cornell University

Bahir Dar University

Tompkins Cortland Community College

Written by:

Tammo Steenhuis, Steven Pacenka, Amy Collick, Seifu Tilahun, Essayas Kaba and Alice Pell

Cover Photo: Graduation ceremony of the 19 students of Masters Cohort I at Bahir Dar University including Cornell President David Skorton and Cornell Vice Provost for International Relations Alice Pell.

Abstract

Access to safe drinking water services in the Ethiopian Highlands is one of lowest worldwide. One of the main reasons is improper design practices because of the lack of appropriate integrated programs at the University level training future teachers in participatory methods in water management and water supply. Therefore the major objective of this program was to teach a cadre of Masters and PhD students integrated water management methods and researching improved methods for water management in the Ethiopian highlands. The HED funding was instrumental in establishing two integrated water management programs at Bahir Dar University, one at the Masters level and one at the PhD level. The programs have graduated 31 Masters students and two PhD students with Cornell University degrees related to Integrated Watershed Management and Water supply These students are now teachers, professionals or graduate students instructing a wider group of students and other professionals integrated methods. Two Master's students and 14 PhD students that started their education with HED funding will receive their degree in the future.

As part of the research, over one hundred water supply systems were surveyed to find the underlying causes of failure and poor performance throughout the Ethiopia highlands in Amhara Regional State. The results show generally that systems with decision making power at the community level during design and construction remained working longer than when the decisions were made by a central authority. In addition, the sustainability was better for water systems that were farther away from alternative water resources and contributed more cash and labor.

In addition we have greatly increased the knowledge base in soil and water management by performing field research. We demonstrated (as the first research group) that most runoff is generated from the periodically saturated bottomlands and from degraded areas (eroded nearly to the subsoil from intensive land management) instead of the steep hillslopes. The major eroding gullies can be found in the saturated areas as well. Management efforts to control soil losses should therefore be directed to these periodically saturated and degraded areas

Overall, the results of this project show the importance of both selecting the appropriate design practices attuned to local conditions prevailing in the Ethiopian highlands and decision making at the local level in contrast to the central authority. Moreover, by teaching methods attuned to local conditions and a monsoon climate instead of copying methods from temperate climates, this project has made a great impact on the research, planning, and training in the Lake Tana Region and in the highlands of Ethiopia.

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1. Overview

1.1 Context and Objectives

The outcomes of many rural engineering activities are less than optimal in Ethiopia due to the lack of community involvement during planning, design, and construction. Water harvesting structures fail, soil and water conservation structures not maintained and access to safe drinking water supplies and sanitation services is among the lowest in Sub-Saharan Africa. The major problem is that many civil and environmental engineers, especially in developing countries, are traditionally trained to optimize designs according to engineering principles.

Therefore, we set out in this project on augmenting engineering curriculum and design principles, involving students in participatory methods. We expected (and has been proven true) that by enabling these students to work with their rural clients rather than imposing design, they would once in leading positions at universities they would alter the engineering curricula to be more sensitive to the local context. This in turn would make students more capable of designing sustainable water resource systems.

This approach was in accordance with our objectives stated in our proposal for the USAID/HED funding, namely:

1. Producing a "client-centered" approach in the design of small-scale water development;
2. Engendering sustainable development of water resources;
3. Promoting the use of safe drinking water; and
4. Improve water supply systems by field based research and design.

1.2 Summary of accomplishments

Enhance the human and institutional capacity at BDU and Ethiopia.

This project had a significant effect on integrated water management and water supply in Ethiopia. A Master's program in Integrated Water Management was developed in 2007 as one of the first graduate programs on the Bahir Dar campus. This Master's program was taken over by Bahir Dar University in 2011. In 2012 a PhD program was initiated by the School of Civil and Water Resources Engineering at Bahir Dar University and Cornell University. HED funding played a central role in these programs. It helped with finishing the research of the first cohort master's students, funded entirely the second cohort of 13 students, and paid partly the first year of the five PhD students. In addition it provided the administrative cost of advertisement and entrance exam of the second cohort of five PhD students. In addition HED funds paid

partially for the research of the five Ethiopia PhD students at Cornell University in Ithaca. The first two of these five students graduated and presently represent 50% of all the PhDs in the Engineering school. They have already leading positions within the University and are still active in research. In addition, HED funded outreach to the community and symposia where the research results were presented.

Our accomplishments are summarized according to the objectives as follows:

Produce a client-centered approach; that enabled students to work across disciplinary boundaries.

We were successful in teaching a client centered approach by designing Master's and PhD graduate programs in integrated engineering water management and water supply. These were the first such programs in Ethiopia and have been replicated at the two other Universities in Ethiopia. Students were admitted in the program with a background of plant science, natural resource management, economics, mathematics, soil science and various disciplines in Engineering. Courses were taught that included field survey methods, economics, watershed management, modeling and water supply. (See appendix A for the detailed list of courses.) While the students during the first field trip were not willing to engage with the farmers (clients), 90 percent of all theses involved a survey of the clients for whom the design was intended. The Master's program is described in Section 2 and the PhD in section 3. Success stories of two students featuring their individual achievements are given in Appendix D.

Promotion of sustainable development.

Sustainable development often fails because the underlying problems are not well understood. For example, 40 percent of all erosion is caused by faulty installation of soil and water conservation practices according to Mituki Hailu, soil scientist and former president of Mekele University. Similarly we found that many approaches in providing potable water would not result in sustainable systems. Most systems were unsustainable because the stakeholders did not have a responsibility of managing the contractors putting in the system. In addition we found when training was provided after the installation the life of the systems was longer. These improved methods for sustainable installation of water supply system and improved siting of soil and water conservation practices are now being taught at the various universities and colleges and implemented at NGO's and local governments. In the PhD program we continue to study design practices that are more sustainable. In Appendix B the titles of the Master's theses, PhD dissertations, 16 refereed papers and 22 conference papers are listed. Full

text of theses and many other products can be retrieved by searching by author or title key words at:

http://soilandwater.bee.cornell.edu/Research/international/eth_pubs.htm

Promotion of the use of safe drinking water.

Based on the research of the Master's students and available literature, under a grant with WaterAid Ethiopia, a set of six briefing notes was prepared. These were:

1: Bottlenecks of operation and maintenance;

2. Wisdom at the source of the Blue Nile – MUS;

3. Sanitation promotion and household latrine;

4 Sanitation promotion;

5. Can Communities Manage Complex Technologies?

6. The Role of Users at the Different Levels of WASH Projects.

HED provided full support for one authors and partial support for the second author of these six reports. Results were also published in a peer reviewed journal "Water Policy" by Tigabu *et al* in 2013. Full text of these publications are available at the website mentioned above and an overview of the findings is provided in Appendix E. Presentations were made at the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods Addis Ababa June 2013 and at International Conference on Science and Technology towards the Development of East Africa (ICST) in Bahir Dar in May 2013 in Bahir Dar. The HED funding played a critical role in obtaining the follow-up grant by WaterAid that aided in the write up and the distribution of the products.

Improve water supply systems by field based research and design.

As carry over from the previous project we improved research on both water supply and soil and water conservation. Above we reported on the research on water supply. In addition, the students and faculty of the Master's and PhD programs have greatly increased the knowledge base in soil and water management and water supply in the Ethiopian highlands by performing field research. They were the first to demonstrate that most runoff is generated from the periodically saturated bottomlands and from degraded areas (eroded nearly to the subsoil from intensive land management) instead of the steep hillslopes. This is of great practical value since it means that the practice of

installing stone bunds randomly on the hillsides carried out under the various food for work programs might not be as effective as placing practices on the degraded and bare areas. In addition we have been first to show that the major gullies start in the saturated areas at the bottom of the watersheds and move upstream. The slumping of the gully walls is a direct result of pressure from the high water table. We have started our work on arresting the advance of the gullies in the PhD program, but further experimentation and theoretical development is required. Finally our research on improvement of water supply systems is continuing.

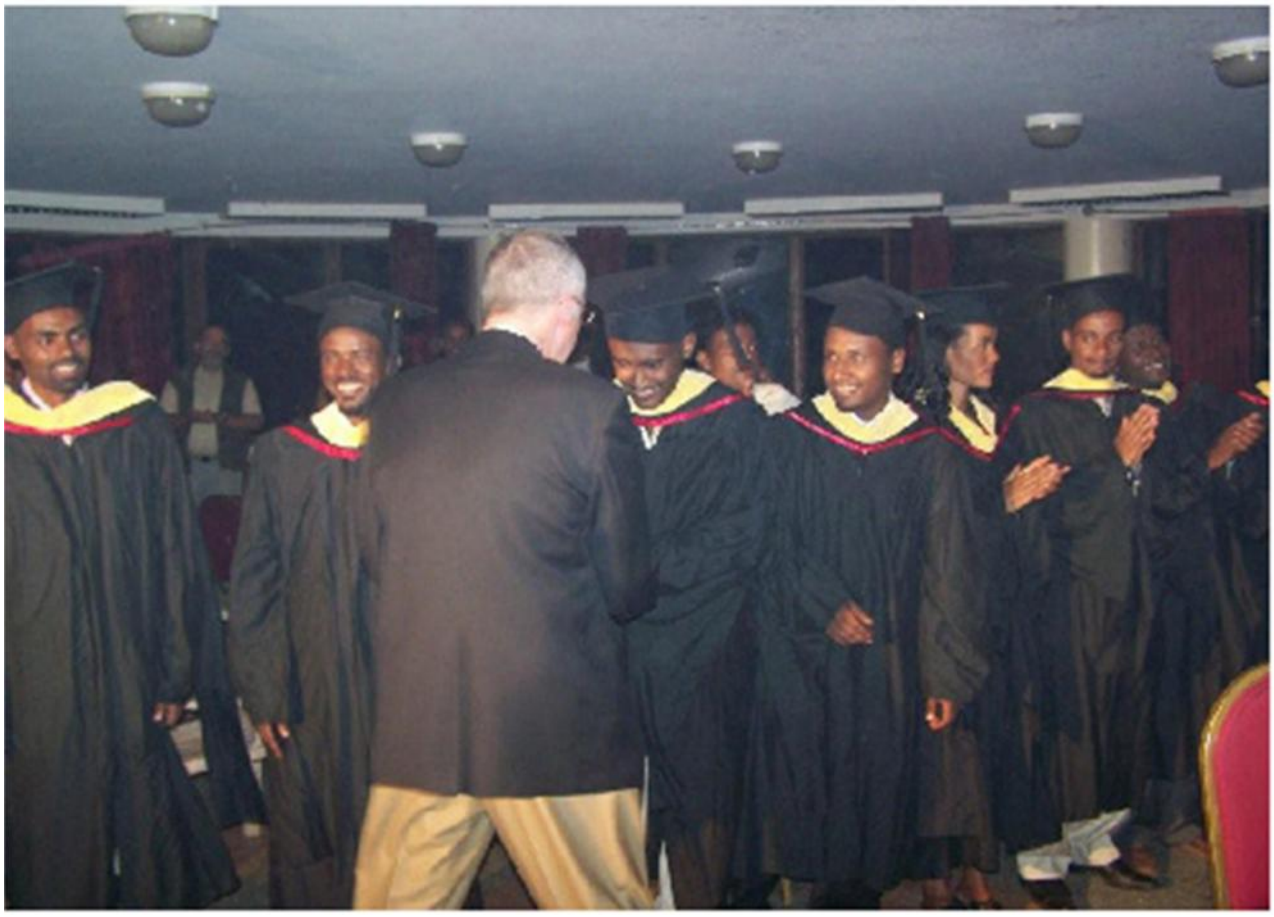


Figure 1: Cornell president David Skorton congratulates the MPS Cohort I students in Bahir Dar on obtaining the Master's degree

1.3 Outreach

This program was very visible. Cornell President Dr. David Skorton and Vice Provost for International Relations Dr. Alice Pell gave speeches at our first graduation ceremony at Bahir

Dar University and President of Bahir Dar University Dr. Baylie Damtie visited Cornell University to give the opening speech at a symposium on water management under water scarce conditions. The US ambassador and USAID personnel have visited the program in Bahir Dar University.

Students and faculty made presentations at: meetings of local chapters and international annual conferences of various professional organizations (such as the soil science society, American Geophysical Union and the European Geoscience Union); Universities in Africa, Europe and US; specialty symposia; and also to local communities in the watersheds where the students carried out their work. The results were published in International and Ethiopian proceedings and International Journals. Publications through fall 2013 included sixteen refereed articles, seven book chapters, and twenty two conference papers. These are listed in Appendix A. Dr. Amy Collick, who was the HED paid coordinator at Bahir Dar, played a central role in the research as well in the writing of publications.

1.4 Cooperation

The primary educational partner within the US was Cornell University. An additional US partner was to be Tompkins Cortland Community College (TC3) in Dryden, NY. It became evident after several meetings that the high teaching load of TC3 instructors would be an obstacle for them to visit Ethiopia to interact with Ethiopian students and gain direct international experience; scheduling trips to match their in-US commitments with Cornell instructor presence in Ethiopia proved impossible. Any future project involving community colleges should include funds to hire substitute teachers to free time for the primary ones to engage in overseas activity.

We worked closely together with a number of organizations, governmental, academic, and nongovernmental.

Amhara Region and other Ethiopian Governmental organizations:

ARARI (Amhara Agricultural Research Institute): Cooperatively performed research in four watersheds: Andit Tid, Anjeni, Debre Mawi and Maybar. We analyzed long-term discharge and sediment data provided by ARARI. Published refereed papers together with ARARI. Our project provided input on long term policies on soil conservation

TaSBO (Tana Sub Basin Organization) and BeSBO (Beles Sub Basin Organization): The Project provided a six week course on watershed modeling to upgrade skills staff of both

offices. In addition we gave hands-on training for discharge, sediment and phosphorus modeling of watersheds. Currently we are advising TaSBO on Lake Tana Management options related to possible future pollution.

.

BoA (Bureau of Agriculture) Bahir Dar**:** The project upgraded staff and advised on water supply systems.

Water and Land Resource Center-Addis Ababa Ethiopia**:** The project cooperated in research in the Debre Mawi watershed and Anjeni Watershed

Universities:

Jimma University. Gave seminar to faculty and discussed cooperation.

Addis Ababa University. Interaction on water management. Interchange of instructors

University of Debre Tabor. Cooperated together with Bahir Dar University on writing a grant proposal to USAID

Woreta College of Agriculture. Project advised on establishing a program in Integrated Watershed Management in their Department of Economics.

International Organizations:

SWISHA (Sustainable Water Harvesting and Institutional Strengthening in Amhara) was located in Bahir Dar and funded by Canada. Project provided training to the staff on computer simulations. SWISHA aided the project with logistic support in the Debra Mawi watershed and making connections with the various governmental organization in Bahir Dar

CGIAR's IWMI (International Water Management Institute) and ILRI (International Livestock Research Institute): Cooperated closely with IWMI on research on rain water management in the Nilebasin II project and in adapting the SWAT water simulation model for the Ethiopian highlands. Participated in research and dissemination activities. Provided two chapters for a book on the Nile.

iDE, International Development Enterprises funded one of the students to work on irrigation project in the Rift Valley.

WaterAid of Ethiopia provided funding and cooperated on publishing a set of six factsheet on Water Supply and Sanitation and its dissemination.
UNICEF as leader of the international WASH (Water Sanitation and Hygiene) initiative was a partner in our outreach work with WaterAid Ethiopia.

Figure 2: Christian Guzman, a Cornell PhD student, interacting with the local community on a transect walk

1.5 Long-Term Impact

Our long-term impact is the establishment of the Master's and PhD programs in Integrated Water Management at Bahir Dar University. These two programs are taken over by Bahir Dar University and are part of the regular University budget. The other impact we have had is on the 43 students in the various programs of which 14 Master's students in Cohort II were fully supported by HED. The remaining students were partially supported by HED. These were

nineteen surviving Master's students in Cohort I, ten PhD students at Bahir Dar University (including three who received Cornell Master's in IWM) and six PhD students at Cornell University in Ithaca (of whom three received Cornell Master's in IWM). Master's students in Cohort I and Cohort II have received their (Cornell) degree with the exception of three in Cohort II. Their subsequent positions are given in the table below.

Table 1. Subsequent Employment of Master's students of Cohorts I and II.

Next Role	**Cohort I 20 students total**	**Cohort II (14 students**
PhD or second MS studies	10 (Cornell x 3, Alaska, Wyoming, Amsterdam, Exeter, Melbourne, Copenhagen, Bern)	4 (BDU x 3, UNESCO/Delft)
College level teaching or extension	4 (Wollo x 2, Jimma, BDU all ET)	2 (Wollo ET, Wageningen)
NGO International	1 (GIZ)	1 (Save the Children)
NGO Ethiopia	1 (ORDA)	1 (ORDA)
Private	1 (consultant)	0
Government - Ethiopia	2 (ARARI, Tana Abbay)	2 (ARARAI, High school head)
Government - International	0	1 (UN World Food Program)
(Thesis still in progress as of December 2013)		1 (a mother; thesis in progress as of December 2013); 1 completed degree requirements after December 2013, not tracked yet
MPS DEGREE NOT COMPLETED	*1 (deceased during studies)*	*1 (left for another university in Europe, finished there)*
TOTAL ADMITTED	20	14

Two of the PhD students, Seifu Tilahu and Essayas Kaba have received their doctoral degrees. Dr. Tilahun is currently director of the Bahir Dar University School of Civil and Water Resources Engineering with 3500 undergraduates and 600 graduate students. He oversees our PhD curriculum. Dr. Essayas Kaba Ayana is the director of the Remote Sensing Laboratory at Bahir Dar University. Both students were supported by HED funds while performing their research in Ethiopia Finally Steenhuis received the prestigious International Award from the American Geophysical Union mainly for the work carried out under this project.

1.6 Remainder of this report

The remaining sections and appendices of this report provide greater detail about teaching, research and publication aspects of the Cornell Master's program that started in 2007 and the Bahir Dar University PhD program that started in 2012.

Part 2 describes the students and courses of the Master's program between 2007 and 2012.

Part 3 describes the PhD programs, both BDU's successor to the Master's program and the closely related Cornell one that is assisting BDU faculty to improve credentials and that provided an earlier option for Ethiopian students before the BDU PhD program became available.

Part 4 describes the research activities of the MPS students with their faculty advisors and collaborating institutions.

Figure 3: Cohort II in the classroom with the guest teacher

2. The Cornell Master's Program at Bahir Dar University

2.1 Master's Program Structure

The Cornell University/Bahir Dar University (CU/BDU) Master of Professional Studies (MPS) program in International Agriculture and Rural Development officially began in early November 2007, when 20 students reported to BDU to begin studies in Integrated Watershed Management and Hydrology. In January 2010 another 14 students came to the Bahir Dar campus. This is the first graduate degree program where a student could earn a Cornell degree without setting foot on a Cornell campus. The core funding for the program for tuition and course-related expenses, but not research costs, came from several sources. Cohort 1 was funded using $150,000 from the Development Innovation Fund (DIF), which is financed by the Ethiopian Government and a World Bank loan. The Ethiopian Government and Bahir Dar University transferred these funds to Cornell University. The second cohort's core funding was provided by Higher Education for Development (HED) using funds from USAID, and by USDA-SEA. Research funds have been contributed by Cornell donors and, for six students, by the International Water Management Institute-Ethiopia.

The program was based at BDU, the primary university in the Amhara region of Ethiopia. BDU's location, adjacent to Lake Tana, makes it ideal for a program in watershed management. Lake Tana contains more than 50% of the stored fresh water in Ethiopia. Excessive siltation due to inappropriate water and vegetation management in the surrounding highlands is damaging the lake. Lake Tana is the source of the Blue Nile River, whose management has been the cause of several on-going disputes among Ethiopia, Sudan and Egypt. The goal of the CU/BDU program is to train professionals who can help to institute more effective and sustainable watershed management practices.

This program has helped to create a strong partnership between BDU and Cornell. The program was coordinated at Cornell by Tammo Steenhuis together with Alice Pell.; Amy Collick, Ayalew Wondie and Seifu Tilahun have served as the Bahir Dar University coordinators Administratively, Ginny Montopoli has been the liaison to the Cornell Registrar's office and CALS instruction. Jim Haldeman and Bob Blake were instrumental in obtaining the initial approval from the graduate school for this unique program.

2.2 Master's Students

The first group of 20 students admitted to the program included 17 men and 3 women with diverse undergraduate backgrounds. The second group consisted of 14 students of which there were 11 men and 3 women. One of the second group is from Sudan. The Ethiopian students were chosen from a field of more than 300 applicants who met Cornell's admissions criteria. The students were selected based on their undergraduate academic performance, grades on an admissions examination, teacher/ employer recommendations and the students' personal statements outlining their motivation for pursuing advanced training in integrated watershed management. Almost all of the students have some practical development experience and were among the top 5% of their university classes. All of the Cornell faculty who worked in Bahir Dar agree that cohort I included an exceptionally talented group of students. The large number of applicants was in part because of the value of a degree from a well-known university in the USA.

Figure 4. Meseret and Getachew of cohort II enjoying the field visit to the Debra Mewi watershed

The Program's Cohort II Students

Bezawit Adana

Birara Chekol Tarekign

Dessalegn Chanie Dagnew

Dessalew Worku

Getachew Ewonetu

Getahneh Kebebe

Hasbtamu Addis

Melisew Misker

Meseret Belachew

Muhammad Elkamil

Tadesse Gasahaw

Tigist Alumu

Tigist Assafa

Zemenu Awoke

The Program's Cohort I Students

Abrham M. Edalamaw

Haimanote K. Bayabil

Aemiro G. Kassa

Hussien A. Oumer

Anteneh Z. Abiy

Tegegne M. Tarekegne

Aschalew D. Tigab

Tegenu A. Engda

Assefa D. Zegeye

Tenagne A. Wondie

Biniam B. Ashagre

Tesfaye H. Demeke

Elias S. Leggesse

Tigist Y. Tebebu

Emebet G. Negash

Tilashwork C. Alemie

Fikru A. Mengstie

Yidnakachew E. Ayalew

Habtamu T. Kassahun

Zelalem K. Tesemma

2.3 The Master's Classes

The students were required to complete 24 credits of classroom instruction and a 6-credit research or development project. The required courses included: 1) Watershed measurement, design, and planning; 2) Watershed modeling; 3) Geographic information systems & remote sensing; 4) Technical writing; 5) Management of soil and waterborne pathogens; 6) Livestock in highland farming systems; 7) Research preparation/IARD seminar; 8) Participatory methods in community watershed management; 9) Nutrient management in agroecosystems; and 10) Economic analysis of agriculture-based livelihood systems. For Cohort II, the Livestock and farming systems course was replaced by a water supply course because the HED funding emphasized water supply. Cohort I presented their research in 2009 at the IWMI workshop "Upstream-downstream impacts in the Nile" and were well received because of their field based approach and the originality of the research. Short summaries of the research projects are given in Appendix B. Cohorts I and II presented during a one day symposium in December 2011 for faculty and government officials in Bahir Dar. Students also reported at the IAESTE symposium in May 2013 in Bahir Dar.

Each teaching block concentrated all of the hours of instruction of a particular course into a 3-4 week period. Six Cornell faculty members: Robert Blake, Dwight Bowman, Steven DeGloria, Chuck Nicholson, Dawit Solomon, and Tammo Steenhuis traveled to Bahir Dar for Cohort I courses at separate times to teach an intensive two- or three-week session. Zach Easton and Daniel Fuka both from the Cornell Department of Biological and Environmental Engineering helped with the second Cohort teaching GIS and watershed modeling. Angela Neilan from Virginia Polytechnic University was instrumental in making the "participatory methods in community watershed management" course a success. The Cornell program coordinator at BDU, Amy Collick, was responsible for teaching technical writing, supervising development of project proposals, and the day-to-day activities of the program.

Figure 5. Angela Neilan teaches the students participatory methods

During a typical week, there were more than 20 faculty-student contact hours, exceeding the minimum required for full time students. The Bahir Dar students are completely immersed in one class at a time, as opposed to their Ithacan counterparts, who typically take multiple courses

concurrently during a semester. To ensure that students get adequate guidance in the preparation of their research proposals, an electronic advising system was developed. Bahir Dar University provided a coordinator, transport for the students to go out to the field and two rooms furnished with computers, classroom furniture, and internet access.

The program was designed to offer students a blend of theoretical and practical studies to build their expertise in watershed management and hydrological sciences. The courses cross the disciplines of: civil and agricultural engineering; crop, soil and animal sciences; natural resource management; economics and other social sciences; and communication. The students have performed well outside of their (undergraduate) disciplinary comfort zones. The undergraduate engineers have been quick to grasp the social, economic, and biological complexities of an integrated approach to watershed management, which if not taken into account can undermine the best technical design.

Students with non-engineering backgrounds have shown an excellent grasp of hydrological engineering concepts and the ability to utilize these concepts in practical applications. For example, on one exam, all of the students were able to model the future pollution status of Lake Tana, assuming that the current pollutant input rates continue. A combination of many skills is crucial to envision and foster positive steps for Lake Tana to avoid the high levels of pollution evident in Lake Victoria and the other Great Lakes of Africa.

Figure 6: Walk through the Enkula watershed

Field trips to nearby watersheds provided important context for the program. On one trip, the students visited a Canadian-sponsored watershed project that is being studied by regional and international researchers. This site, only 40 km from Bahir Dar, is the location for some students' thesis research. Another field trip allowed the students to mingle with water resources and watershed management specialists from the International Water Management Institute and other national and international organizations. Students visited a large-scale irrigation scheme that included a large earthen dam, reservoir, and irrigated area. This visit highlighted the importance of the perceptions of members of the

upstream and down-stream communities, and the utilization and maintenance of the irrigation scheme, to the managers of the watershed supplying the reservoir. The third set of field trips focused on agricultural systems and their contributions to water pollution and soil erosion. For the participatory methods course, the Cohort I students developed community surveys pertinent to their research and tested the questions during a 3-day field trip to Debre Tabor. Cohort II went to Woldya, to one of the more successful watersheds projects in Ethiopia in which Cornell was involved in the early nineteen nineties.

Figure 7: Cohort II students on the first day of the Watershed Management course,

2.4 Challenges Faced

The program has not been without some challenges: The broadband internet connection at Bahir Dar University is good compared to the prevailing standards in rural Ethiopia. However, when there is no electricity – which was especially the case during the end of the dry season during the first years there were outages every other day -- there is no internet. Electricity supply in Bahir Dar is currently good due the new Tana Beles hydropower station. Internet-based courses were not feasible at the time, but the CU-BDU students could access the Cornell library system including electronic journal subscriptions thanks to modifications made by the Mann Library staff.

There were misunderstandings about the amount of salary provided and the value of the Cornell Master's degree during the initial phases of the program. Inconsistent information given

by the first two instructors was part of the problem. Lack of direct contact with US-based Cornell graduate students who could explain misunderstandings and differences between the Ethiopian and American educational systems also played a role. (Some of this was from the lack of overlap of incoming students with continuing ones; Peers a year or two farther along can be an excellent resource for the incoming students.) These issues were fully resolved. All the graduates of the program have become fully aware of the unique education they have been receiving and are grateful to HED and Cornell University for sponsoring the program.

Figure 8: Hussien and Abraham are really happy in their Cornell gowns

Obtaining the required funding for Cohort II was more difficult and time consuming than initially anticipated since the funding has to come from outside. HED, USDA and a Cornell donor were found but the program could not start until a year after the entrance exam was given. Several students therefore could not participate. Cornell's College of Agriculture and Life Sciences provided a grant for their portion of tuition and fees.

The Cornell admissions panel's merit-based selection criteria caused some misunderstandings with potential Ethiopian institutional sponsors, who had their own system of selection criteria

for further studies. Indeed, some institutions did not provide leave to the students; eleven students in Cohort I had to resign their jobs to enter the program, leaving them without income. Funds for support of students' research have been received from IWMI and three U.S. donors.

Students have found it challenging and rewarding to adjust to the less formal and more practical style of American higher education in engineering curricula (including social sciences tailored for engineers). Instead of teaching theoretical principles, the program taught practical application of theoretical principles directly related to Ethiopian conditions. The relatively informal student-faculty interactions with Cornell faculty differ from those that they experienced as undergraduates. While the less formal atmosphere encourages exploration and application of new ideas, students were not always certain about what is permissible and what is not.

Although the program focused on training students, the participation of Bahir Dar University staff in each course has steadily improved over the course of the program. The Master's program, independent within BDU in the beginning, now has an academic home. Being within the administrative structure of the university, the program will obtain funding through the regular university process from the Ethiopian government. As of September 2011, the MPS program began to be taught as a Bahir Dar University program with students receiving a MSc from Bahir Dar University.

As of December 2013 all nineteen students of Cohort I and eleven of thirteen have completed their MPS degree; one more from Cohort II has completed requirements and will receive their degree in May 2014, and the last has a third draft thesis under review. (Cohort I began with 20 then suffered the loss of Emebet Negash who was killed in a vehicle accident. Cohort II began with 14, one of whom left to begin and complete studies at the University of Delft.

Figure 9. Cohort II PhD students relaxing in the faculty cafe at the Polytechnic campus in Bahir Dar

3. The BDU and Cornell PhD Programs

3.1 Cornell's Existing PhD Program

Cornell's long-standing PhD program in the Graduate Field of Biological and Environmental Engineering (BEE) provided opportunities for BDU faculty to improve their credentials beyond the Masters level. BDU faculty members and partnership principals Seifu Admassu and Essayas Kaba completed Cornell PhD requirements in 2012 and 2013 respectively. BDU faculty member Abeyou Wale should receive his Cornell PhD in 2015. Seifu was appointed as director of the BDU School of Civil and Water Resources Engineering. It has 6000 undergraduate students and 600 MS students.

This Cornell PhD program also provided a way for three of our MPS graduates to work at the PhD level in a way strongly affiliated with BDU, prior to BDU having its own PhD option. MPS cohort I students Tigist Yazie, Haimanote Bayabil, and Assefa Zegeye were accepted into Cornell's program and have completed their course requirements, and as of late 2013 were conducting their field research within Ethiopia.

Additionally, this same curriculum and other PhD curricula at Cornell provided a way for non-Ethiopian students to contribute to Ethiopia by conducting their research within Ethiopia. Student Matt Hurst (field of Civil and Environmental Engineering) completed studies related to waterborne disease in Ethiopia. BEE field Student Christian Guzman continues studies of erosion and related sediment transport. Both of these students pursued projects within Ethiopia, spent considerable time there, and worked with the local communities.

3.2 BDU's New PhD Program

BDU's PhD program in Integrated Water Management (IWM) in the School of Civil and Environmental Engineering at the Institute of Technology at Bahir Dar University (BDU) was officially approved in April 2012 by the BDU Senate. The IWM PhD program was initiated after handing over successfully the Master’s program in Integrated Watershed Management to the BDU Faculty of Agriculture. Some coursework of the MPS program was carried into the PhD program, and other into BDU's MSc program in Engineering Hydrology.

The structure of the PhD program is based on the graduate program at Cornell and has, for example, graduate student committees with chairpersons chosen by the students. The program recognizes that natural resources (including water) can only be managed successfully with an interdisciplinary effort.

Figure 10: Visiting the main weir of the Debre Mawi watershed during a field trip. From left to right: Dessalegn Chanie, Seifu Tilahun, Mamaru Ayalew, Getaneh Kebede and Fasikaw Atanaw. Muluken Lakachew is not depicted.

The IWM PhD program is unique in that it is the first PhD program in the BDU Institute of Technology and the only integrated PhD program in Natural Resources in Ethiopia. Working across disciplinary boundaries is not easy and should be learned while at the University. Cornell support for this PhD program is essential since there is a lack of associate and full professors in Ethiopia who can serve as major professors for the students committees. In addition teaching classes by Cornell faculty is important so that the same high standards are maintained as at Cornell. The IWM PhD program is coordinated by Dr. Seifu Tilahun, who is an assistant professor in the Department of Water Resources Engineering and currently the director of the School of Civil and Water Resources Engineering. He received his doctorate in the Biological and Environmental Engineering at Cornell University in January 2012.

In July 2012, twelve students applied to the PhD program. Admittance exams were held in mid-August. Five of the twelve students were admitted in September 2012. These students and their expertise are listed in the table below.

Fasikaw Atanaw		Instructor in the Department of Water Resources Engineering at Bahir Dar University. Formerly he was bureau head in the Amhara Water Resources Agency. He is a halftime teacher. Fasikaw is a water resources engineer by training.
Getaneh Kebede Ayele		On leave as an instructor from Woreta College. He is an economist and is one of the Cohort II graduates from Cornell Master's program in Integrated Watershed Management at Bahir Dar University
Muluken Lakachew		Head of the Lake Tana Sub-basin Authority before he joined the PhD program. He has a Master's degree in Civil Engineering from Germany and is a part time independent consultant
Dessalegn Chanie Dagnew		Received his Master's degree from the Cornell/BDU program in Integrated Watershed Management and was formerly with the Amhara Tourist Bureau. He has an undergraduate degree in economics

Mamaru Moges Ayalew		Graduated from Master's program in Engineering Hydrology at BDU. He worked as civil engineer for various state agencies and aided in the research of the Cornell PhD students of the IGERT program

The second cohort of five students has been admitted in September 2013 and consists of four males and one female. They are:

Name	Previous MS Program	Previous research
Debebe Lijalem	Eng. Hydrology	SCS runoff curve numbers for Ethiopia
Meseret Belachew	Watershed management	Assessed performance of drinking water supply systems
Adugnaw Taddesse	Eng. Hydrology	Ran SWAT-WB with climate change
Azalu Alebachew	Tropical land Resources Management, Mekele, Tigray	Land suitability assessment for rainfed upland rice and cater beans.
Temesgen Enku	ITC, University of Twente (Netherlands)	Evaporation estimates from Satellite observations

The first three semesters for the first BDU PhD cohort are finished in fall 2013. Cohort II finished their first semester. All students of Cohort I passed the Admission to Candidacy exam, collected data during this past rainfall season, and have partly analyzed these data.. The three BDU courses for PhD students that were taught partly with the help of Cornell faculty and graduate students included "Integrated Watershed Management", "Advanced Research Methods and

Statistics" and "Participatory Methods for Community Water Management." (The latter course brought back Angela Neilan of Virginia Polytechnic who taught for both Master's Cohorts.) In addition the students took two Master's level courses in areas in which they were deficient individually. The students have done extremely well. For example, the final project paper on improving sediment rating curves in the course on Integrated Watershed Management, to which all five first cohort PhD students contributed, has been presented at the International Research Symposium held at Bahir Dar University in May 2013. Several other papers were also presented at an IWMI research symposium in July 2013.

The research of the first PhD cohort students is taking place in three watersheds in the Lake Tana basin with the main intentions of finding better ways to reduce sediment losses and increase food production. Although it might be surprising, thirty years of research has not resulted in a decrease in sediment concentration in rivers mainly because erosion control practices have been imposed on farmer's lands by both donor agencies and central government bureaus, thereby replacing the traditional practices which are often the most effective in reducing soil loss. It is our intent to improve the management of water and soil by better understanding the functioning of the landscape and how the people interact with the landscape functions. The first year research results are being analyzed and written up.

4. Research Aspects

4.1 Masters Students

In order to earn a Cornell Master's degree, students had to earn 24 credit hours of course credit and defend successfully a thesis (6 credits). The students' research findings have been exciting and actually contributed new knowledge in our understanding of watersheds' hydrologic behavior. For example three students in Group 1 -- Tigist, Aneteneh and Assefa -- all did their research in the Debra Mawe watershed 40 km south of Bahir Dar. Tigist observed gully formation and proved that the greatest erosion rates occurred by gully erosion when the water table is above the bottom of the gully. Her findings explain the many gullies that form in the lowest part of the landscape where the slope is the flattest and the water velocity the slowest. Anteneh who cooperated with Tigist identified geologic features that explain why in certain places the water table was elevated. Finally Assawa measured upland erosion in the same watershed and found that erosion rates were greater at the bottom of the hill with the flattest slopes than at the top of the hill with the steepest slopes. By measuring the moisture content at the different slope positions he could prove that more overland flow was generated downhill than upslope, causing more erosion downslope than upslope. A final interesting fact was that upslope erosion caused on the average a 1mm per year soil depth loss while gully formation was equivalent to an almost 5 cm soil loss over the same watershed.

Another group of students of Cohort I -- Tegenu, Haimanote, Elias and Biniam -- looked at the relationship between water table depth and runoff processes. They found high infiltration rates throughout the watersheds, and saturated bottom parts where all the infiltrated water from the hillsides accumulated. Most overland flow was generated in the bottom part of the landscape with shallowest slopes, which may seem counterintuitive. They also showed that subsurface flow plays an important role in the hydrology of the watershed.

Achalew, Tegegne and Yidnekachew did surveys on water supply and irrigation, and confirmed that systems in which people had a say in the design from initiation of the project were most successful. Tesfay, who compared management systems in three watersheds, similarly found that management succeeded when the farmers could make choices in what measures should be implemented. This is a similar finding to the New York City watershed in which farmers are also in the driver's seat on how best to reduce phosphorus and pathogen inputs to the reservoirs. In the Koga watershed, payment for environmental services was investigated by Habtamu, and Fikru investigated the factors that affect adoption of soil and water conservation practices. Tilashwork determined that the two most problematic effects of eucalyptus trees on the surrounding crops are the minimal amount of light that can penetrate the canopy and the

soil becoming water repellent. Although not investigated, these trees are also more effective in removing water from the subsoil during the dry periods than other tree species. Finally Zelalem studied if the flow in the Nile is decreasing over time.

Cohort II started their research in fall 2010 and most have finished. The topics of their research are given in Appendix C. Four students -- Dessalign, Habtamu, Meseret, and Zemenu -- have studied how to improve rural community water supply systems. This is important since 30-40% of installed systems have been failing within three years after establishment. A detailed report on their findings is attached as Appendix E.. Bezawit is studying erosion in one of the head watersheds of Lake Tana. The research of Birara, an employee of the bureau of agriculture, has been especially interesting and his personal story (Appendix D) illustrates why Ethiopian students are investing time in post-graduate studies.

Ethiopia is becoming more developed and with this development waste generation increases. Dessalew has researched how best to maintain the current practice of recycling. In addition he has looked at how a current landfill pollutes the neighbors' wells. He found high *E. Coli* counts in most sampling points and extreme high zinc content in two of the sampling points likely from batteries that are being dumped in the landfill. Getaneh and Tigist Alemu are looking at the impact of irrigation practices on income of male and female household members. Melesew and Tigist Alamu are studying existing traditional irrigation systems and how these practices can be employed in newly developed schemes. Tadesse is researching how sustainable irrigation systems are in the drier parts of Ethiopia. Finally Muhammad will be looking at the effectiveness of soil and water conservation practices based on long term data in three watersheds where such conservation practices have been installed.

Finally, this group of Ethiopian students with their instructors has been amazingly productive scientifically. A total of 16 refereed manuscripts in international journals, seven book chapters and twenty two proceedings papers have been published through fall 2013 and we are sure that more will follow.

4.2 PhD students with completed or advanced research activity

The HED contract supported in part the research of 17 PhD students. There are currently ten students within integrated watershed management PhD program in Bahir Dar University and six students have or will receive Cornell PhD degrees. Two of the six at Cornell have finished: Seifu Admassu Tilahun and Essayas Kaba Ayala. They are now both Assistant Professors in the school of Water Resources Engineering at Bahir Dar University. Seifu is dean and director of the school of Civil and Water Resources Engineering and Essayas is director of a newly established remote sensing center. As of late 2013 four Ethiopian students and one US student are still working on their research under Cornell auspices and within Ethiopia. The Ethiopians are Tigist Tebebu, Haimanote Bayabil, Abeyou Wale and Assefa Zegeye, and the US student is Christian Guzman.

BDU Faculty member and Cornell PhD recipient Essayas Kaba's objective for his research was to use remote sensing techniques for enhancing ground based water resources monitoring systems that are often difficult to maintain consistently in developing countries. The decline in the number of stations, data quality and changes in the data holding policy has made water resources data less reliable for use in operational purposes. He evaluated the utility of existing freely available remotely sensed images to monitor water resource systems. In this dissertation Moderate Resolution Imaging Spectroradiometer (MODIS) images on the basis of their capability to (1) measure total suspended solid (TSS) and turbidity and generate historical TSS data, (2) estimate the water storage variation of Lake Tana and (3) monitor the state of biomass in the upper Blue Nile basin . The usability of historical TSS data in hydrologic modeling was also tested. Lake water samples were collected concurrent with the satellite overpass over the lake at the entry location of Gumera River, a major tributary to the lake. Reflectance in the red and near infrared (NIR) 250 m-pixel images taken on sampling days were correlated and validated using measured TSS and turbidity. The validated correlations were applied to the ten year image archive of MODIS to generate a 10-year TSS time series for the lake. In addition, MODIS images of the years 2002 – 2003, where the lake level variation was at its minimum, were used to generate the lake near-shore bathymetric model. The new near-shore bathymetric model reproduced water level measurements with a better accuracy than the existing bathymetric model of the lake.

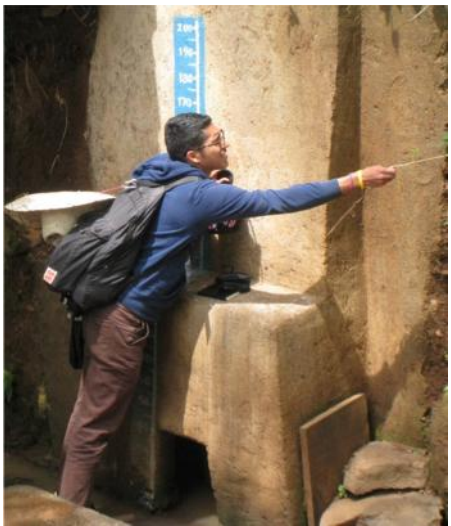
The usability of the TSS data was tested by initializing a hydrologic model for the Gumera watershed using the Soil and Water Assessment Tool (SWAT). The ten year TSS data generated were used to calibrate the model. The model was capable of predicting the monthly TSS variation. The potential of MODIS images in monitoring biomass recovery was also assessed at river basin scale. The enhanced vegetation index (EVI) – land surface temperature (LST) relation is used to map the trend in the disturbance of plantations put in place as conservation

measures. In this dissertation the potential of satellite imagery as a data gap filling alternative to ground based monitoring systems in data scarce regions is tested.

BDU Faculty member and Cornell PhD recipient Seifu Tilahun's PhD research objective was to study the reason why long term efforts to reduce erosion in the Blue Nile Basin have not led to declining river sediment concentrations. Lack of progress on sediment reduction indicates that runoff and erosion processes are not fully understood. Runoff processes were investigated in Debre Mawi, a 95-ha watershed south of Lake Tana. During the rainy period of the 2010 and 2011 monsoons, storm runoff and sediment concentrations were measured from four sub-watersheds and at the main watershed outlet. In addition, perched groundwater tables, infiltration rates, rill erosion from agricultural fields and gully expansion were measured. The results show that saturation excess runoff was the main runoff mechanism because median infiltration rate was only exceeded 3% of the time. Early during rainy period, runoff produced from shallow soils upslope infiltrated before it reached the outlet, and sediment concentrations were very high as rill networks developed on the ploughed land. At the end of July, the bottom lands became saturated, the runoff coefficient at the outlet became greater than upslope areas and rill networks were fully developed reducing the velocities and thereby the sediment concentrations.

Seifu developed a semi-distributed hillslope erosion model relating sediment concentration with overland flow using only four calibrated sediment parameters based on input data from various watersheds in Blue Nile Basin. The erosion model assumed that sediment concentration is transport limiting at the beginning of the rainy phase when lands are plowed and source limited at the end. Overland flow was simulated with the semi-distributed water balance hydrology model. The model predicted daily sediment concentrations well in three small watersheds including the Debre Mawi as well as in the Blue Nile Basin at the Sudanese border. The implication of this research is that shallow degraded soils and bottom lands with gullies are the greatest sediment sources and should be targeted for erosion control.

Cornell PhD student Christian Guzman wants to realize his dream of helping poor rural people by giving them full access to the environment where they live. This means a sustainable environment that serves as a source of fertile soil and clean water. He understands that this demands understanding of the synergy of sociological, political, and economic conditions.



Christian finished his MS degree on erosion patterns in the Ethiopian highlands in his first year at Cornell. The paper is

published in HESS. Currently he is concluding his interdisciplinary doctoral research in Ethiopia on causes of the increasing sediment concentration in rivers. These concentrations have been greater despite the many soil and water conservation projects implemented by governmental and donor organization. He has learned the local Amharic language and is collecting his data with local communities through preparation, facilitation, and analysis of focus group discussions and transect walks.

Cornell PhD student and Cornell master's recipient in Bahir Dar Tigist Tebebu has an almost unbelievable life story. She grew up in a rural area in Ethiopian near Lake Tana where she studied at night by candles or moonlight. She did well in college and obtained a degree in Natural Resources. (In Ethiopia students are assigned to a department and cannot choose the discipline.) She applied to the Cornell Master's program at Bahir Dar and was selected from 140 applicants. After finishing her Master's, and obtaining a green card for the US, she applied and was admitted to the PhD degree. For her Master's thesis, Tigist conducted her research on gully erosion in the 523 ha of the Debre-Mewi watershed south of Bahir Dar, Ethiopia. She installed piezometers and measured the extent of the gully from aerial photographs and actual GPS measurements. She found that the gully was rapidly expanding from 0.65 ha in 2005 to 1.43 ha in 2008. As one of the first researchers in Ethiopia, she discovered that in actively eroding sections, the water table is generally closer to the ground surface on the gully shoulder than in stabilized sections. Piping and tunneling, together with a high water table, facilitate the slumping of the gully wall and its retreat. Recent area-specific short-term gully erosion rates are equivalent to an astonishing 500 t ha-1 yr-1 for the 17-ha watershed (equivalent to 4 cm soil loss averaged over the watershed). In addition, she conducted semi-structured group interviews and found that gullying started in the beginning of the 1980`s following clearing of indigenous vegetation. She hypothesized that the gully increased surface and subsurface runoff from the hillside to the valley bottoms. This is a new concept for Ethiopia and currently there is an active debate among the Natural Resource professionals on how to include this new information in management practices to stop gully erosion. For her PhD she is examing the effect of the formation of a hardpan on the hydrology and soil losses in the Ethiopia highlands.

Cornell PhD student and BDU faculty member on leave Abeyou Wale is currently working with IWMI on developing and testing hydrology models that apply to the Ethiopian landscape. The ultimate goal is

designing better rain water management practices that are resilient for the expected climate change in the future.

Cornell PhD student and Cornell master's recipient in Bahir Dar Assefa Zegeye is working with the Amahara Regional Agricultural Research Institute (ARARI) on developing methods to arrest the rapidly expanding gulliues and to reduce reservoir siltation. In Ethiopia, gullies are expanding at alarming rate covering large areas. He will be evaluating the applicability of the BSTEM and CONCEPTS models for developing better gully bank rehabilitation options in the Debre-Mewi watershed, about 30 km south of the Lake Tana. Input-parameter values such as: cross-section geometry, water surface elevations and pore-water pressures in the bank, flow discharge, bank material properties (texture and density), and bank material shear-strength (cohesion and friction angle) are obtained directly from field surveying and testing. Some of the data has already been collected along the five soil layers comprising the gully banks. Bank failures such as planar, cantilever and piping are the most widely observed types of gully bank failures in the study area. Planting of vegetation on the bank top for sallow gullies and face, re-grading the bank slope to a flatter angle are some of the gully rehabilitation options will be some options investigated by the model and the validated by experiments.

Cornell PhD student and Cornell master's recipient in Bahir Dar Haimanote Bayabil spent three months in the Maybar watershed in the Highlands of Ethiopia, during his Master's program. He installed thirty piezometers to observe the ground water table on the hill sites and in the valley bottom. He also looked at the severity of soil degradation. He was the first student to prove

that the surface runoff in Ethiopia is often generated in the saturated valley bottom and rock outcrop areas and not from the hillsides. He subsequently modeled the discharge from the watershed based on these principles and his model fitted the data better than any other model. His research (together with that of others from the program) has resulted already in several publications.

For his PhD research Haimanote is studying the effect of charcoal and biomass and deep rooted crops to more efficiently use the rain water for crop production. He installed 24 runoff plots and performed a

number of studies to characterize the soil physical properties. He is currently analyzing the data for the first year. The initial results are quite interesting. He received funding for the first year from a Borlaug LEAP Fellowship and he received the Richard Bradfield research award within Cornell.

These students' and others' research are documented in the many publications listed in an appendix to this report.

4.3 A Promising Future: New Multi-Continent Research Project

A proposal was developed for submission to a UK national funding consortium entitled "Adaptive governance of mountain ecosystem services for poverty alleviation enabled by environmental virtual observatories (MOUNTAIN-EVO)". Funding was approved in mid 2013. This work combines the Imperial College of London (overall lead: Wouter Buytaert), BDU, University of Central Asia in Kyrgyzstan, Society of Hydrologists and Meteorologists (SOHAM) of Nepal, the Consortium for Sustainable Development of the Andean Ecoregion (CONDESAN), and other local to international organizations. Documentation: Proposal. From the summary: This project will blend cutting-edge concepts of adaptive governance with technological breakthroughs in citizen science and knowledge co-generation to break this vicious circle. Our central research question is how recent conceptual and technological innovations in environmental sensing, data processing, interactive visualisation and participatory knowledge generation can be leveraged to implement demand-driven, interactive and multidirectional approaches to knowledge generation about ESS. Our approach to this question is built around the notion of Environmental Virtual Observatories: decentralised and open technology platforms for knowledge generation and exchange that enable participation of marginalised and vulnerable communities bypassed by the traditional mechanisms. Our case studies are 4 remote and poor mountain regions characterised by acute degradation of ESS, in particular water supply, soil fertility, and land cover. We will implement a process of participatory data collection and processing on these ESS and their trade-offs, embedded in the local NGO and educational setting. Mechanisms of continuous evaluation and improvements will be set up, and tested for usefulness, robustness and impact on human wellbeing. Our goal is not to develop specific solutions to specific problems. Rather, we will leverage the cross-disciplinary nature of our consortium to create a flexible and adaptive set of tools, protocols and concepts to promote citizen science on ESS for poverty alleviation. As such, the project aims at nothing less than reconceptualising the approach to managing ESS for poverty alleviation.

Acknowledgments

The work described here received essential financial support from several sponsors. Most prominent among the donors was the US Agency for International Development through Higher Education for Development, which provided student support and travel support for Master's and PhD courses, and also research support. Cornell University provided salary funding for most of the teaching activities at the Master's level and the PhD level. Bahir Dar University provided the initial funding for the program through a grant involving the Ethiopian Ministry of Education and the World Bank. In addition, Bahir Dar University provided at no cost all in-country logistical support. Some of the student activity described was supported by fellowships from the National Science Foundation, and most recently USAID through the National Academy of Sciences.

Cooperation of ARARI in providing data, giving permission to use the research site and aid with research and transportation was beyond all expectation and greatly appreciated. Similarly IWMI was greatly supportive of this project. Several students received research grants, provided opportunities for the students the present their results and aided in teaching the students. The support of Bahir Dar University is unparalleled. They made us part of the campus, provided all logical support, teaching space and instruction resources. Other organizations that helped us are Boa Gete's outfit, MoWR, TaSBO, WaterAid, and many others as enumerated in section 1.

Finally this program would not have been possible without the support and hard work of the students in the Master's and PhD programs.

USDA Agricultural Research Service provided an instructor who led part of a course at Bahir Dar.

Appendix A: MPS course schedule

Course Schedule 2007-2008, Cohort I

Dates	Course Number	Course Title	Instructors	No. of credits
Nov 1-21, 2007	BEE 694	Watershed design, measurement & planning	Tammo Steenhuis Amy Collick	3
Nov 21-28		Interim period		
Nov 29-Dec 28	BEE 694	Watershed modeling	Tammo Steenhuis, Amy Collick	4
Dec 28-Jan 6, 2008	IARD 694	Technical writing seminar/computer skills	Amy Collick	1
Jan 7-Feb 2		Christmas break (Ethiopian)		
Feb 2-Feb 9		Technical writing	Amy Collick	1
Feb 18-Mar 6	CSS 471	Geographic information systems & remote sensing	Steve de Gloria	3
Mar 10-21	VETMI 783	Management of soil and waterborne pathogens	Dwight Bowman	2
Mar 24-Apr 18	ANSC 694	Livestock in highland farming systems	Bob Blake	3
Apr 20-25		Research preparation/IARD seminar	Tammo Steenhuis, Amy Collick	1
Apr 28-May16	BEE 697	Participatory methods for community watershed and water supply management	Tammo Steenhuis, Angela Neilan, Amy Collick	3
May 18-Jun 6 (two weeks)	CSS477	Nutrient cycling in natural and managed ecosystems	Dawit Solomon, Johannes Lehmann	2
Jun 9-20	AEM 694	Economic analysis of agriculture-based livelihood systems	Chuck Nicholson	2
Throughout	IARD 699	Seminar in international agriculture and rural development	Amy Collick, All	1
July- Nov 2009	IARD599	IARD MPS thesis	IARD faculty	6

Course Schedule 2010, MPS cohort II

Dates	Course Number	Course Title	Instructors	No. of credits
Mar 4-Mar 13, 2010	BEE 694	Hydrology, erosion and watershed management	Steenhuis Seifu Tilahun	2
Mar 14-Mar 26	VETMI 783	Management of soil and waterborne pathogens	Bowman, Liotta	2
Mar 29-Apr 16	BEE 695	Geographic information systems & remote sensing	Fuka, Abeyou, Steenhuis	3
Apr 19-Apr 30	BEE 697	Rural water supply	Steenhuis, Collick	2
May 2-May 21	IARD 699	Technical writing and preparation of research proposals	Collick and Seifu Tilahun	1
May 24-Jun 13		Research period	*	
Jun 15-July 9	AEM 694	Economic analysis of agriculture-based livelihood systems	Nicholson	3
Jul 12-Aug 6		Research period		
Aug 9-Aug 27	CSS 672	Nutrient cycling in natural and managed ecosystems	Solomon and Lehman	3
Sep 6-Sep 24	DSOC 694	Participatory methods for community watershed and water supply management	Neilan and Makki	3
Sep 27-Oct 22	BEE 694	Watershed modeling	Easton, Fuka Steenhuis	4
Throughout	IARD 699	International agriculture and rural development seminar	Steenhuis, Collick, Seifu	1
Oct to Dec 2011	IARD 599	IARD MPS thesis	IARD faculty	6

*) Student research period will begin on May 24 pending the approval of a student's research proposal Special topics in the courses after May 24 will relate in part to research location and/or topic by student. The research period is finished after approval of the thesis by the student's special committee.

Course Descriptions

AEM 694: Economic Analysis of Agriculture-based Livelihood Systems

2 credits. C. Nicholson

Introduces the application of economic theory and analytical methods for the evaluation of coupled human-natural systems with an emphasis on agriculture-based livelihood systems. Discusses principles of partial budgeting analysis, static and dynamic optimization and system dynamics modeling. Exercises illustrate the application of these methods to assess technological and policy interventions at the enterprise, farm and market level.

AN SC 694: Livestock in highland farming systems

3 credits. B. Blake

Focuses on the systematic analysis of constraints and opportunities in the animal component of integrated crop-tree-livestock systems. Emphasis is on strategic use of animal and plant resources, animal performance with restricted inputs, decision-making, and alternative production systems for the Ethiopia highlands.

BEE 694: Watershed design, measurement and planning (Cohort 1)

3 credits. T. Steenhuis & A. Collick

Introduces students to the physical principles governing water and sediment movement. Emphasis is on practical application and designs for improved water and erosion control in degraded highland watersheds. Assignments involve engineering problems relevant in the Ethiopian context, with hands-on experience as possible. Also covers design of water harvesting systems with limited data.

BEE 694: Watershed modeling

4 credits. T. Steenhuis & A. Collick

Introduces students to concepts and tools for modeling watersheds using a system dynamics framework. Emphasis is on the integrating existing sources of information (maps, surveys, etc) and local knowledge about Amhara watersheds with research findings from the project.

BEE 697/DSOC 694: Participatory Methods for Community Watershed and Water Supply Management

3 credits. A. Neilan, F. Makki, and A. Collick

In-depth practical, field-based course designed to provide experience with participatory methods to help communities manage their own watersheds within an overall regulatory framework. Special emphasis is given to action research approaches involving all relevant stakeholders.

CSS 420/BEE 695: Geographic information systems & remote sensing

3 credits. S. DeGloria. D. Fuka and T. Steenhuis

Introduces students to the principles and applications of geographic information systems and remote sensing for the characterization and assessment of agricultural and environmental resources. Covers methods and equipment for accessing, updating, and mapping spatial data and information. Considers needs assessment, coordinate systems, map accuracy assessment, database design and maintenance, data transformation and analysis, and project design.

CSS 672: Nutrient cycling in natural and managed ecosystems

3 credits. J. Lehmann and D. Solomon

Covers nutrient cycling in soil and the interface between the soil and the biosphere, atmosphere, and hydrosphere. Examines the biogeochemistry of nutrient elements in natural ecosystems, disturbed or degraded ecosystems, and agricultural systems, including pollution in watersheds.

IARD 599: International Agriculture and Rural Development Project in Integrated Watershed Management

6 credits. IARD faculty

Problem-solving thesis entailing fieldwork. The aim of the thesis is to give students supervised experience in dealing intellectually and analytically with a professional problem related to integrated watershed management.

IARD 699: International Agriculture and Rural Development Seminar

2 credits. A. Collick, R.Blake and T.S. Steenhuis

Serves as a forum for discussion of key issues in international agriculture and rural development, with particular attention to interdisciplinary complexities of integrated watershed management.

VETMI 783: Management of soil and waterborne pathogens

2 credits. D. Bowman

Involves an in-depth look at pathogens in animal and human waste and their survival in soil and water. Emphasis is on methods of pathogen control, with special attention directed to water sanitation and supply in the Ethiopian context.

BEE 494: Hydrology, Erosion and Watershed Management (Cohort II)

3 credits. T. Steenhuis A. Collick and Seifu Tilahun

Introduces students to the physical principles governing water and sediment movement. Emphasis is on practical application and designs for improved water and erosion control in degraded highland watersheds. Assignments involve engineering problems relevant in the Ethiopian context, with hands-on experience as possible. Also covers design of water harvesting systems with limited data.

BEE 694: Watershed Modeling (Cohort II)

4 credits. Zach Easton and Tammo Steenhuis

Introduction of concepts and tools for modeling watersheds using a system dynamics framework. Emphasis is on the integrating existing sources of information (maps, surveys, etc) and local knowledge about Amhara watersheds with research findings from the project. Both simple and more complex models will be discussed

BEE 697: RURAL WATER SUPPLY (Cohort II)

2 credits. Tammo Steenhuis, Amy Collick

Focuses on the systematic analysis of water supply systems and its management. Realistic assessment of both traditional household water supply systems and improved systems. Field trips to view the systems of water supply. Discussions with experts and stakeholders on best methods for water supply.

Appendix B: Publications through 2013

Cornell University Masters Project Reports and PhD Theses

Author	Title	Year
Anteneh Zewdie Abiy	Geological controls in the formations and expansions of gullies over hillslope hydrological processes in the Highlands of Ethiopia, northern Blue Nile region	2009
Meseret Belachew Addisie	Assessment of Drinking Water Quality and Determinants of Household Potable Water Consumption in Simada District, Ethiopia	2012
Zemenu Awoke Alemeyehu	Assessment of Challenges of Sustainable Rural Water Supply: Quarit Woreda, Amhara Region	2012
Tilashwork Chanie Alemie	The effect of Eucalyptus on crop productivity, and soil properties in the Koga watershed, western Amhara region, Ethiopia	2009
Biniam Biruk Ashagre	SWAT to identify watershed management options: (Anjeni watershed, Blue Nile basin, Ethiopia)	2009
Yidnekachew Ewnetu Ayalew	Irrigation, Food Production and Consumption Pattern in Smallholder Rural Households	2009
Essayas Kaba Ayana (PhD)	Remote Sensing Tools for Land and Water Management in Data Scarce Blue Nile Basin	2013
Getaneh Kebede Ayele	The Impact of Selected Small-Scale Irrigation Schemes on Household Income and the Likelihood of Poverty in the Lake Tana Basin of Ethiopia	2011
Haimanote Kebede Bayabil	Modeling rainfall-runoff relationships and assessing impacts of soil conservation research program intervention on soil physical and chemical properties at Maybar research unit, Wollo, Ethiopia	2009
Melisew Misker Belay	Organization and Management of Irrigation Schemes in Eastern Amhara, Ethiopia: In Case of Sanka Traditional and Golina Modern Irrigation Schemes	2012
Habtamu Addis Beyene	Factors Affecting the Sustainability of Rural Water Supply Systems: The Case of Mecha Woreda, Amhara Region, Ethiopia	2012
Dessalegn Chanie Dagnew	Factors Determining Residential Water Demand in North Western Ethiopia, The Case of Merawi	2012

Author	Title	Year
Aschalew Demeke	Determination of household participation in water source management: Achefer, Amhara region, Ethiopia	2009
Tesfaye Habtamu Demeke	Assessment of Sustainable Watershed Management Approach: Case Study Lenche Dima, Tesgur Eyesus and Dijjil Watershed	2011
Bezawit Adane Demisse	Discharge and Sediment Yield Modeling in Enkulal Watershed, Lake Tana Region, Ethiopia	2011
Abrham Melesse Endalamaw	Optimum utilization of ground water in Kobo valley, Eastern Amhara, Ethiopia	2009
Tegenu Ashagrie Engda	Modeling rainfall, runoff and soil loss relationships in the northeastern Highlands of Ethiopia, Andit Tid watershed	2009
Aemiro Gedefaw Kassa	Simulating the Hydrologic Response of Gilgel Abbay Watershed with a Simple Semi-Distributed Water Balance Model	2011
Habtamu Tilahun Kassahun	Payment for environmental service to enhance resource use efficiency and labor force participation in managing and maintaining irrigation infrastructure, the case of the upper Blue Nile basin	2009
Elias Sime Legesse	Modeling Rainfall-Runoff relationships for the Anjeni watershed in the Blue Nile Basin	2009
Getachew Ewonetu Mamo	Identifying Major Constraints of Ground Water Use for Irrigated Crop Production: Fogera Plain, North Western Ethiopia	2013
Fikru Assefa Mengstie	Assessment of adoption behavior of soil ad water conservation practices in the Koga watershed, Highlands of Ethiopia	2009
Hussien Ali Oumer	Land use and land cover change, drivers and its impact: A comparitive study from Kuhar Michael and Lenche Dima of Blue Nile and Awash basins of Ethiopia	2009
Birara Chekol Tarekegn	A Case Study of Gully Erosion in the Ethiopian Highlands: The Warke Watershed	2012
Tegegne M. Tarekegne	Sustainability of rural water supply and sanitation services in Ethiopia: A case study of twenty villages in Ethiopia	2009

Author	Title	Year
Tigist Yazie Tebebu	Assessment of hydrological controls on gully formation near Lake Tana, northern Higlands of Ethiopia	2009
Zelalem Kassahun Tesemma	Long term hydrologic trends in the Nile basin	2009
Seifu Admassu Tilahun (PhD)	Observations and Modeling of Erosion from Spatially and Temporally Distributed Sources in the (Semi) Humid Ethiopian Highlands	2012
Tenagne Addisu Wondie	The impact of urban storm water runoff and domestic waste effluent on water quality of Lake Tana and local groundwater near the city of Bahir Dar, Ethiopia	2009
Assefa Derebe Zegeye	Assessment of upland erosion processes and farmer's perception of land conservation in Debre-Mewi watershed, near Lake Tana, Ethiopia	2009

Refereed

Authors	Title	Year	Journal
Hussien Ali, Katrien Descheemaeker, Tammo S. Steenhuis & Suraj Pandey	Comparison of Landuse and Landcover Changes, Drivers and Impacts for a Moisture-Sufficient and Drought-Prone Region in the Ethiopian Highlands.	2011	Expl. Agric. Vol. 47(SI) , pp. 71-83
Haimanote K. Bayabil, Seifu A. Tilahun, A.S. Collick & T.S. Steenhuis	Are Runoff Processes Ecologically or Topographically Driven in the (Sub) Humid Ethiopian Highlands? The Case of the Mayabar Watershed	2010	Ecohydrology Vol. 3 , pp. 457-466
A.S. Collick, Z.M. Easton, Tegenu Ashagrie Engda, Biniam Biruk, Seifu A. Tilahun, Enyew Adgo, Seleshi B. Awalachew, Gete Zeleke & T.S. Steenhuis	A simple semi-distributed water balance model for the Ethiopian highlands	2009	Hydrological Processes Vol. 23 , pp. 3718-3727

Authors	Title	Year	Journal
Z.M. Easton, D.R. Fuka, E.D. White, A.S. Collick, Biniam Biruk Ashagre, M. McCartney, Seleshi B. Awulachew, Abdassalam A. Ahmed & T.S. Steenhuis	A multi basin SWAT model analysis of runoff and sedimentation in the Blue Nile, Ethiopia	2010	Hydrology and Earth Systems Science Vol. 14 , pp. 1827-1841
C.D. Guzman, S.A. Tilahun, A.D. Zegeye & T.S. Steenhuis	Suspended Sediment Concentration-Discharge Relationships in the (Sub) Humid Ethiopian Highlands	2013	Hydrology and Earth System Sciences Vol. 17(3) , pp. 1067-1077
B.M. Liu, A.S. Collick, Gete Zeleke, Enyew Adgo, Z.M. Easton & T.S. Steenhuis	Rainfall-Discharge Relationships for a Monsoonal Climate in the Ethiopian Highlands	2008	HPtoday Vol. in press
O.V. McHugh, A.N. McHugh, P.M. Eloundou-Enyegue & T.S. Steenhuis	Integrated Qualitative Assessment of Wetland Hydrological and Land Cover Changes in a Data Scarce Dry Ethiopian Highland Watershed	2007	Land Degrad. Develop Vol. 18 , pp. 1-16
O.V. McHugh, T.S. Steenhuis, B. Abebe & E.C.M. Fernandes	Performance of in situ rainwater conservation tillage techniques on dry spell mitigation and erosion control in the drought-prone North Wello zone of the Ethiopian highlands	2007	Soil & Tillage Research Vol. 97 , pp. 19-36
Tigist Y. Tebebu, Anteneh Z. Abiy, Assefa D. Zegeye, H.E. Dahlke, Z.M. Easton, Seifu A. Tilahun, A.S. Collick, Selemyihun Kidnau, S. Moges, Farzad Dadgari & T.S. Steenhuis	Surface and subsurface flow effect on permanent gully formation and upland erosion near Lake Tana in the northern highlands of Ethiopia	2010	Hydrology and Earth Systems Science Vol. 14 , pp. 2207-2217
Zelalem K. Tessema, Yasir A. Mohamed & Tammo S. Steenhuis	Trends in Rainfall and Runoff in the Blue Nile Basin: 1964-2003	2010	Hydrological Processes Vol. 25 , pp. 3747-3758
Aschalew D. Tigabu, Charles F. Nicholson, Amy S. Collick & Tammo S. Steenhuis	Determinants of household participation in the management of rural water supply systems: A case from Ethiopia	2013	Water Policy

Authors	Title	Year	Journal
Seifu Admassu Tilahun, Tegenu Ashagrie Engda, Elias Sime Legesse, C.D. Guzman, Assefa Derebe Zegeye, A.S. Collick, A. Rimmer & T.S. Steenhuis	An efficient semi-distributed hillslope sediment model: the Anjeni in the sub humid Ethiopian Highlands	2011	Hydrol. Earth Syst. Sci. Discuss. Vol. 8 , pp. 2207-2233
S.A. Tilahun, C.D. Guzman, A.D. Zegeye, T.A. Engda, A.S. Collick, A. Rimmer & T.S. Steenhuis	An efficient semi-distributed hillslope erosion model for the subhumid Ethiopian Highlands	2013	Hydrol. Earth Syst. Sci. Vol. 17 , pp. 1051-1063
S.A. Tilahun, R. Mukundan, B.A. Demisse, T.A. Engda, C.D. Guzman, B.C. Tarakegn, Z.M. Easton, A.S. Collick, A.D. Zegeye, E.M. Schneiderman, J.-Y. Parlange & T.S. Steenhuis	A Saturation Excess Erosion Model	2013	Transactions of the ASABE Vol. 56(2) , pp. 681-695
E.D. White, Z.M. Easton, D.R. Fuka, A.S. Collick & T.S. Steenhuis	Development and application of a physically based landscape water balance in the SWAT model	2011	Hydrol. Proc. Vol. 25(6) , pp. 915-925
Assefa Derebe Zegeye, T.S. Steenhuis, R.W. Blake, Selemyihun Kidnau, A.S. Collick & Farzad Dadgari	Assessment of Upland Erosion Processes and Farmer Perception of Land Conservation in Debre Mewi Watershed, near Lake Tana, Ethiopia	2011	Ecohydrology and Hydrobiology Vol. 10(2-4) , pp. 297-306

Conference Presentations (not refereed)

Author	Title	Year	Proceedings
Getaneh K. Ayele, Charles F. Nicholson, Amy S.Collick, Seifu A.Tilahun & Tammo S. Steenhuis	The impact of small-scale irrigation schemes on household income and the likelihood of poverty in the Lake Tana basin of Ethiopia	2013	Proceedings of the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods

Author	Title	Year	Proceedings
Haimanote K. Bayabil, Johannes C. Lehmann, Birru Yitaferu, Cathelijne Stoof & Tammo S. Steenhuis	Hydraulic properties of clay soils as affected by biochar and charcoal amendments.	2013	Proceedings of the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods
Haimanote K. Bayabil, Johannes C. Lehmann, Birru Yitaferu, Cathelijne Stoof & Tammo S. Steenhuis	Spatial Variability of Soil Physical and Hydraulic Properties Affecting Runoff and Moisture Retention Characteristics of Tropical Soils: The Case of Anjeni Watershed	2013	Proceedings of the International Conference on Science and Technology towards the Development of East Africa (ICST 2013), pp. 300-310
A.S. Collick, Z.M. Easton, Enyew Adgo, Seleshi B. Awulachew, Gete Zeleke & T.S. Steenhuis	Application of a physically-based water balance model on four watersheds throughout the upper Nile Basin in Ethiopia	2008	In: Abtew & Melesse. Proceedings of the Workshop on the Hydrology and Ecology of the Nile River Basin under Extreme Conditions
Dessalegn C Dagnew, Seifu A Tilahun, Amy S Collick, Tammo S Steenhuis & Charles F Nicholson	Determinants of Residential Water Consumption and Connection in Ethiopia; Evidence from Merawi	2013	Proceedings of the International Conference on Science and Technology towards the Development of East Africa (ICST 2013), pp. 239-246
C.D. Guzman, S.A. Tilahun, A.D. Zegeye, B. Yitaferu, R.W. Kay, G.N. Nagle & T.S. Steenhuis	Finding Eroding Areas and Patterns with GIS and Community Knowledge in the Ethiopian Highlands	2012	Proceedings for the ITU/MEDFRIEND International Conference on Sediment Transport Modeling in Hydrological Watersheds and Rivers, Istanbul, Turkey.
E.J. Langendoen, T.Y. Tebebu, T.S. Steenhuis & S.A. Tilahun	Assessing Gully Widening and Its Control in the Debra-Mawi Watershed, northern Ethiopia	2013	Proceedings of the International Conference on Science and Technology towards the Development of East Africa (ICST 2013), pp. 214-221
O.V. McHugh, A.S. Collick, B.M. Liu, Debele Bekele, J.E. Haldeman, T.S. Steenhuis, A. Yitayew & Gete Zeleke	Can integrated watershed management bring greater food security in Ethiopia?	2004	IFAC WORKSHOP "Modeling and Control for Participatory Planning and Managing Water Systems"

Author	Title	Year	Proceedings
Mamaru A. Moges, Fasikaw A. Zemale, Muluken L. Alemu, Getaneh K. Ayele, Dessalegn C. Dagnew, Solomon S. Demissie, Seifu A. Tilahun & Tammo S. Steenhuis	Evaluation of Sediment Concentration Discharge Relationship for a Monsoonal Climate: Lake Tana Basin	2013	Proceedings of the International Conference on Science and Technology towards the Development of East Africa (ICST 2013), pp. 255-261
T.S. Steenhuis, A.S. Collick, Seleshi B. Awulachew, Enyew Adgo, Abdassalam Ahmed & Z.M. Easton	Modelling erosion and sedimentation in the upper Blue Nile [[Ethiopia]]	2008	Proceedings of the Workshop on the Hydrology and Ecology of the Nile River Basin under Extreme Conditions
T.S. Steenhuis, J. Taylor, Z. Easton, A. Collick, N. van de Giesen, J. Liebe, Abdassalam A. Ahmed & M. Andreini	Rainfall-discharge relationships for monsoonal climates	2009	In: Seleshi B. Awulachew, T. Erkossa, V. Smakhtin & A. Fernando. Improved water and land management in the Ethiopian highlands: Its impact on downstream stakeholders dependent on the Blue Nile. Intermediate Results Dissemination Workshop held at the International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia
Tammo S. Steenhuis, Tigist Y. Tebebu, Birara C. Tarekegn, Anteneh Z. Abiy, Assefa D. Zegeye, Getaneh K. Ayele, Christian D. Guzman & Seifu A. Tilahun	Hydrological Controls on Gully Formation in the Ethiopian Highlands (Extended Abstract)	2013	New Nile Perspectives: Scientific Advances in the Eastern Nile Basin, Khartoum, Sudan, May 6-7, 2013.
Tammo S. Steenhuis, Seifu A. Tilahun, Muhammad Elkamil, Fasikaw Atanaw, Abeyou W. Worqlul, Essayas K Ayana, Anteneh Z. Abiy, Muluken L. Alemu, Zelalem K. Tesemma & Yasir A. Mohamad	Simulating discharge and sediment concentrations in the increasingly degrading Blue Nile basin	2013	Proceedings of the International Conference on Science and Technology towards the Development of East Africa (ICST 2013), pp. 291-299

Author	Title	Year	Proceedings
Tigist Tebebu, Christine Baver, Cathelijne Stoof & Tammo Steenhuis	Visualizing clogging up of soil pores in the tropical degraded soils and their impact on green water productivity	2013	Proceedings of the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods
Tigist Y. Tebebu, Anteneh Z. Abiy, Assafa Adzo, Helen E. Dahlke, Eric D. White, Amy S. Collick, Selemyihun Kidnau, Farzad Dadgari & Tammo S. Steenhuis	Assessment of hydrological controls on gully formation and upland erosion near Lake Tana, Northern Highlands of Ethiopia	2009	In: Seleshi B. Awulachew, T. Erkossa, V. Smakhtin & A. Fernando. Improved water and land management in the Ethiopian highlands: Its impact on downstream stakeholders dependent on the Blue Nile. Intermediate Results Dissemination Workshop held at the International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia
Tigist Y. Tebebu, Anteneh Z. Abiy, Assafa Adzo, H.E. Dahlke, E.D. White, A.S. Collick, Selemyihun Kidnau, Farzad Dadgari & T.S. Steenhuis	Assessment of hydrological controls on gully formation and upland erosion near Lake Tana, Northern Highlands of Ethiopia	2010	Proceedings of the 4th Joint Federal Interagency Hydrologic Modeling Conference and the 9th Federal Interagency Sedimentation Conference, Las Vegas NV, June 27-July 1st, 2010.
Tigist Y. Tebebu, Assefa D. Zegeye, Eddy J. Langendoen, Getaneh K. Ayele, Seifu A. Tilahun, Essayas K. Ayana & Tammo S. Steenhuis	Arresting gully formation in the Ethiopian highlands	2013	Proceedings of the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods
Seifu Admassu Tilahun, Rajith Mukundan, Bezawit A. Demisse, Tegenu Ashgary, Christian Guzman, Birara C. Tarakegn, Zachary M. Easton, Amy S Collick, Assefa D. Zegeye, Elliot M. Schneiderman, J.-Yves Parlange & Tammo S. Steenhuis	A Saturation Excess Erosion Model	2011	International Symposium on Erosion and Landscape Evolution CD-Rom Proceedings (18-21 September 2011)

Author	Title	Year	Proceedings
Seifu A. Tilahun, Aschalew D. Tigabu, Tegegne M. Tarekegne, Meseret B. Addisie, Habtamu A. Beyene, Zemenu A. Alemeyehu, Manyahlshal Ayele, Amy S. Collick & Tammo S. Steenhuis	Factors in sub-optimum performance of rural water supply systems (as lessons learned for rain water management systems) in the Ethiopian highlands	2013	Proceedings of the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods
Abeyou Wale, Amy S Collick, David G Rossiter, Simon Langan & Tammo S. Steenhuis	Realistic assessment of irrigation potential in the Lake Tana basin, Ethiopia.	2013	Proceedings of the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods
E.D. White, Z.M. Easton, D.R. Fuka, A.S. Collick, M. McCartney, Seleshi B. Awulachew & T.S. Steenhuis	A Water Balance-Based Soil and Water Assessment Tool (SWAT) for Improved Performance in the Ethiopian Highlands	2009	In: Seleshi B. Awulachew, T. Erkossa, V. Smakhtin & A. Fernando. Improved water and land management in the Ethiopian highlands: Its impact on downstream stakeholders dependent on the Blue Nile. Intermediate Results Dissemination Workshop held at the International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia
Assefa Derebe Zegeye, Tigist Yazie Tebebu, Anteneh Z. Abiy, H.E. Dahlke, E.D. White, A.S. Collick, Selemyihun Kidnau, Farzad Dadgari, M. McCartney & T.S. Steenhuis	Assessment of hydrological and landscape controls on gully formation and upland erosion near Lake Tana	2009	In: Seleshi B. Awulachew, T. Erkossa, V. Smakhtin & A. Fernando. Improved water and land management in the Ethiopian highlands: Its impact on downstream stakeholders dependent on the Blue Nile. Intermediate Results Dissemination Workshop held at the International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia

Book chapters

Author	Title	Year	Book
Seleshi B. Awulachew, M. Tenaw, T.S. Steenhuis, Z.M. Easton, Abdassalam Ahmed, K.E. Bashar & A. Hailesellassie	Impact of watershed interventions on runoff and sedimentation in Gumera watershed, Ethiopia	2010 (in press)	In: Seleshi B. Awulachew, D. Molden & D. Peden. The Nile River Basin: Water, Agriculture, Governance and Livelihoods
Z.M. Easton, Seleshi B. Awulachew, T.S. Steenhuis, A. Habte, B. Zemedam, Y. Seleshi, K. Bashar, V. Smakhtin & D. Pedon	Hydrological processes in the Blue Nile River Basin [[Ethiopia]]	2010 (In Press)	In: Seleshi B. Awulachew, D. Molden & D. Peden. The Nile River Basin: Water, Agriculture, Governance and Livelihoods
M. McCartney, T. Alemayehu, Y. Seleshi Shiferaw, Y.A. Ibrahim, Z.M. Easton & Seleshi B. Awulachew	Simulating current and future water resource development in the Blue Nile River Basin [[Ethiopia]]	2010 (In Press)	In: Seleshi B. Awulachew, D. Molden & D. Peden. The Nile River Basin: Water, Agriculture, Governance and Livelihoods
T.S. Steenhuis, A.S. Collick, Z.M. Easton, Elias S. Leggesse, Haimanote K. Bayabil, E.D. White, Seleshi B. Awulachew, Enyew Adgo & Abdassalam A. Ahmed	Predicting discharge and erosion for the Abay (Blue Nile) with a simple model [[Ethiopia]]	2009	In: Abtew & Melesse. Hydrology and Ecology of the Nile River Basin Under Extreme Conditions, pp. 200-212
T.S. Steenhuis, Z.M. Easton, Seleshi B. Awulachew, Abdassalam Ahmed, K. Bashar, Y. Selassie, Enyew Adgo & Seifu Tiluhan	Erosion, sediment loss and land degradation with emphasis on the Blue Nile River Basin [[Ethiopia]]	2010 (in press)	In: Seleshi B. Awulachew, D. Molden & D. Peden. The Nile River Basin: Water, Agriculture, Governance and Livelihoods
Tammo S. Steenhuis, Seifu A. Tilahun, Zelalem K. Tesemma, Tigist Y. Tebebu, Mamaru Moges, Fasikaw A. Zimale, Abeyou W. Worqlul, Muluken L. Alemu, Essayas K. Ayana & Yasir A. Mohamed	Soil Erosion and Discharge in the Blue Nile Basin: Trends and Challenges Nile River Basin: Ecohydrological Challenges, Climate Change and Hydropolitics	2014 (in press)	In: Assefa Melesse, Wossenu Abtew & Gebriye Shimelis.

Author	Title	Year	Book
Seifu.A. Tilahun, Christian.D. Guzman, Assefa.D. Zegeye, Essayas K. Ayana, A.S. Collick, Birru Yitaferu & T.S. Steenhuis	Spatial and Temporal Patterns of Soil Erosion and in the semi-humid Ethiopian Highlands: A Case Study of the debre Mawi Watershed Nile River Basin: Ecohydrological Challenges, Climate Change and Hydropolitics	2014 (in press)	In: Assefa Melesse, Wossenu Abtew & Gebriye Shimelis Setegn.
Tegenu A. Engda, Haimanote K. Bayabil, Elias S. Legesse, Essayas K. Ayana, Seifu A. Tilahun, Amy S. Collick, Zachary M. Easton, Alon Rimmer, Seleshi B. Awulachew & Tammo S. Steenhuis	Watershed Hydrology of the (Semi) Humid Ethiopian Highlands		in a book, title and date unknown

Other publications

Author	Title	Year	Published as	Type
Habtamu T. Kassahun, Tegenu A. Engda, A.S. Collick, Husien A. Oumer, Haimanote K. Bayabil, Tigist Y. Tebebu, Anteneh A. Zewdie, D. Solomon, C.F. Nicholson & T.S. Steenhuis	The Effect of Land Use and Its Management Practices on Plant Nutrient Availability and Carbon Sequestration [[Ethiopia]]	2009		other
Habtamu T. Kassahun, C.F. Nicholson, D. Solomon, A.S. Collick & T.S. Steenhuis	Economics and policy context for the biological management of soil fertility (BMSF) in Ethiopia	2009		other
Seifu A. Tilahun & Amy S. Collick	Can Communities Manage Complex Technologies?	2012	(Briefing note 5)	Tech report
Seifu Admassu Tilahun & Amy S. Collick	Wisdom at the source of the Blue Nile - MUS	2011	(Briefing note 2)	Tech report
Seifu Admassu Tilahun & Amy S. Collick	Bottlenecks of operation and maintenance	2011	(Briefing note 1)	Tech report

Author	Title	Year	Published as	Type
Seifu A. Tilahun & Amy S. Collick	Sanitation promotion and household latrine	2011	(Briefing note 3)	Tech report
Seifu A. Tilahun & Amy S. Collick	Solar Power: An Alternative Technology for Pumping Water	2011	(Briefing note 4)	Tech report
Seifu A. Tilahun & Amy S. Collick	The Role of Users at the Different Levels of WaSH Projects	2011	(Briefing note 6)	Tech report
Seifu A. Tilahun, Amy S. Collick & Manyahlshal Ayele	Assessment of Water Supply and Sanitation in Amhara Region	2012		Tech report

Appendix C: MPS Students' Research

MPS Cohort I Student Research

Supported through CP19 Upstream/downstream project: BDU, ARARI, IWMI, and Cornell

Name	Title	Site	Progress report/adv	Advisors
Tesfaye Habtamu	Success and Failures in Watershed Management projects: A post implementation evaluation	GTZ-DT, AMREW-Yeku, Lenche DIma, SIDA-Debremarkos	BDU	Mike Walter Tammo Steenhuis
Tegenu Ashagrie	Northern Highlands of Ethiopia and Factors Affecting Adoption Decision of Soil and Water Conservation Measures: Case of Andit-Tid Watershed	Andit Tid	ARARI	Tammo Steenhuis Zach Easton Seleshi
Binyam Biruk	Formulation of Best Management Options in a Watershed Using the SWAT Model: *Anjeni Watershed, Lake Tana Catchments of Blue Nile Basin, Ethiopia*	Anjeni	IWMI	Tammo Steenhuis Eric White Zach Easton Seleshi
Fikru Assefa	Assessment of adoption behavior of soil and water conservation practices in Koga Watershed, Highland of Ethiopia	Koga		Alice Pell Beth Medvecky Tammo Steenhuis Fitsum and Amare
Haimanote Kebede	Modeling Rainfall-Runoff-Sediment Relationships and Assessing Impacts of SCRP/Soil Conservation Research Project Intervention on Soil Physico-Chemical Properties of Maybar Area, Wollo, Ethiopia	Maybar	BDU	Tammo Steenhuis Beth Medvecky
Elias Sime	Physical Based Erosion Assessment in the Anjeni Watershed, Highlands of	Anjeni	BDU/	Tammo Steenhuis

	Ethiopia		ARARI	Yves Parlange Seleshi [[??]]
Tigist Yazie	Assessment of gully formation near lake Tana, in the Blue Nile Basin, Ethiopia	Debre-Mewi	CU	Mike Walter, Tammo Steenhuis, Helen Dahlke Selamyihun Kidanu Matthew MCarthy

Supported By IWMI through Dr. Katrien

Hussien Ali	Analysis of Land Use Change and Its Impact on Biomass Production Using Remotely Send Vegetation Indices and a Simple Water Balance Model in Two Contrasting Sites of Amhara Region	Lenche Dima and Lake Tana	IWMI	Tammo Steenhuis Amy Collick Katrien de Scheemaeker Zach Easton

Supported through Dr. Yasir

Zelalem Kassahun	Long-term hydro-meteorological trends in the Nile basin	Blue Nile Basin	IWMI	Tammo Steenhuis Jery Stedinger Yasir Mohammed

Supported through Cornell University

Name	**Title**	**Site**	**Advisors**
Abrham Melesse	Optimum Utilization of Ground Water for Irrigation in Kobo Valley, Eastern Amhara, Ethiopia	Kobo Valley	Tammo Steenhuis, Mike Walter, Zach Easton
Aemiro Gedefaw	Streamflow responses to precipitation	Gilgel Abay River	Tammo Steenhuis, Zach Easton
Anteneh Zewdie	Hillslope hydrologic processes as influenced by selected soil properties	Debre Mewi	Mike Walter, Tammo Steenhuis Helen Dahlke Dr. Semu Moges Arbamich U

Aschalew Demeke	Assessment of Selected Water Supply Sources, Community Water Use Behavior and Attitudes towards Participation in Water Source Protection: Achefer Watershed, the Nile Basin, Ethiopia	Achefer	Chuck Nicholson Robert Blake Amy Collick
Assefa Derebe	Assessment of Erosion processes and Farmers' Perception of Land Conservation in Debre-Mewi Watershed, Near Lake Tana, in the Northern Ethiopian Highlands	Debre Mewi	Tammo S.Steenhuis, Robert Blake Amy Collick Selamyihun Kidanu
Habtamu Tilahun Kassahun	Environmental Service to Enhance Environmental Productivity in Ethiopian Watershed	Koga	David Lee Chuck Nicholson Tilahun IWMI/ILRI?
Tilashwork Chanie	The Effect of Eucalyptus on Crop productivity, Soil nutrients and Water availability in Koga Watershed, Western Amhara region, Ethiopia	Koga Watershed	Tammo Steenhuis Johannes Lehman , Dawit Solomon, Enyew Adgo, Matthew McCarthy
Tenagne Addisu	The impact of urban storm Water runoff and domestic waste effluent on quality of Lake Tana and local ground water near the city of Bahir Dar, Ethiopia	Bahir Dar town	Tammo Steenhuis Amy Collick Dr. Ayalew Wondie
Tegegne Mekonnen	Comparing methods alleviating rural water supply and sanitation problems in building sustainability in Libokemkem Woreda, Ethiopia	Libokemkem Woreda	Chuck Nicholson Robert Blake
Yidnakachew Ewnetu	Relationships between water availability, use and the estimated annual household caloric adequacy in Gumara watershed, Ethiopia	Gumera	Chuck Nicolson Tammo Steenhuis

MPS Cohort II Student Research

All supported by funds of HED/USAID and Cornell University and supervised by Tammo Steenhuis, Amy Collick and Charles Nicholson

Bezawit Andane:	Assessment of temporal hydrological variation due to watershed management option by using validated distributed swat model in Gummera watershed, Ethiopia
Birara Chekol Tarekegn	Assessment of gully formation and development in the high lands of Blue Nile Basin, Ethiopia.
Dessalegn Chanie Dagnew	Factors determining residential water demand in north western Ethiopia: The case of Merawi Town
Dessalew Worku	Environmental and health impact of solid waste: assessment on solid waste disposal site of Bahir Dar City, Ethiopia
Getachew Ewonetu	Assessment of Ground Water use Constraints to Irrigation Crop Productions at Fogera Plain, North Western Ethiopia.
Getaneh Kebede Ayele	The impact of selected small scale irrigation schemes on poverty reduction in Ethiopia Highland, Tana Basin, Ethiopia
Habtamu Addis	Challenges in rehabilitation of non-functional rural water supply: Mecha, Amhara Region, Ethiopia
Melisew Misker	Organization and management of traditional irrigation schemes In Eastern Amhara, Ethiopia
Meseret Belachew	Assessment of water supply sources and determinants of household water consumption in Simada woreda, Ethiopia
Muhammad Elkamel	Effectiveness of Soil and Water Conservation Practices in the Blue Nile Basin
Tadesse Geshaw	Effect of irrigation on groundwater levels in the Lake Ziway, Rift Valley Ethiopia
Tigist Alemu	Assessing the Impact of Irrigation in Male & Female Households Productivity and Income
Tigist Assefa	Assessment of the factors affecting the structural failures of irrigation and water harvesting schemes in Jari integrated watershed development project
Zemenu Awoke	An Assessment of Challenges of Sustainable Rural Water Supply: Quarit Woreda, Amhara Region

Appendix D: Student Case Studies 2011 and 2013.

Birara

Program in Integrated Watershed Management and Water Supply Cornell University/Bahir Dar University, Bahir Dar, Ethiopia

Soil erosion harms upstream farmers and fills reservoirs downstream.

Birara is a Cohort II graduate of the Cornell University Master's program in Integrated Watershed Management and Water Supply conducted at Bahir Dar University, Ethiopia in which he studied innovative ways of making watershed protection improvements more successful. He has a long term plan to educate himself in order to qualify for higher positions that have more pay so his two children can have a good university education once they graduate from high school.

As an extension agent with a high school diploma and with a family of four, he decided to further his knowledge. He decided first to attend a two year college, graduated and went back to work. He then went on to Mekele University to obtain a BS degree in Land Resource Management and Environmental Protection. Seeing the announcement for the Cornell University Master's program, he applied and was admitted. The interdisciplinary Cornell Masters program is supported by HED and hosted by the School of Civil And Water Resources Engineering at the University of Bahir Dar in Bahir Dar on the shores of Lake Tana in Ethiopia. The Master's program offers the student a program that is taught by American teachers in blocks on the Bahir Dar University campus. It offers a Cornell degree without ever setting foot on the Cornell campus. This has many benefits including an ability to educate 10 students in Ethiopia for the cost of sending one Ethiopian Master's student to the US.

For his research, Birara studied gully erosion in the same watershed where as an extension agent he was in charge of implementing soil and water conservation structures. He noted that after the structures were put in place, the gully erosion became worse. By installing weirs to measure the river flow and water table measuring devices, in treated and non-treated areas, he will be able to find the relationship between gully formation and the earlier soil and water conservation practices. This will help farmers and development professionals to fine tune the recommendations for conserving water and soil.

Birara is determined to further his education and obtain a PhD degree. The Cornell Masters degree and the support provided to this program by HED gave him an excellent chance to obtain a scholarship and fulfill his wish.

Getaneh.

Getaneh Ayele is a second year PhD student in the Water Management Graduate Program in the School of Civil and Water Resources Engineering at Bahir Dar University. He is researching the integration of the hydrologic, economic and community perspectives to reduce upland and gully erosion in the Birr Watershed, Upper Blue Nile Basin, Ethiopia.

Erosion in the Ethiopian highlands has been occurring over thousands of years, providing a continued supply of nutrients for the agriculture in the Nile valley and possibly being a strong reason why the dynasty of Pharaohs in Egypt could sustain itself well over centuries. As long as losses are less than the formation rate of the soil, erosion is not a problem. In recent years, however, sediment concentration in rivers has been continuously increasing, despite the millions of dollars and many volunteer labor hours invested in erosion control, threatening the sustainable productions of upland crops and filling up downstream reservoirs. Erosion can occur from the steep lands, and most efforts to reduce erosion have been directed towards protecting the hillsides. However recent research at the University of Bahir Dar found that more erosion was generated from only the small degraded portion of hillsides and from the lower lands where gully formation is rampant.

Based on this research Getaneh Ayele decided with his advisors to try to rehabilitate a gully in the Birr watershed. The Birr watershed is highly degraded and productivity of the land has been rapidly declining so that the only productive lands remaining are the bottom lands. Even this land is being threatened by rapidly deepening and widening gullies due to head cuts moving upstream.

To start the process, Getaneh discussed first with the religious leaders and local respected elders, and then with each local village farmers about his idea to rehabilitate the gully. At first the religious leaders, local elders and farmers were of the opinion that it was impossible to rehabilitate existing gullies, because they were created by their God to punish them due their wrong acts against his will. Only after showing photos of other rehabilitated gullies and a visit of two farmers to a rehabilitated gully an agreement was reached with the farmers to rehabilitate one gully as a trial to see if it was possible (Figure 1). After ample discussions and consensus, a relatively large upland gully was selected that was being formed in grazing land in the middle of

the village with twenty farming families.. This gully not only damaged the grazing lands but also would cut the paths between the villages. The twenty farmers of the comminute and surrounding farmers came to the agreement that each would contribute labor and wood to fence for the protection of the gully and share equally the grass at the end of the rainy season They also set 50 birr/Animal as punishment for anyone who allowed his animal in to the enclosed gully. After this agreement, Getaneh organized a meeting with the local community, religious leaders, administrators, extension workers, and woretas expert to share responsibility and their involvement in the gully rehabilitation (Figure 1).

Grass grew well in the gully after closure during the rainy season and the twenty farmers whose land surrounding the rehabilitated gully did not want to share the grass anymore (Figure 6). The farmers in other villages that contributed their labor and wood complained as expected because the initial agreement was not kept. Moreover, they argued that they could not graze their cows on this land as they were used to and needed the fodder as well. The conflict escalated and on the day, that the twenty farmers started to harvest the grass, the other village farmers came and stopped then cutting more grass. The conflict was resolved by the elders in the village by having the 20 farmers apologize and sign a promissory note to

contribute labor and wood in the next program to rehabilitate on the second village's gully.

Discussion with the local community

The most significant accomplishment, however, was that due to this project the farmers as a group negotiated with the local Woreda Office that they could use their mandatory volunteered labor for installing soil and water conservation practices to rehabilitating gullies, instead of digging deep infiltration furrows in the uplands that they considered inferior to their own practice of a graded small farrow carrying of excess direct runoff. This potentially can make a huge difference in decreasing sediment concentration in rivers and decreasing the rate that reservoirs fill up.

Before and after

Appendix E : Highlighted Research Paper

Factors in sub-optimum performance of rural water supply systems (as lessons learned for rain water management systems) in the Ethiopian Highlands

Seifu A. Tilahun[1,2], Aschalew D. Tigabu[3], Tegegne M. Tarekegne[3] , Meseret B. Addisie[3], Habtamu A. Beyene[3], Zemenu A. Alemeyehu[3], Manyahlshal Ayele[4], Amy S. Collick[1,3,5], Tammo S. Steenhuis[1,2,3]

[1]School of Civil and Water Resources Engineering, Bahir Dar University, Bahir Dar, Ethiopia

[2]Department of Biological and Environmental Engineering, Cornell University, Ithaca, NY, USA

[3]Integrated Watershed Management Master's Program, Cornell University, Bahir Dar, Ethiopia

[4]WaterAid Ethiopia, Addis Ababa, Ethiopia

[5]USDA-ARS, State College PA USA

(Final version is in the Proceedings of the Nile Basin Development Challenge Science Meeting on Rainwater Management for Resilient Livelihoods, Addis Ababa, Ethiopia, July 2013. Published as NBDC Technical Report 5 by ILRI, Nairobi, Kenya.)

Abstract

Access to safe drinking water services in the Ethiopian Highlands is one of lowest worldwide due to failure of water supply services shortly after construction. Over hundred water supply systems were surveyed to find the underlying causes of failure and poor performance throughout the Amhara Regional State. The results show generally systems with decision making power at the community level during design and construction remained working longer than when the decisions were made by a central authority. In addition, the sustainability was better for water systems that were farther away from alternative water resources and contributed more cash and labor. The results of this study of the importance of decision making at the local level in contrast to the central authority is directly applicable to the introduction of rain water management systems as shown by earlier efforts of installing rain water harvesting systems in the Ethiopian highlands

Media Grab

Hundred surveyed water supply systems provided evidence for the importance of full community involvement both to lighten the burden of the overworked Woreda staff, achieving greater quality of construction and sustained operation. Great poverty prevented payment and caused failure

Introduction

Ethiopia has adopted the millennium development declaration and is devoted to the achievement of the millennium development goal (MDGs). Among the MDGs the most important development objectives are reducing poverty by enhancing by enhancing economic growth, increasing agricultural production and improving rural water supplies.

Rural water-supply schemes in Ethiopia are partially or fully funded from governmental and nongovernmental resources. Many governmental organizations (GOs), nongovernmental organizations (NGOs), donors and international nongovernmental organizations (INGOs) through bilateral or multilateral projects and programs have been working for two decades in Ethiopia to increase coverage and to provide safe water supplies and sanitation to underserved populations in poor and remote rural areas in the highland.

In Africa and other developing countries, sustainability of rural water supply is quite low with 30 to 60% of the schemes becoming non-functional within 5 years after implementation. Failure of water supply systems in sub-Saharan Africa includes lack of community participation, lack of recovery of operation and maintenance costs, poor training, disinterested users committees (Carter et al, 1999, Carter, 2009; Mengesha et al, 2003)), weak administrative support (Bhandari and Grant, 2007) non-suitability of the technology for its intended use (e.g., hand pumps cannot provide sufficient water for cattle in Mali, Gleitsmann et al. 2007) and finally limited sustainability of imposed community management structures, (Harvey and Reed, 2006: Deneke et al, 2011)

Despite the many efforts in Ethiopia, both the failure of constructed water supply points and rain water management structures are common Key factors in sustainability of either system in the Ethiopian highland are not very well known and no information is available how these factors vary spatially. Since rainwater management structure have only recently been implemented we made an in-depth analysis on how the sustainability of developed rural water supplies is affected by available alternative water resources, operation and maintenance practices, Water Use Committees (WUCs); community participation and project cost. Detailed surveys were carried out in five Wordeas, and a more general survey in the remaining part of Amhara. In this paper an overview is given of the survey results of the performance of the more than 100 water point. More information can be found by searching http://soilandwater.bee.cornell.edu/research/international/eth_pubs.htm and includes the full report to WaterAid-Ethiopia, briefing notes and the thesis of the student-authors

Material and Methods

Several studies on rural water supply systems are combined in this overview. They can be divided in two studies (A and B). Study A was carried out by five master's students in the Cornell/BDU program on Integrated Water Management. In-depth surveys, consisting of formal interview, focal group discussion and field observation were conducted of 80 water supply systems in five districts (Woredas): Achefer, Mecha, Libokemekem, Quarit and Semada (Figure 1). In order to understand better why systems failed water system selection was changed

slightly during the study. In the initial survey the selection of water supply systems was random in the Achefer, Libokemekem and Semada Woredas. In the follow-up survey in Mecha and Quarit Woredas, water supply points were selected randomly with the restriction that half of the water points were functional and the other half were non-functional From 12-20 water supply systems per Woreda were investigated (Table 1) In all Woredas, households were randomly selected with 160 households (HHs) in all districts except in Libokemekem (200 HHs) and Quarit (180HHs) (Table 1). Study B was intended to obtain a broad overview of all water supply systems in the Amhara region in the Ethiopia highlands and consisted of a survey of 32 water supply schemes located in 29 different Woredas (Figure 1). The survey was done by faculty members of School of Civil and Water Resources Engineering at Bahir Dar University and was funded by WaterAid Ethiopia.

Data collection by formal surveys and focal group discussions was done in Study A from July to November in 2008 for Achefer and Libo-Kemekem districts and for the remaining districts, from September to December 2010. Surveys for Study B were conducted from October 2010 to March 2011.

Table 1: Description of study areas (Source: PCC, 2008 and WaterAid Ethiopia)

Study Area Name	Area (km^2)	population size 2007 census	Zone	% of rural population	Site Selections
Achefer	2500.00	173,211	West Gojam	93	randomly 16 villages
Libo Kemekem	1706.20	198,374	South Gondar	89	random 20 villages
Mecha	1612.50	292,250	West Gojam	92	8 villages functional 8 not functional
Semada	2281.72	228,271	South Gondar	96	randomly 16 sites
Quarit	613.6	166,848	west Gojam	98	6 villages functional 6 not functional
Amhara Region	161,828	17,214,056	11 zones	89%	32 sites selected

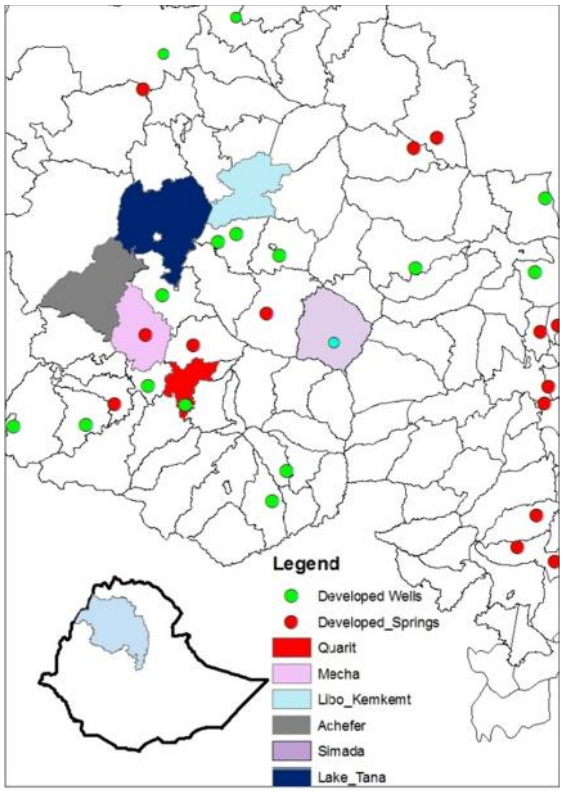


Figure 11: Map with locations of water supply points (red and green points) studied at regional level and Woredas (shaded area) where studies

RESULTS AND DISCUSSION

Functionality of schemes. In Study A (Table 1), water supply schemes consisted of hand dug wells, shallow wells, and natural (or gravity) springs. The hand dug wells were less than 30 meter deep with the exceptions of the Semada district where the depth was 60 m. In study B in addition to the same types of water supply systems, 2 boreholes were surveyed.

In the Achefer, Libokemekem and Semada Woredas (Figure 1) were water supply systems were selected at random (Tables 2 and 3), about two thirds were operational, one tenth completely not functioning and the remainder needed major repairs: The percentage of failed and broken water supply systems is nearly equal to that reported by African Development Fund in 2005.

Amount of water use per day: The average water use from functional systems in study A was between 10 and 15 l/day per capita was significantly less than the WHO guidelines of 20 l/day, (Mengesha et al., 2003; Minten et al., 2002; and Collick, 2008). In the Achefer, and Semada Woredas we found that an increase of household by one person decreases significantly the per capita water consumption by 1.5 l/day. In addition in Achefer Woreda increase in travel by 1 km to the water source decreased water use by 6.2 l/day per capita. Thus, both large family size and improved sources of water force households to use unimproved water sources when at closer distance than the improved source.

Alternative sources**:** Generally in most watersheds several sources are available for obtaining drinking water. In the Amhara region (study B) we found that besides the improved sources 65% of the villages had unprotected alternative source. In addition 24% of the village had choice between two improved sources. In the in Semada Woreda, about 68% of the 160 respondents had more than one source. The availability of alternative unprotected spring water sources affects the sustainability of developed scheme. For example in the Mecha Woreda we found that approximately two thirds of the systems failed for households that used spring

water before the new system was installed. In contrast, less than 20% was in need of repair for households that used traditional hand dugs in the back yard before the improved system was installed. These results are directly related to the belief of the rural population that the quality of water is good from spring and poor from hand dug wells. Thus for spring users there is no need to use water from a protective source and once the system is broken there is very little incentive to repair it. The opposite is true for communities that used water from the traditional hand dug wells and consequently more improved sources remain operating. Similarly to Semada Woreda in the Achefer villages the functionality was inversely related to the availability of alternative drinking water sources. It was found that in a village without alternative sources, none of the water system was completely broken

Table 2: Functionality of schemes with technology type in the three districts where water points are selected randomly. HDW is hand dug wells

Study areas	**Type of scheme**	**number of water supply schemes**	**Functional**	**non-functional**	**functional with breakage**
Libokemekem	HDW	16	13	3	0
Achefer	HDW	8	7	0	1
	Springs	8	2	0	6
Semada	HDW	6	5	0	1
	Springs	10	4	1	5
Amhara Region	HDW	15	6	3	6
	shallow well	3	0	2	1
	Springs	12	6	1	5
	borehole	2	2	0	0
Total		**80**	**45**	**10**	**25**

Table 3: Distribution of water point types where they are selected randomly for functional and non-functional categories

Study areas	Type of scheme	number of water supply schemes	Functional	non-functional	functional with breakage
Mecha	HDW	14	8	0	6
	Springs	2	0	2	0
Quarit	HDW	8	5	3	0
	springs	4	0	3	0

Operation and maintenance**:** Surveys in Libokemekem, Semada, Quarit and Mecha Woredas were directed towards understanding the various aspects of willingness to pay for operation and maintenance (O & M) of water facilities. The percentage of payers was in the order of 30% except in the Quarit district in which the functional system had great number of users contributing. In almost all cases the amount collected did not cover the cost of maintenance. An interesting fact and often overlooked in reasons for failure of water systems is that the cash for obtaining water was just too costly for the poor families and therefore obtained lower quality water from the traditional sources to save money.

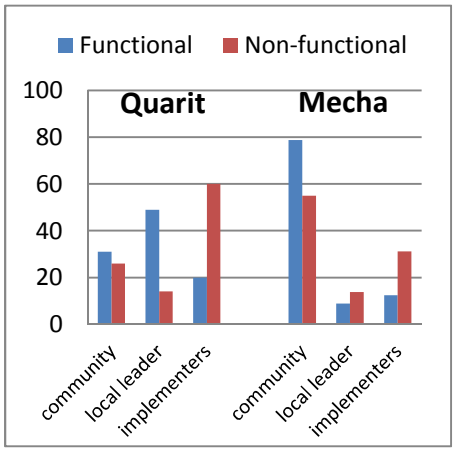


Figure 12: Community, local leader and implementer's share of responsibility in site selection in Quarit and Mecha Woredas

WUCs: Water Use Committees (WUCs) were instituted in many villages for governing water systems (for example 90% in Semada, 100% Achefer and 62% Mecha of the villages had WUC's) The idea of water point management through WUC is reasonable taking into account both the scattered rural settlement pattern and the small number of Woreda level experts relative to the number of water supply systems. In the Quarit Woreda, for example, only five experts (1 office head, 1 planning and documentation expert, 1 operation and maintenance expert, 1 pump attendant and 1 water quality expert) for the total of more than 200 water supply points. In many cases the WUCS were ineffective, had unclear responsibilities and authority in part due to outsider initiated institutional structure dominated by local administrators from government rather than local indigenous institutions as described in Deneke et al (2011). This is demonstrated in Semada Woreda where 47% of the respondents did not know the existence and/or the role of water user committee. Well-functioning WUCs are important because for instance in Achefer Woreda, there was a direct

and statistically significant (p<10%) relationship between trust of WUCs and the amount of cash contributed.

Community Participation: In Ethiopia, just like other African countries, the degree of community participation is extremely important This is well demonstrated in the surveys in the study of the Quarit and Mecha Woredas (Figure 2). The functionality of the system was much greater when either the community of a local leader had the responsibility for selecting the water points rather than the implementer. This is also the reason that the number of operational systems was much greater in the Mecha compared to Quarit system because local communities and leaders were more involved in the selection process.

Project cost: Participation of households during water source installation is an important indicator for future project sustainability This was well demonstrated in the Achefer Woreda where there was no complete failure and where for over 75% of the systems labor was provided for site clearing and construction and material were given such as wood. In addition 10 to 12% the project cost was covered by the community. There was a similar situation in Mecha district in which nearly half of the community contributed cash, labor and local materials in case of the functional water points. In nonfunctional water point, majority of the community participate by providing only food and local beer for laborers

Conclusions and recommendations

Despite many years of development efforts, both access to safe water supplies and well-maintained rainwater management systems in the Ethiopia highlands continues to be challenging. There are many parallels between the implementations of rural water systems and rainwater management systems. Success of either system depends largely on effective community participation in assuring that the systems function to the satisfaction of the users.

In case of water supply systems 10 and 20% have failed completely. This will in near future be increased by 35% unless immediate solutions are devised by understanding the factors for unsustainability.

The availability of alternative water sources was an important factor in the failure of the system. Labor shortages often forced the family members to obtain water from a water point that was closest to the home. It is important for the sustainability of the system to consider providing sufficient water at a fair distance from their house by improving unprotected alternative sources near the houses.

The members of the community have often insufficient cash resources for payments Therefore most cash collected for O & M should be spent on maintenance rather than operation such as payment for guard. Operation payments could be in kind by through participation of all households.

For the sustainability of the water points, the degree of participation of community or local leaders should be high. Although in all cases the communities requested for the water supply

system and provided some level of services, only in the currently operational systems local traditionally community leadership participated in the selection of site, project scheduling, and important decisions during construction,

The final important factor in success of the water systems was the functioning of the Water User Committees (WUCs) In most cases in failed systems WUCs was found to be selected for formality to fulfill the requirement of implementers. They weren't fully recognized by the community and the communities did not trust them. It might be preferable to use local indigenous institutions as described in Deneke et al (2011) or local traditional leaders to assure WUCs that are trusted by the communities, so that payments will make for repair and systems can be repaired when broken.

References

Bhandari, B. and Grant, M. (2007). User Satisfaction and Sustainability of Drinking Water Schemes in Rural Communities of Nepal. Sustainability: Science, Practice, & policy e-journal: 3(1)

Carter, R. C., Tyrrel, S. F. and Howsam, P. (1999): Impact and sustainability of community water supply and sanitation programmes in developing countries. Journal of the Chartered Institute of Water and Environmental Management, 13: 292 – 296

Carter, R.C. (2009). Operation and maintenance of rural water supplies: Rural Water Supply network Perspectives no 2

Collick, A. (2008). Community Water Use in the Yeku Watershed and Hydrological Modeling in Watersheds of the Upper Nile Basin, Northern Ethiopia: Dissertation, Cornell University, Ithaca, NY, USA.

Deneke, T.T., Mapedza, E., and Amede, T. (2011). Institutional Implications of Governance of Local Common Pool Resources on Livestock Water Productivity in Ethiopia. Experimental Agriculture 47 (S1), Supplement 1: 99-111.

Gleitsmann B.A., Kroma, M. M. and Steenhuis, T.S.. (2007). Analysis of a rural water supply project in three communities in Mali: Participation and sustainability. Natural Resources Forum 31 (2007) 142-150..

Harvey, A. & Reed, A. (2007). Community-Managed Water Supplies in Africa: Sustainable or Dispensable? Community Development Journal . 42: 365–378.

Mengesha, A., Abera, K. & Mesganaw, F. (2003). Sustainability of Drinking Water Supply Projects in Rural of North Gondar, Ethiopia, Ethiopian J. Health Dev. 3: 221-229.

Minten, B., Razafindralambo, R., Randriamiarana, Z. & Larson, B. (2002). Water Pricing, the New Water Law, and the Poor: An Estimation of Demand for Improved Water. Water Services in Madagascar, SAGA Working Paper. USAID-Ilo program-Cornell University

PCC (Population Census Commission) of Federal Democratic Republic of Ethiopia (2008) Summary and statistical report of the 2007 population and housing census: population size by Age and Sex, United Nation Population Fund, Addis Ababa, Ethiopia

Drinking Water Supply, Sanitation and Hygiene Promotion Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Final Project Report

Implementing Partners:

1. Makerere University School of Public Health, Kampala, Uganda
2. University at Albany, State University of New York, USA.
3. Tuskegee University, USA

Funding Support: Higher Education for Development (HED) / USAID

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Executive Summary:

Sanitation and personal hygiene are major problems in Uganda, and the situation is particularly serious in urban slum communities where lack of funds and infrastructure restrict access to clean drinking water, leading people to collect drinking water from surface sources or superficial pipes containing drainage water from superficial soils. To make the situation even worse, the homes traditionally have an attached outhouse which results in transport of infectious and other contaminants into superficial water sources. In addition there are no facilities for washing hands after use of the toilets.

The goals of this project have been to provide education and training to residents of two slum communities of Kampala and Mukono. The project was entitled WASH, for WAter, Sanitation and Hygiene. Offices were established in both communities, employing community members who were trained to assist in the project activities. Major activities included placement of “tippy-tap” near outhouses which are typically attached to home and training residents to tip the tippy-tap so as to be able to wash their hands after using the toilet. Educational activities were held both for community members and in schools. Environmental health students from Makerere University were trained to deliver many of these activities. Chlorine tablets were distributed to residents so as to reduce or eliminate infectious organisms in drinking water.

1. Partnership overview

1.1. Background

While there has been rapid growth of a poor population in the slums in Africa, and in Uganda in particular, slums lack adequate safe drinking water and sanitation services, leading to poor personal and general hygiene. The situation is aggravated by the fact that urban authorities lack the resources to satisfactorily provide the required services and infrastructure. As a result, slums have become breeding grounds for disease, making the search for solutions to improve health in slums of utmost urgency.

In slum settlements of Kampala and Mukono, the major risk factor for diarrhoeal diseases is contaminated drinking water and food, due to low latrine coverage, low safe water coverage, and poor domestic and personal hygiene practices. The majority of the community members have insufficient knowledge of the link between water, sanitation, hygiene and health, evidenced by the epidemics of cholera and typhoid, and a high incidence of diarrhoeal diseases particularly in children under 5 years. As a result of poor planning, often the location of pit latrines and other sanitary facilities is such that they end up contaminating the drinking water sources. The majority of the pit latrine facility users have insufficient knowledge of the link between fecal matter and health, making the utilization and maintenance of such facilities poor. Insecure tenure in these communities contributes to the problem.

The envisaged plausible solution to which this project was targeted was to seek solutions within the affected communities in order to improve the prevailing poor environment in slums as a deliberate effort to improve community health. This therefore necessitated the implementation of this project in 2 urban slum areas in Uganda so as to improve the health status of the inhabitants through application of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities.

1.2. General Objective

To improve the health status of the inhabitants of the two communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities through community pro-active and sustainable interventions.

1.3. Specific Objectives

1.3.1. Baseline Phase

- Examine the socio-economic and cultural factors and practices that result into the current environment and community health status in the two study sites.
- Analyze the linkages between the bio-physical factors and health status in the two study sites with a focus on diarrheal diseases.

1.3.2. Intervention Phase

- Initiate and pilot community based health interventions for reducing morbidity due to ill health with specific emphasis on diarrheal diseases.

1.4. Performance Objectives

1. To enhance both human and institutional capacity at Makerere University in dealing with water and sanitation issues in local communities.
2. To survey the water sources and sanitation facilities available in the study areas.
3. To estimate the current incidence of selected water-borne and excreta diseases in the population through use of government and other medical information, with an emphasis on children.
4. To identify risk factors associated with identified water and excreta related diseases in these specific communities.
5. To determine constraints limiting access and proper utilization of water and sanitation facilities that impede hygiene conditions in the study areas.

6. To develop greater capacity within the study communities to identify and deal sustainably with water and sanitation issues, and to transfer that knowledge to other communities.
7. To equip the US institutions with experience and data that could be transferred to other study areas in low-income countries.
8. To use the information obtained to promote policies that will address the infrastructural and educational issues within the governments of Uganda and other nations.

1.5. Project Areas

1. Kikulu zone, Kisaasi parish, Kawempe division, Kampala city
2. Kikooza, Ngandu, Lweza and Kiteega zones, Mukono Municipality

1.6. Project Duration: August 2010 – September 2013

1.7. Main Project Staff

1. Dr. John Ssempebwa – Principal Investigator (MakSPH)
2. Prof. David Carpenter – Principal Investigator (University at Albany, US)
3. Prof. Ramble Ankumah – Principal Investigator (Tuskegee University, US)
4. Assoc. Prof. William Bazeyo – Principal Investigator (MakSPH)
5. Dr. Simon Kasasa – Principal Investigator (MakSPH)
6. Mr. David Musoke – Administrator (MakSPH)
7. Mr. Roger Semakula – Kawempe Field Coordinator
8. Mr. Daniel Kabirigo – Mukono Field Coordinator

1.8. Main Project Activities

- Community sensitization on Water, Sanitation and Hygiene (WASH)
- Promotion of handwashing using the *tippy tap* technology
- Support clean-up exercises in the community
- Providing advisory roles in WASH
- Supporting health clubs in primary schools
- Training community members in a short course in WASH
- Analysis of water from community water sources
- Capacity building of youth in WASH
- Supporting Bachelors of Environmental Health Science programme at Makerere University
- Promoting drinking safe water through household chlorination
- Support to conferences
- Research

1.9. Summary of Impact and Prospects for Sustainability

The project had a significant impact at institutional and community levels. At Makerere University, the laboratory capacity was greatly strengthened by the acquisition of water testing kits and microscopes. In addition to conducting practicals using the kits, students of Environmental Health Sciences benefitted from obtaining field exposure and carrying out internships at the sites. The communities benefitted from the various project activities which improved their knowledge, attitudes and practices in WASH. Key informant interviews and focus group discussions conducted during the evaluation indicated that these activities certainly led to reduction in diarrhoea cases and related diseases in the community, hence directly improving their lives (evaluation reports will be submitted separately when they are ready).

For sustainability, the project trained and used existing community health workers including village health team members in the implementation of several activities. This ensured that individuals already involved in health promotion are better equipped to improve the health and wellbeing of their respective communities. Capacity building of youth was also carried out to ensure that they will be able to continue promoting WASH in the area even beyond the project. Many of the community activities, such as clean-up campaigns, were conducted by community members themselves with only limited support from the project. This was necessary so that these activities can continue even after the project ended.

2. Partnership results

2.1. Project Initiation

The project team held several meetings with local leaders, responsible health departments and the general community to introduce the project to them. The project then established a field office (rented by the partnership) in each study site. A community member was recruited from each area as a caretaker of the office and for community mobilization during project activities.

2.2. Baseline Survey

A baseline survey to assess the WASH status of the community was conducted. This survey involved 102 and 111 households in Kampala and Mukono respectively. The baseline survey involved: a household survey (questionnaire and checklists), 8 focus group discussions, 24 key informant interviews, bacteriological analysis of drinking water, stool analysis from children under 5 with diarrhea, and soil analysis (from all households involved). The results of the baseline survey revealed that the WASH status of the community was poor. This justified the selection of these sites for implementation of the project. The project also carried out video recording of the baseline situation.

The state of some of the water sources in Mukono during the baseline survey.

2.3. Dissemination of Baseline Findings / Health Education

The results of the baseline survey were disseminated to the respective communities in meetings organized by the project. During these 6 meetings held in June and July 2011, the project team provided health education in the community on the various WASH concerns identified based on the findings of the survey. These included drinking water safety, hand washing, waste management, excreta disposal and personal hygiene. Over 200 community members attended these meetings. See Appendix 17 for Baseline Survey Report.

Community members attending sensitization sessions.

2.4. Support of Conferences

The project supported 3 Makerere University Environmental Health Students' Association (MUEHSA) annual conferences in 2011, 2012 and 2013. These 2-day conferences attracted several students and practitioners from across the country from environmental health and other professions. International delegates from UK, Rwanda, Kenya and Tanzania have also been attending these conferences. The 2013 conference attracted over 120 delegates. These conferences were crucial in sharing research findings as well as discussing and addressing emerging environmental health

issues. The exposure of students to presentations from international delegates was highly appreciated.

In 2013, the project supported the Joint Annual Health Scientific Conference organized by Makerere University College of Health Sciences (MakCHS) which included MakCHS' 9th annual conference. This conference held in Kampala in September 2013 was well attended with over 400 participants. The project provided financial support to the organization of this conference, which was attended by faculty and students (undergraduate and postgraduate) of Makerere University School of Public Health as well as Environmental Health graduates under their umbrella organization of the Environmental Health Workers Association of Uganda.

One of the conference posters (left). A section of the MUEHSA's 2013 conference participants (right).

2.5. Stool Examination Among Children

In the first year of the project, continuous stool sample collection and examination from children under 5 years old with diarrhea was conducted. Basing on the results, children were referred to nearest health facilities for treatment. However, this activity was not sustainable as the community's expectations of providing medicine to the sick children

could not be met by the project. Nevertheless, families whose children were examined were appreciative of this initiative by the project.

2.6. Promotion of Hand Washing

The project promoted hand washing at critical times, particularly after visiting the toilet. Special trainings on hand washing, specifically the use of the *tippy tap* technology, were conducted. The *tippy tap* uses a 3-5 litre jerrycan, a string and pedal to provide a simple but effective means of hand washing after toilet use. Following these trainings, over 200 households in the study areas constructed these hand-washing facilities at their latrines with support of the project. The introduction of the *tippy tap* technology greatly improved the hand washing practices of the general community including among children who enjoyed using the facility after latrine use.

A youth teaches colleagues how to make a *tippy tap* (left). A young girl demonstrates the proper hand washing procedure (right).

2.7. Clean-Up Exercises

The project team supported the communities in routine clean up exercises in their area to improve sanitation. This improved on the aesthetic appearance of the areas as well as reducing on waste in the community. Such waste would otherwise be a source of vector breeding such as flies and rats.

Community members cleaning their area.

2.8. Home Improvement Campaign

The project mobilizers and community health workers implemented a home improvement campaign in the area. This involved carrying out house to house visits to ascertain the WASH status of the households. Basing on the findings of the inspection, the team would health educate household members on the ideal requirements in a home. This activity was useful to households as they were told the WASH shortfalls in their homesteads as well as providing them with appropriate measures to improve the situation. An estimated 500 households were reached by the project. The Mukono District Health Inspector and Health Assistant were involved in these campaigns and other project activities.

Home improvement campaign activities.

2.9. Capacity Building of Makerere University Faculty

Over 25 members of the Department of Disease Control and Environmental Health at Makerere University School of Public Health were involved in various activities of the project as a form of capacity building. The activities they were involved in included health education, community training, school training, research and providing advisory roles to the community in WASH. This also gave the faculty an opportunity of closely working with a community as well as appreciating the challenges faced by urban slums in the country. The experiences gained by the faculty have also been useful during their teaching of students at the university.

Academic staff training community members (left) and school pupils (right).

2.10. Field Exposure of Environmental Health Students

Over 100 Bachelor of Environmental Health Science students at Makerere University were able to gain field exposure by their involvement in project activities. The activities they were mainly involved in included household visits, sanitary inspection of water sources and promotion of hand washing using *tippy taps*. This field exposure was very important to the students to add to the theoretical knowledge that they were taught in class.

Bachelor of Environmental Health Sciences students learning how to make a *tippy tap* (left) and inspecting a water source.

2.11. Student Field Attachment

To accomplish their university mandatory requirement of carrying out 6-weeks internship, a total of 12 students of Environmental Health Sciences at Makerere University in 3 different years were attached to the project field sites. These students were not only learning from the project team but also actively taking part in ongoing activities. Specifically, these students were involved in the home improvement campaign, community health education, school training, community demonstrations, inspection of water sources, clean-up exercises and research activities.

Students health educating school pupils (left). A student during household assessment (right).

2.12. Strengthened Laboratory Capacity at Makerere University

The project procured 3 microscopes and 3 bacteriological water-testing kits to strengthen the laboratory capacity at Makerere University. These kits have been used and continue to be used by students of Environmental Sciences at Makerere University to conduct practical sessions. Faculty also use the equipment during their research activities.

2.13. Water Quality Assessment

Research has been conducted to assess the quality of water from sources in the communities. This involved carrying out water sampling and analysis from communal and household sources. Results showed that some of the water sources were contaminated. The findings were disseminated to the community and households whose water was contaminated were advised to treat it before drinking such as by boiling.

Collecting a water sample (left) and measurement of residual chlorine from a piped water source (right).

2.14. Support of Health Clubs

The project supported health clubs in 2 primary schools in the project communities. These schools were Kikulu primary school (Kampala) and Lweza primary school (Mukono). The project conducted several activities in WASH among the health club member of these schools including training, health education, demonstrations, and drawing competitions. The training of these pupils not only benefitted them but also other pupils in addition to family members of the health club members. These sentiments were obtained from the pupils as well as teachers in both schools. At the end of the project, 200 health club pupils received educational materials in form of bags

with different health promotional messages that will continue to promote WASH even beyond the project.

Pupils in a drawing competition (left) and learning how to make a *tippy tap* (right).

2.15. 'Talking Compound' Messages in Schools

To promote appropriate WASH practices in the 2 primary schools, the project supported the development of 'talking compound' messages which were displayed in appropriate places in the school compounds. The messages were 'Wash hands after visiting the toilet' 'Sleep under a mosquito net', 'Wash your hands before eating food' 'Remove stagnant water from your compound' and 'Keep the environment clean'. These messages were greatly appreciated by the schools as they helped promote sanitation and hygiene among the entire school population.

Dr. John Ssempebwa (centre of photo) with pupils at one of the messages (left). A pupil stands behind a message in the school compound (right).

2.16. Capacity Building of Youth in WASH

A total of 20 youth in the project sites were trained in several WASH techniques including inspection of households and water sources, use of water testing equipment and research. This helped build the capacity of the youth in the project sites as a sustainability strategy.

A youth being taught how to measure residual chlorine (left) while others try out a *tippy tap*.

2.17. Community Volunteers Trained in WASH

The project trained 41 community members in a short course in WASH. The short course was offered twice: in March 2012 and August 2013. Those trained were village health team members, local leaders or individuals involved in community work in their area. The trainees were responsible of promoting WASH in their respective communities through health education, house-to-house visits, clean-up exercises and improving solid waste management among other responsibilities.

Trainees in Mukono in 2013 (left) and Kampala in 2013 (right) pose with their certificates after completing the WASH training.

2.18. Promotion of Drinking Safe Water Through Household Chlorination

The project partnered with a non-Governmental Organization (Uganda Health Marketing Group) to promote use of chorine tablets (Aquasafe) as an option of treating drinking water at households. This involved conducting training sessions on the use of Aquasafe and subsequently promoting its use on the community. Aquasafe tablets are sold relatively cheaply in the community, therefore some households will be able to access and afford these tablets even after project completion. This method, which was unknown by many community members, was greatly appreciated, particularly by

households that had difficulty in boiling water for drinking. It should also be noted that the project sensitized the community on household chlorination, removing the negative perceptions they previously had about the tablets.

Community trainings on household water chlorination in Mukono (left) and Kampala (right).

2.19. International Students' Research

The project supported 2 masters students in conducted their academic research in the study sites. Ms. Anne Kelleher, MA Public Health student at Nottingham Trent University (UK) and Ms. Lindsey Daudt, MSc Global Health at Trinity College Dublin (UK) carried out their research in the project in 2013. Anne studied the role of community health workers in community development while Lindsey assessed the hand washing practices of the community. The successful completion of both research studies was a major success by the project as these 2 students were the first in the respective countries to conduct their academic research in a developing country. They greatly appreciated the support and environment the project provided and promised to encourage other students with the capacity to do the same in future years. The 2 students were also involved in house-to-house visits where they interacted with several members of the community. Both students from the UK were self-funded and it would

have been ideal to have students from the US involved in similar activities, but funding was the major constraint.

Lindsey doing her research in Kikulu zone, Kampala.

2.20. WASH Certificate Curriculum

The project supported the development of the curriculum for an 8-weeks certificate course in WASH to be hosted at Makerere University School of Public Health. The course was developed due to the need arising from several people working in the WASH sector in Uganda but with no training. This course will be run during recess terms of the university (July – August) and the first intake will be in 2014.

2.21. Project Visitors

The project received several visitors, both local and international. Local visitors included those from health authorities, non-Governmental Organizations, community-based organizations, health facilities and the general community. International visitors included the project partners (Prof. David Carpenter – University at Albany and Dr. Chris De Rosa – USAID), Dr. David Kahler (USAID) and US students from different universities including North Western University under the School of International Training program

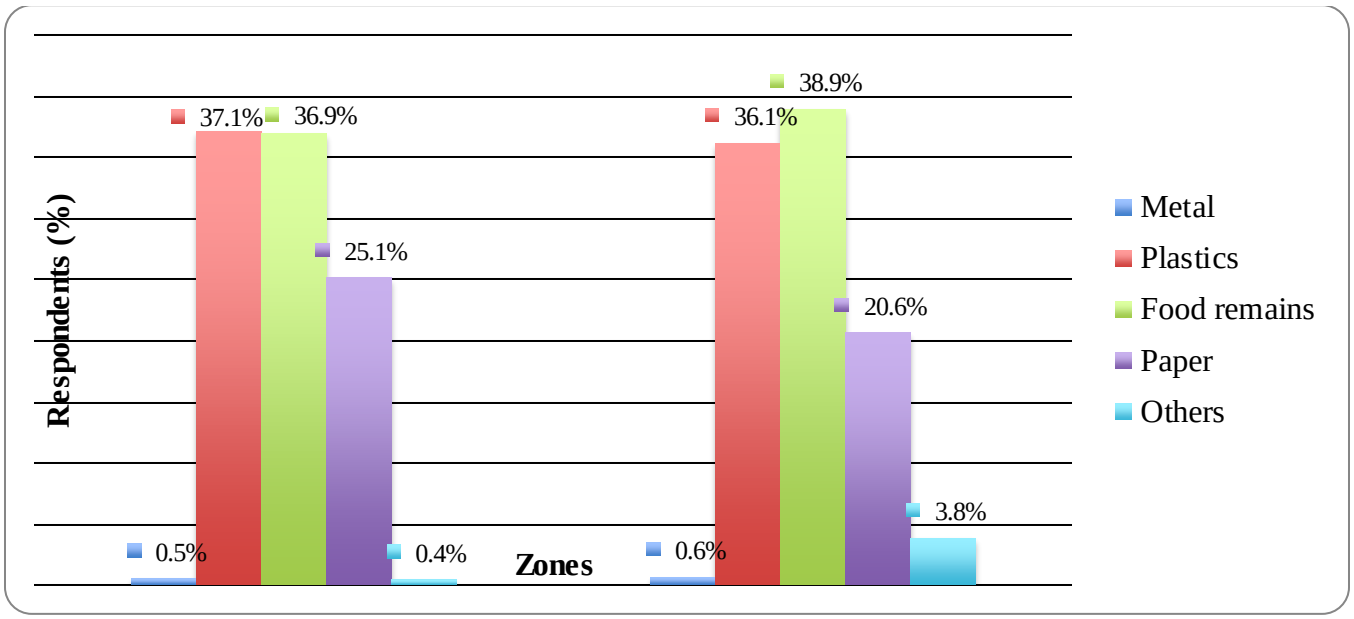
housed at Makerere University School of Public Health. These students not only learnt what had been done by the project but also participated in some activities such as clean up exercises.

Some of the US students who visited the project.

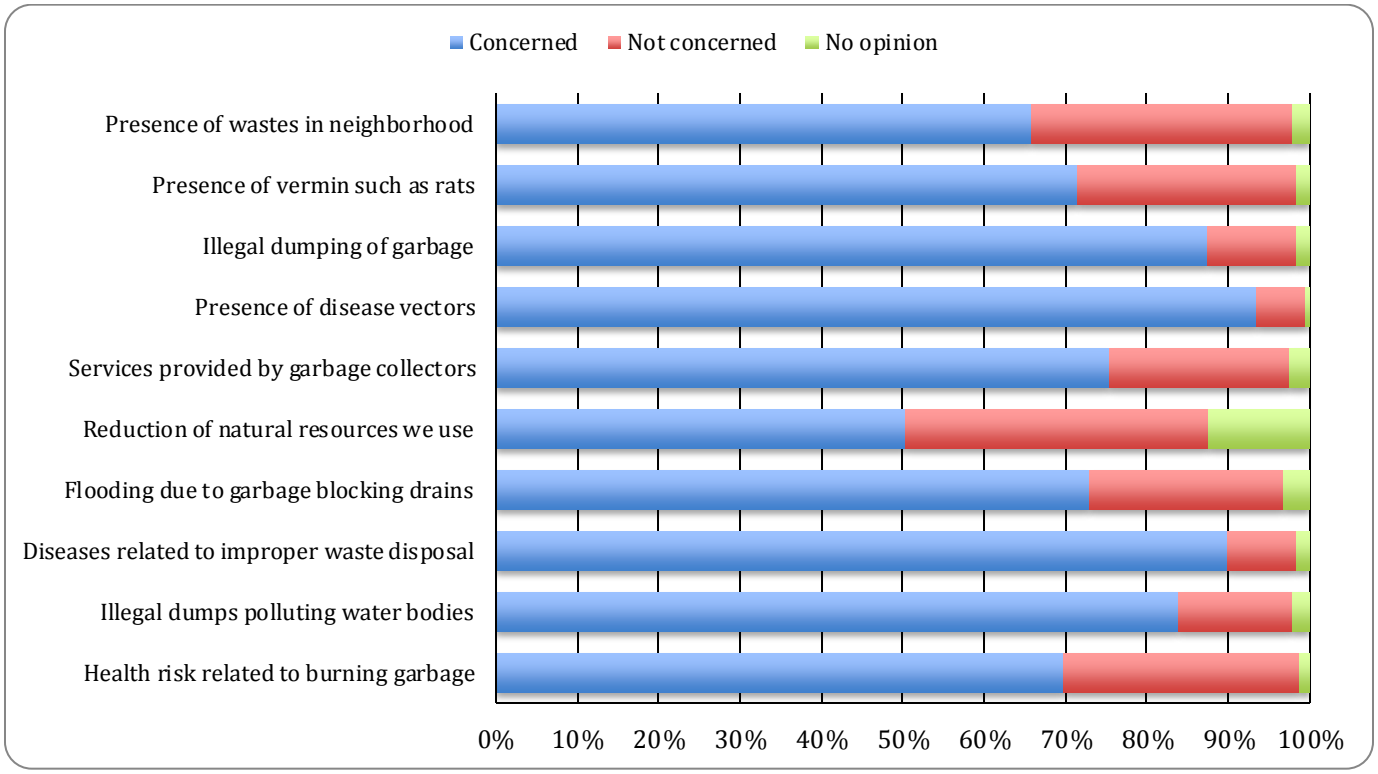
2.22. Solid Waste Research

Research to assess the community knowledge, attitudes and practices on solid waste management was conducted in June 2013. This provided information that was useful in advising the community on how to improve on waste management in their area. The report for this research will be submitted separately once it has been finalized.

2.22.1. **Figure 1.** Comparison of Waste Generation in the Two Zones



2.22.2. **Figure 2.** Respondents' Concerns About Solid Waste Management



Although most of the respondents were concerned about several solid waste aspects, many of them could not do much about it due to the several challenges faced in these communities included limited

resources. It should be noted that this research was carried out towards the end of the project therefore there were few interventions carried out after the data was analysed.

2.23. Exhibitions

The project exhibited part of its work at several fora in Uganda, including during the national Independence Day celebrations in Mukono district, at the third Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) in Entebbe, and the Uganda National Council for Higher Education Inter-University Exhibition, in Kampala all in 2012. Exhibits mainly included the activities it was conducting in the 2 urban slums.

Village health members of Mukono display the project poster during the National Independence Day celebrations in 2012.

2.24. Conference Presentations

Two conference presentations from the project work were made and presented at the 3rd All Africa Congress on Environmental Health held in Durban, South Africa in November 2012, and at the 10th Makerere University Environmental Health Students' Association (MUEHSA) conference held in Kampala in April 2013. See Appendices 13 and 14 for each presentation, respectively.

David Musoke (left) responds to questions after his presentation in Durban. Ralwance Ndejjo makes his presentation at the MUEHSA conference (right).

2.25. Completion of Masters Degree

Mr. Shedrack Nayebare who was supported by the project to pursue an MS at University at Albany completed his studies in 2012. His supervisors noted that he was a committed and outstanding student during his time in the US.

2.26. Support to Plastics Collection

At the start of the project, the baseline survey had established challenges in solid waste management in the slums. During dissemination of baseline findings and subsequent trainings, the community was educated on the preferred options of waste management, including recycling. In its final year, the project supported a youth organization (Youth Centre Support Network) to reduce waste in Kikulu zone by collection of plastics. This was done through sensitizing the community during the various sessions on the importance of recycling waste particularly in urban slums. The youth involved in plastics collection were also trained on the ideal ways of handling the waste. This activity greatly improved the management of solid waste as fewer plastics were available in the general waste stream. The plastics were later taken by the youth for recycling at a recycling plant in Kampala. Recycling of waste was one of the strategies of solid waste management that was introduced to the project sites at the start of the project, and therefore was one of the major initiatives that originated from the trainings of the project.

Before the collection of plastics, many were indiscriminately disposed of (left). Some of the collected plastics (right).

2.27. Exchange Visits

Visits were organized between members of the 2 study sites to learn from each other and share experiences. These 2 exchange visits organized in October 2012, which involved 20 community members, were crucial for each group to appreciate the challenges faced by the other as well as to understand how they promote WASH in their communities. These exchange visits also provided an opportunity for learning how the other community had implemented project interventions. There was a missed opportunity to have exchange visits between the teachers of the 2 schools involved mainly due to difficulty in aligning school schedules to that of the project.

Community members inspect a water source (left) and share experiences (right) during an exchange visit.

2.28. Advisory Roles in WASH

The project provided advisory roles in WASH to the project communities in the entire 3 years. This included routine visits to the communities where meetings were held to discuss WASH issues that were being faced. This helped support the community and provide information necessary to promote WASH in the area.

3. Project Challenges

3.1. Delays Due To Obtaining Ugandan Government Approval For The Project

In Uganda, research studies like this must be approved at the level of the Presidents. While this is a rather pro-forma process, it took almost one year to obtain approval and significantly delayed the project from being started. This was the major factor that necessitated the request for a one-year, no-cost extension.

3.1. Delays Associated With Obtaining Human Subjects Approval

There were major delays in obtaining human subject approval in spite of the fact that this was only an educational study. The University at Albany IRB insisted that every person involved in training activities took the CITI training tests, which were unfamiliar to most of the participants and caused major delays in getting the project started.

3.2. Delays In Distribution Of Funds To Uganda

On multiple occasions progress was delayed because of the slowness of transfer of funds from Albany to Kampala. The system requires that the work be done before payment can be made, but many times the work could not be done without the funds to support it.

3.4. Migration In And Out Of The Community

One of the major challenges the project faced was the frequent migration of people in and out of the project sites. Being slums, some of the population are not permanent residents and hence move to other areas whenever there is need, such as in search of jobs. This negatively affected the project as some of the members trained left the community. This challenge was mainly addressed by selecting members who had stayed in the area for a long time and were expected to stay there for the major project trainings.

3.5. Demonstrations in Kampala

During the course of project implementation, there were some demonstrations in Kampala under the 'walk to work' protests, which were politically driven. These affected the project as movement in the city was impossible during these times hence halting implementation of certain activities. To overcome this challenge, the project had to make up for the lost time by implementing pending activities immediately after the demonstrations ended.

3.6. Unfavorable Weather

During certain times of the year, bad weather—notably heavy rains—prevented the team carrying out certain project activities such as house-to-house visits and other field activities. As soon as the weather improved, the project team was able to implement the pending activities planned for the respective periods.

3.7. Unfavorable Community Behaviors

In certain circumstances, the behavior of some members of the community was undesirable regarding implementation of project activities. For example, even with extensive mobilization, some members of the community would not show up for health education sessions. This was because being slums, some of the population felt less concerned about community activities as it was not their permanent residence. However, the many who attended these sessions were expected to pass on the messages to other members of the community.

Some community members also stole the *tippy taps* from some toilets in the area. This was either to use them at their own toilets or using the jerrycans for other purposes. This forced some community members to lock the jerrycan in the toilet as opposed to having it installed outside the facility. Although the community was extensively

sensitized on the importance of these hand-washing facilities, some members still continued with this negative practice.

3.8. Closure of Makerere University

During the 3 years of project implementation, Makerere University has been closed on a number of occasions—most recently in August 2013. The closures were either due to strikes by students and/or staff. Implementation of project activities during these periods was affected as in some instances certain offices could not be accessed. Once the university had re-opened, the project team had to implement the pending activities to make up for the lost time.

4. Collaboration with Other Stakeholders

5. Sustainability

Due to the lack of additional grant support we do not have the possibility of continuing and expanding our studies in these two communities at the moment. We do, however, have major activities that will continue collaboration between Albany and Kampala scientists. Mr. Shedrack Nayebare, whose Masters project focused on drinking water issues in Uganda and who was supported by this grant, has entered the PhD program in the Department of Environmental Health Sciences where his current project involves health effects of air pollution in developing countries. Mr. Akankunda Bwesigye is a DrPH student, and I am a member of his dissertation committee. His project involves HIV monitoring and prevention activities in Uganda. The first graduate of the University at Albany School of Public Health MPH program was Dr. Jotham Musinguzi, currently the Regional Director of the Partners for Population Development at the Africa Regional Office. Dr. Musinguzi has been identified as a Distinguished International Alumunus of the University at Albany and will be receiving this award in Albany in May, 2014. We have many contacts, including especially Dr. Ssempebwa who received his PhD here,

and all of these contacts will continue to be collaborators to the degree that funding can be obtained to support our activities.

6.

6. Conclusion

The success of this project demonstrated how the partnership between US universities and one in Uganda helped improve the lives of residents in urban slums by promoting improved water, sanitation and hygiene practices by fully involving the community in implementation of proactive and sustainable interventions. The training of WASH community volunteers, local leaders and youth in the communities to take lead in implementing project activities was crucial in the success of the project and can be replicated in other programs. In addition, the US institutions played an important role in the project's success, especially after the visit by Prof. Carpenter who shared his experiences with students and colleagues when back in the US. The MS student also interacted greatly with US faculty and students during his time at University at Albany and Tuskegee University, which benefitted both institutions.

The involvement of students and support of their activities added another dimension to the project of supporting the training program at Makerere University. The students were eager to learn about project activities in the field as well as taking part in planned activities. This therefore benefited the students, the project, and the communities in which they worked.

The acquisition of water testing kits and microscopes significantly strengthened the laboratory capacity at Makerere University. This has greatly supported the Bachelors program in Environmental Health as well as research by staff at the School of Public Health. This equipment will continue to be used at the university even beyond the project period which is a sustainability component of the project.

The health clubs in the 2 primary schools greatly benefited from the project activities in the schools. It was therefore a beneficial strategy to not only work with the general

community but also promote sanitation and hygiene in schools. The pupils were always enthusiastic and eager to learn, probably because they were members of health clubs with interest in health issues. It was noted that the sessions conducted in the schools not only benefitted the trained pupils but also other pupils in the school and family members of the pupils. The 'talking compound' messages put in the compounds of the schools were also key in reminding the pupils and promoting ideal practices for the improvement of their hygiene and health.

As a means of ensuring sustainability, the project focused on capacity building of community members who were promoting WASH in their communities. These members who were trained by the project were mainly community health workers who were expected to stay in their communities for a long period and who will continue with the health promotion work they were involved in before and during project implementation. Several youths who were also involved in several project activities including demonstrating and installing *tippy taps* for community members will continue doing so to ensure project initiatives continue even beyond after the project ended.

Although the project focused on capacity building (training, sensitization and health education), the communities also had challenges in WASH infrastructure including few and unprotected water sources, dilapidating housing, poor state of human excreta disposal facilities, and insufficient health facilities. With more funding, these communities would benefit from interventions targeting improvement of health infrastructure. Even if this was beyond the scope of the project, it was appreciated as a need that could be addressed to further improve the lives of the inhabitants of these (and other) slums in Uganda.

The partnership between the 3 universities will continue even beyond the project as there is potential for more research and developmental projects to assist various communities in Uganda. Although the project focused on WASH, numerous problems face the population in Uganda including diseases (such as HIV/AIDS, malaria,

tuberculosis), nutrition, poverty, illiteracy, ignorance and health system challenges (few health facilities, regular stock-out of drugs, poor state of health facilities, insufficient health workers and poor health worker attitude). Therefore with more support from HED / USAID or any other agencies, the partnership will be able to improve lives of more communities in Uganda, and these experiences will also benefit the US institutions. Other future opportunities for the partnerships include but are not limited to staff and student exchange visits, joint academic programs, collaborative project, joint projects and conferences.

The project was implemented in 2 urban slums. However, it is worth noting that Kampala alone has over 10 slum communities some in worse conditions. This shows that there is a lot of potential to replicate project interventions in other slums with more resources. This project was clearly a pilot with its success critical for use to improve WASH in other slums areas in Kampala, Mukono and other parts of the country.

7. Appendices

Appendix 1: Article Published in the Makerere University School of Public Health Newsletter in 2012

Higher Education for Development (HED) Project to Promote Sanitation and Hygiene in Urban Communities

The HED Project is a three-year drinking water supply, sanitation and hygiene promotion health intervention, aimed at improving the health status of the inhabitants of urban communities in two Urban Communities of Kikulu zone (Kawempe Division) Kampala City and in Kikooza, Lweza, Ngandu and Kitega in Mukono Municipality. The goal of the project is to improve the health status of the inhabitants of these communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities. This will involve training of communities to take care of water and sanitation issues.

The project is implemented with two partner universities – University at Albany, State University of New York and Tuskegee University, Alabama. So far the project has conducted a baseline survey on water, sanitation and hygiene (WASH), trained community members in WASH, supported local conferences and provided advisory roles in WASH among the communities. The project also identifies cases with diarrhoea especially among children less than 5 years of age and follows them up to ensure they seek appropriate treatment.
"With the promotion of improved sanitation and hygiene practices among these urban communities, WASH related diseases notably diarrhoea will significantly reduce", said Dr. John Ssempebwa, the Principal Investigator.

Dr. John Ssempebwa, Chair Department of Disease Control and Environmental Health demonstrating how to use the hand washing facility.

Appendix 2: "SUCCESS STORY" – HED / USAID June 2012

WASH Methodology Provides Communities in Uganda with Safe Water

State University of New York, Albany / Makerere University

Photo Courtesy of Dr. David Carpenter

A Ugandan child using the tippy

In many areas around the world, clean water is a rare commodity. In sub-Saharan Africa and the Ugandan populations of Kalerwe and Ngandu, the lack of access to safe water is a major health concern. These areas, which are experiencing rapid growth, acquire water from pipes that are barely underground and often filled with standing water and waste. Because these communities do not have access to the necessary services or infrastructure for safe, sanitary water, they are quickly becoming a breeding ground for disease.

A Higher Education for Development (HED) partnership between State University of New York, Albany (UAlbany) and Makerere University introduced the Water, Sanitation and Hygiene (WASH) Methodology to the residents of Kalerwe and Ngandu. WASH Methodology incorporated the introduction of "tippy taps" to Ugandan residents and educated them about the necessity of clean water, hygiene and the effects of disease on the body. Dr. David Carpenter, partnership director and director of the Institute for Health & Environment at UAlbany, spoke of the fear these residents had for their health. "They were concerned that there was a lot of illness in the community. They wanted to know why and what they could do to reduce it," he said.

Makerere University students trained in environmental health held sessions with the community to teach the importance of hand washing, keeping food from contamination, preventing the spread of germs, and the basic principles of sanitation. Residents also were trained on a series of relatively inexpensive methods of chlorinating contaminated water and making it safer to drink using chlorine packets.

"They were concerned that there was a lot of illness in the community. They wanted to know why and what they could do to reduce it."

— Dr. David Carpenter,

A DVD was produced as a result of the partnership funded by the United States Agency for International Development (USAID) to further educate residents of the necessity of clean water. The level of participation and excitement at the sessions was high. Residents shared what they learned about hygiene, improving sanitation in their homes and the introduction of tippy taps.

Tippy taps are central to WASH Methodology. These one- or two-gallon plastic jugs are filled with water and hung on the end of a stick which tips the tippy tap releasing a small stream of water for washing one's hands. "This has turned out to be one of the best ways to improve health in these poor communities that people in various African communities have found to work. When I was there last summer, there had been a tippy tap installed on almost every one of the outhouses in both communities." Carpenter continued, "The people are proud of it, and they were using it."

With the success and acceptance of tippy taps, Dr. Carpenter is enthusiastic about the next phase of the SUNY/Makerere partnership. Contingent upon additional funding, Carpenter also hopes to create facilities to survey water sources and sanitation. "We're very determined to continue and expand this program," he said.

Appendix 3: Article Published in the Makerere University College of Health Sciences Annual Report 2011-12

The Higher Education for Development (HED) Project continues to strengthen local capacity in Water, Sanitation and Hygiene

The HED project has played a significant role in strengthening the capacity of local communities in Water, Sanitation and Hygiene (WASH) in Kampala and Mukono. With the aim of promoting sanitation and hygiene in urban slums, the project has focused on working with community resource people so as to improve their capacity to address WASH challenges in their areas. The targeted groups include youth, village health teams and local leaders. Health Clubs in primary schools have also been involved in the various activities. Some of the project activities carried out include short-course training and sensitization in WASH; water sampling and analysis; promotion of hand-washing using the *tippy tap* technology; supporting clean-up exercises; providing advisory roles in WASH; supporting health clubs in schools; and promoting drinking safe water through household chlorination. Exchange visits between the 2 project sites have been made which have enabled groups learn from each other, and share experiences and best practices. The project Principal Investigator Dr. J. C. Ssempebwa noted that there has been a significant improvement in the WASH status of these communities since the project began. "*The individuals who have benefitted from project activities have played a big role in promoting ideal sanitation practices at households within their communities.*" – said Dr. Ssempebwa. Students of Environmental Health Science have also benefitted from field exposure by their involvement in various project activities. The field sites are also being utilized for the university mandatory field training for Bachelors students during the recess term. A curriculum for a short course in WASH to be offered at the School of Public Health is in the final stages of development. The project is housed in the Department of Disease Control and Environmental Health although team members emphasise inter-departmental collaboration. It is being implemented in Kikulu zone, Kawempe division, Kampala; and Kikooza, Ngandu, Lweza and Kitega zones in Mukono municipality. The other implementing partners are University at Albany, New York, and Tuskegee University, Alabama, USA. Funding Support is provided by Higher Education for Development (HED).

Appendix 4: Article to be Published in the Makerere University School of Public Health Annual Report 2012-13

HED Project promotes sanitation and hygiene in urban slums in Kampala and Mukono

The HED project has continued to improve the water, sanitation and hygiene (WASH) status in two urban slums in Kampala and Mukono districts through community proactive and sustainable interventions. A total of 22 WASH volunteers were trained in a short course provided in August 2013 in order to equip them with knowledge and skills to carry out health promotion in their areas. This training was facilitated by faculty from the Department of Disease Control and Environmental Health. During the closing ceremony of the training, the Project Principal Investigator Dr. John Ssempebwa noted that training of such community members is a significant form of sustainability as these volunteers will continue promoting WASH in their areas even beyond the project.

Other recent activities implemented by the project include supporting the 10th Makerere University Environmental Health Students' Association (MUEHSA) annual scientific conference and the Joint Annual Scientific conference which included the 9th Annual Scientific conference of Makerere University College of Health Sciences. Four Bachelors of Environmental Health Science students carried out their mandatory university field attachment in the project sites where they got exposure in WASH issues as well as participated in ongoing project activities. Two international graduate students from the UK also carried out their academic research in the project area. This strengthened the collaboration between MakSPH and the two UK universities (Nottingham Trent University and Trinity College Dublin). The project also supported the development of a curriculum for a short course in WASH which will have its first intake in 2014. This course will target people working in the WASH sector including those in NGOs but do not have qualifications in the field. Other ongoing activities of the project include support to primary school health clubs, clean-up campaigns, promotion of household point-of-use water chlorination, home improvement campaigns, research, and site exchange visits which were greatly appreciated by both study communities.

Appendix 5: 10th Annual Scientific Conference MUEHSA Certificate of Appreciation for Funding

Makerere University

Environmental Health Students' Association (MUEHSA)

School of Public Health

Certificate of Appreciation

This is to certify that

Higher Education for Development

has funded the 10th Annual Scientific Conference of Makerere Univesity Environmental Health Students' Association (MUEHSA) held at Grand Global Hotel from 11th -12th April, 2013.

Theme: Inter-sectoral collaboration; a sustainable approach to combating emerging & re-emerging diseases.

HED Higher Education for Development

MU-JHU CARE LTD
MU-JHU Research Collaboration

World Health Organization

THE ALLIED HEALTH PROF COUNCIL UGANDA

Mrs. Ruth Mubeezi Neebye
Patron (MUEHSA)

Dr. William Bazeyo
Dean - School of Public Health

Appendix 6: Images of Project Participants and Team Members

Environmental Health students clearing a drainage channel with support from the project.

Health club members of Kikulu primary school pose with bags they received as educational materials with WASH messages.

A group of students from the US involved in a cleanup exercise with residents of Kikulu zone.

Dr. David Kahler with students of Environmental Health Sciences at Makerere University.

Prof. Carpenter, Dr. De Rosa, Dr. Ssempebwa, other Makerere University staff, local leaders, teachers and pupils at Kikulu primary school.

Appendix 7: A Letter Of Appreciation To The Project From One Of The Study Communities

BASIIMA KIKOOZA
P.O BOX 201
MUKONO CENTRAL DIVISION

16TH - 08 - 2013

TO:
MAKERERE HIGHER EDUCATION FOR DEVELOPMENT
(HED)

RE: APPRECIATION

We greet you in the name of our Lord Jesus Christ.

We the residents of Basiima Kikooza L.C I we thank Makerere (HED) for the great work you have done in teaching / training us on healthy and sanitation in our community and schools eg Lweza Primary School for the three years we have been with you and all the students from from Makerere who have been coming to co-operate with us plus the Kawempe / Kikulu VHT'S who came to discuss healthy matters, we appreciate the work done.

May the Lord reward you abundantly for the good heart you have shown us.

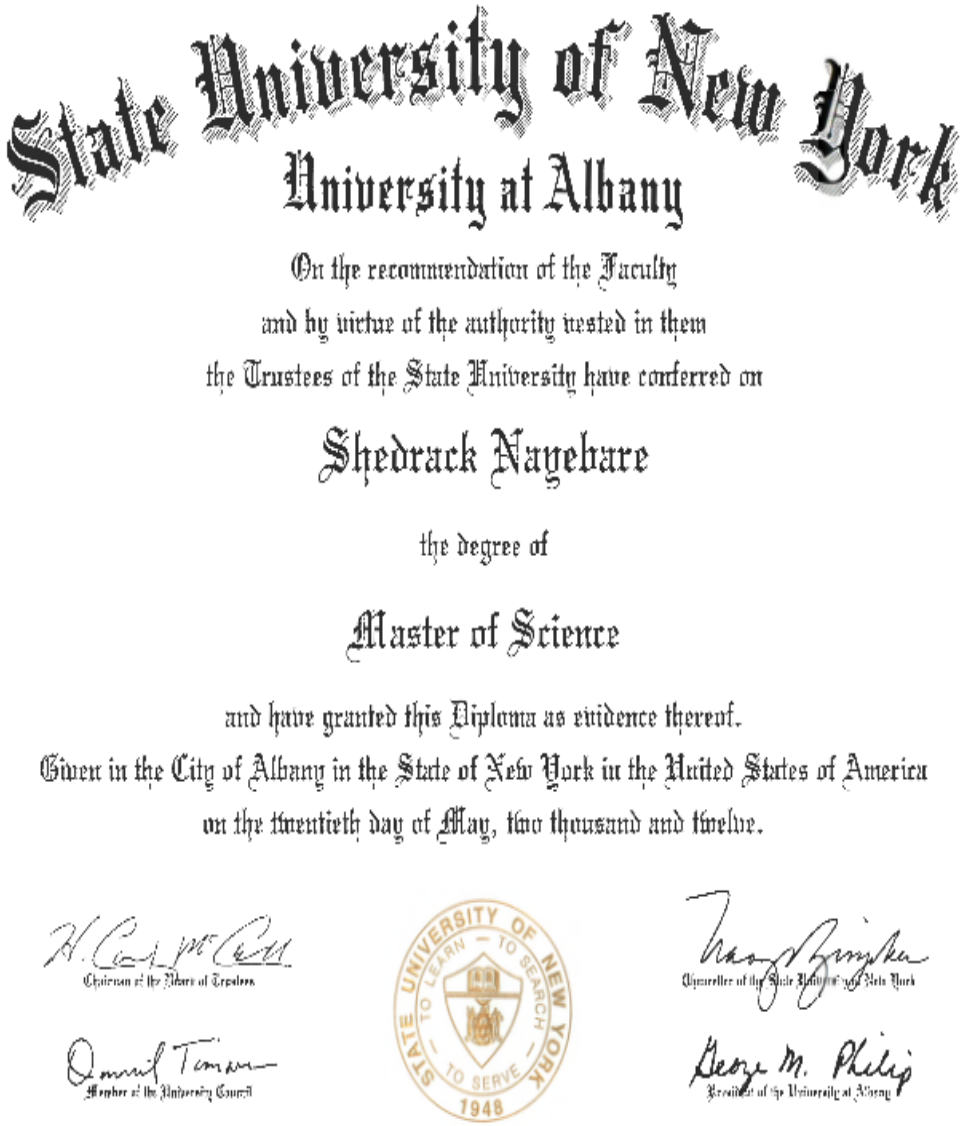
Yours faithfully,

Ndagire Rose

NDAGIRE ROSE
V.H.T BASIIMA /KIKOOZA

CHAIRPERSON L.C. 1
BASIIMA - KIKOOZA ZONE
★ 19 AUG 2013 ★
MUKONO CENTRAL DIVISION

Appendix 8: MS Certificate of Shedrack Nayebare



State University of New York

University at Albany

On the recommendation of the Faculty
and by virtue of the authority vested in them
the Trustees of the State University have conferred on

Shedrack Nayebare

the degree of

Master of Science

and have granted this Diploma as evidence thereof.
Given in the City of Albany in the State of New York in the United States of America
on the twentieth day of May, two thousand and twelve.

Chairman of the Board of Trustees

Member of the University Council

STATE UNIVERSITY OF NEW YORK — TO LEARN — TO SEARCH — TO SERVE — 1948

Chancellor of the State University of New York

George M. Philip
President of the University at Albany

Appendix 9: A Sample Certificate Awarded During Trainings

HED
Higher Education for Development

Certificate of Attendance

This Certificate is awarded to:
Nyeko Denis

for participating in the course on Water, Sanitation and Hygiene
with support from Higher Education for Development (HED)
organized by Makerere University School of Public Health
from 5th – 6th March 2012,
Kampala, Uganda.

Dr. John Ssempebwa
Principal Investigator
HED Water and Sanitation Project
Makerere University School of Public Health

Assoc. Prof. William Bazeyo
Dean, Makerere University
School of Public Health

UNIVERSITY AT ALBANY
State University of New York

TUSKEGEE UNIVERSITY

Appendix 10: The Project Poster Used During Exhibitions

MAKERERE UNIVERSITY COLLEGE OF HEALTH SCIENCE
SCHOOL OF PUBLIC HEALTH
PROMOTION OF SANITATION AND HYGIENE IN URBAN SLUMS IN KAMPALA AND MUKONO

- **Implementing partners:**

- Makerere University School of Public Health, Kampala, Uganda
- University at Albany, State University of New York, USA.
- Tuskegee University, Alabama, USA

- **Funding Support:**
  Higher Education for Development (HED)

- **Study sites:**
  Kikulu zone, Kawempe division, Kampala city
  Kikooza, Ngandu, Lweza and Kitega zones, Mukono municipality

- **Main activities:**

- Community sensitization on Water, Sanitation and Hygiene (WASH)
- Promotion of handwashing using the tippy tap technology
- Support clean-up exercises in the community
- Providing advisory roles in WASH
- Supporting health clubs in primary schools
- Training community members in a short course in WASH
- Analysis of water from community water sources
- Capacity building of youth in WASH
- Promoting drinking safe water through household chlorination

A training session among health club members of Kikulu primary school Kawempe

Pupils of Lweza primary school (Mukono) learning how to construct hand washing facilities for use at latrines

Community members at the Mukono Field Office

Members possing with their Certificates after a Short Training in WASH

A youth being taught how to use specialized equipment to analyze water

Appendix 11: MUEHSA 2011 Conference Programme

The conference was held on 7th and 8th April 2011 at Makerere University College of Engineering, Design, Art and Technology Conference Hall.

Time	Activity	Responsible Person
Day One: Thursday 7th April 2011.		
9:00 am – 9:30am	Arrival and Registration	Ms. Ahirirwe Rita Sherry
9:30am – 9:40am	Welcome remarks by MUEHSA President	Mr. Onzima Donald Degason
9:40am – 9:50am	Remarks from the Patron and Head of Department Disease Control and Environmental Health Patron and	Dr. John Ssempebwa
9:50 am– 10:00am	Remarks from the Assistant Commissioner Environmental Health division Ministry of Health	M/s. Julian Kyomuhangi
10:00 am - 10:15am	Opening Remarks from the chief guest.	The Permanent Secretary Ministry of Health
10:15am – 10:30am	Key note address:	Mr. Mwesigye Collins; National Programme Officer, Water and Sanitation-WHO
10:30am – 11:15am	**Break tea and photography session**	Mr. Tagoya Adrian
Session One:	Chairperson: Mr. Katwere Ssemwanga	
11:15am – 11:30pm	Influenza (h1n1) pandemic: risk perceptions, behavioral responses and vaccination uptake among students of Lund University, Sweden. A cross- sectional internet-based survey.	Mr. Musinguzi Geofrey BEH, MPH, Makerere University School of Public Health
11:30am – 11:45am	Sanitation and Hygiene: A Key Component In Achieving Millennium Development Goals.	Mr. Tumukunde Deo Makerere University, Uganda. School of Public Health
11:45am – 12:00 noon	Assessment of Poverty as a Challenge In Improving Hygiene And Sanitation In The Slums Of Tororo Municipality.	Mr. Obonyo John
12:00 noon – 12:15pm	SANITATION IN UGANDA: Challenges & Opportunities.	Mr. Matovu Jafari General Secretary – PEAU(Private Emptiers' Association Uganda)
12:15pm – 12:30pm	Hygiene and Sanitation around Bwindi Impenetrable National Park, a Population, Health and Environment Approach.	Mr. Joseph Byonanebye. BEHS, MPH (SGU Alumni) Dept of Disease Control & Environmental Health

12:30pm – 1:00pm	Remarks and discussions	
1:00pm – 2:00pm	**Lunch**	**Conference organizers**
Session Two:	Mr. Mbaha Emmery	
2:00pm– 2:15pm	Improvement of solid waste management in Muhanga town.	M/s Iribagiza Karambizi Marlène E.H.S Student Kigali Health Institute, Rwanda
2:15pm – 2:30pm	Assessing the challenges of improving urban environment health through improved solid waste management and climate change mitigation: City of Blantyre, Malawi.	Mr. Kenneth J Gondwe Senior Lecturer Faculty of Engineering University of Malawi- The Polytechnic
2:30pm – 2:45pm	Water aid's experience using Sanitation and hygiene sector wide approach'	M/s. Irene Kharono Programme Officer, Organisation Development & Capacity Building WaterAid, Uganda
2:45pm – 3:00pm	Institutional water safety and public health:	Mr. Chemisto Syata Ali SNV-Uganda Country Office.
3:00pm – 3:30pm	Remarks and discussions	
Session Three: Mr. Mangeni Mathias		
3:30pm – 3:45pm	Assessment of factors associated with occurrence of Diarrheal Diseases in Batwa (Pygmies) children under five years of Age in Kayonza Sub-County, Kanungu District.	Mr. Kiconco Arthur BEHS Makerere University School of Public Health
3:45pm – 4:00pm	The impact of community Own resource persons on improving child health through health promotion activities".	Mr. Ntaro Moses Asst. Coordinator Community Based Education Mbarara University of Science and Technology(MUST)
4:00pm – 4:30pm	Remarks and Discussion	
4:30pm – 5:30pm	**Evening Tea Break**	**Ushers**
Day two: Friday 8th April 2011		
8:00am – 8:45am	Arrival and registration	Ms. Ahirirwe Rita Sherry
8:45am – 9:00am	Recap of Day One presentations	Mr. Bainomugisha Kenneth
9:00am – 9:30am	Report from the Environmental Health Workers Association, Uganda	EHWA Secretary
9:30am – 9:40am	Remarks and Discussion of EHWA report.	
9:40am – 10:10am	**Break tea**	**Ushers**
Session One	Chairperson: Mr. Agondua Joseph	
10:10am – 10:30am	Evaluating the role of the social sciences to global public health	Dr. Linda Gibson Senior Lecturer in Public Health Division of Criminology, Public Health and Social Policy

		Nottingham Trent University, UK
10:30am – 10:50am	Continuous Professional Development - Opportunities for Ugandan EHOs	Mr. Musoke David Department of Disease Control and Environmental Health Makerere University School of Public Health.
10:50am– 11:10am	Professional Associations and International Partnerships.	Mr. Peter Minhinnett, UK
11:10am – 11:30am	Private sector involvement in Environmental Health	Mr. Ogwal Alex
11:30am – 12:00noon	Remarks and discussions	
Session Two	Chairperson: M/s Aber Harriet	
12:00pm – 12:15pm	Sanitation and Hygiene Challenges: Reflections from the community	M/s. Maureen Nakalinzi Uganda Village Project
12:15pm – 12:30pm	Hygine and sanitation in a rural set up; a study conducted in Bokoli location Western Province Kenya	M/s. Viola Kipkemoi Moi University, Kenya
12:30pm – 12:45pm	Presentation from the National Management Authority (NEMA)	M/s Anne Nakafeero Environmental Health Officer, Wakiso District.
12:45pm – 1:00pm	Remarks and discussion	
1:00pm – 2:00pm	**Lunch**	**Conference Organizers**
Session Three:	Mr. Mugano Felix	
2:00pm – 2:20pm	The Use of Electronic Teaching Resources to Enhance Student Learning on Taught Environmental Health Programmes	Mr. Alan Whitfield Programme Leader MSc Environmental Health, University of Derby, UK.
2:20pm – 2:35pm	The Environmental Health Profession: Prospects for Students.	Mr. Mbaha Emmery Ministry of Health, Uganda
2:35pm – 2:50pm	Student Community Service: Report on the MUEHSA – SPH Mukono Project.	The MUEHSA Academic Committee
2:50pm – 3:20pm	Remarks and discussions	
3:20pm – 3:50pm	**Conference conclusions and resolutions**	
3:50pm – 4:15pm	Swearing in of the Incoming MUEHSA executive committee members.	Chairperson Electoral Commission
4:15pm – 4:30pm	Remarks by the Chairperson, conference organizing committee	M/s. Mirembe Bernadette Basuta
4:15pm – 4:35pm	Remarks by the Dean School of	Dr. William Bazeyo

	Public Health.	
4:35pm – 5:00pm	Official Closure and Issuing of certificates.	
5:00pm – 7:00pm	**Cocktail**	**Venue: Makerere University Club 5**

Appendix 12: MUEHSA 2013 Conference Programme

Time	Activity	Responsible person
Day one :Thursday 11th April , 2013		
9:00am-9:30am	Arrival and registration of guests	Conference organizers
9:30am-9:45am	Welcome remarks by MUEHSA president	Mr. Asiku Norman
9:45am-10:00aam	Remarks from matron MUEHSA 2012/2013	Mrs. Ruth Mubeezi
10:00am-10:15am	Opening remarks from the guest of honour	M/s Julian Kyomuhangi Asst. Commissioner Environmental Health division, MOH
10:15am-10:30am	Key note address on the theme: Intersectoral collaboration; a sustainable way in combating emerging and re-emerging diseases	Mr. Katwere David Ssemwanga, Secretary Public Health Board, Allied Health Professionals Council.
10:30am-11:15am	MORNING TEA BREAK	USHERS
	SESSION ONE	Chairperson: Mr. Kenneth Bainomugisha
11:15am-11.30 am	MTCT –PLUS MODEL OF CARE THE MULAGO HOPITAL EXPERIENCE	Dr. Deo Wabwire MUJHU
11:30 am-11:45 am	Disaster Management	Assoc. Prof. Christopher Garimoi Orach, Deputy Dean, School of Public

		Health
11:45 am-12:00 pm	The secret behind hand washing	Mr. Agaba Collins, Mbarara University of Science and Technology
12:00 pm-12:15 pm	Knowledge, attitudes and practices of hand washing among primary school pupils in Mukono District	Mr. Charles Ssemugabo BEHS alumnus
12:15pm-12:30pm	Integrated approach to the reduction of diarrhea and intestinal worms in Kasaali village, Kabalore district	Mr. Lugobe Henry Mark Mbarara University of Science and Technology
12:30 pm-1:00pm	Remarks and Discussions	
1:00 pm-2:00 pm	LUNCH BREAK	USHERS
	SESSION TWO	Chairperson: Ms. Aber Harriet
2:00 pm-2:15 pm	Community led total sanitation in hygiene and sanitation promotion	Mr. Atuhaire Brian World Vision
2:15 pm-2:30 pm	Participatory epidemiology; community knowledge, perceptions and practices about Anthrax in Kasese and Rubirizi Districts	Mr. Joseph Byonanebye MakSPH
2:30 pm-2:45 pm	From malaria education to control to elimination: lessons for Uganda	Dr. Adoke Yeka MakSPH
2:45 pm-3:30 pm	Remarks and Discussions	
	SESSION THREE	Chairperson: Ms. Ayugi Harriet
3:30 pm-3:45 pm	Knowledge, attitudes and practices on food hygiene and safety among food handlers in	Oporia Frederick BEHS III, MakSPH

	food vending places in Mbale Municipality	
3:45 pm-4:00 pm	Empowering communities to improve household sanitation in Rubanda must COBERS site, southwestern Uganda	Mr. Kajabwangu Rogers Mbarara University of Science and Technology
4:00 pm-4:30 pm	Remarks and discussions	

Day two: Friday 12th April, 2013		
Time	**Activity**	**Responsible person**
9:00am-9:30am	Arrival and registration of guests	Conference organizers
9:30am-9:45am	Recap of day one presentations	Mr. Mugumya Ivan
9:45am-10:00aam	Report from Environmental Health Workers' Association of Uganda, EHWAU	Mr. Mbaha Emmery President EHWAU
10:00am-10:15am	The Role of Allied Health Professionals' Council in the training and practice of the environmental health profession in Uganda.	Registrar, Allied Health Professionals' Council
10:15am-10:30am	MORNING TEA BREAK	USHERS
	SESSION ONE	**Chairperson: Mr. Felix Walyawula**
10:30am-11:15am	Prevalence, awareness and control of hypertension in Uganda	Mr. Musinguzi Geofrey MakSPH
11:15am-11.30 am	Controlling Marburg epidemic outbreak in Kabale District, November 2012	Mr. Nyamutale Peter ADHO, Kabale district

11:30 am-12:00 am	Remarks and discussions	
	SESSION TWO	**Chairperson:** **Mr. Kabuye Isaac**
12:00 am-12:15 pm	Improvement of water, sanitation and hygiene in 2 urban slams in Uganda through community proactive and sustainable interventions	Mr. Ndejjo Rawlance BEH MakSPH
12:15pm-12:30pm	The Effect of Indoor Residual Spraying on Malaria and Anaemia in a High-transmission area of Northern Uganda.	Dr. Adoke Yeka MakSPH
12:30 pm-1:00pm	Remarks and discussions	
1:00 pm-2:00 pm	**LUNCH BREAK**	**USHERS**
	SESSION THREE	**Chairperson:** **Mr. Ejoga Sammy**
2:00 pm-2:15 pm	Preparing grant proposals and CVs	Mr. Musoke David MakSPH
2:15 pm-2:30 pm	An assessment of pesticide knowledge, attitudes and practices among small holder farmers in Wakiso and Pallisa districts	Ssekabojja Daniel BEH III MakSPH
2:30 pm-2:45 pm	Marketing concepts on WASH	Mr. Otai Justin MOH, Environmental Health Division
2:45pm-3:00pm	assessment of knowledge, attitudes and practices on safe male circumcision for HIV prevention in Namugongo sub-county, Kaliro district	Batema Edmond BEHS III, MakSPH
3:00 pm-3:20 pm	Remarks and discussions	

3:20 pm-3:50 pm	Conference conclusions and resolutions	Mr. Okoth Raphael & Ms. Ashaba Maggie
3:50 pm-4:20 pm	Swearing in of incoming Executive	Electoral Commission
4:20 pm-4:30 pm	Remarks by Chairperson, conference organizing committee	Mr. Balugaba Bony Enock BEH II MakSPH
4:30pm-4:45 pm	Remarks by the department chairperson	Dr. Ssempebwa John
4:45pm-5:00pm	Closing remarks by the Dean, School of Public Health	Assoc. Prof. William Bazeyo
5:00pm-5:30pm	Official closure and issuing of certificates	Organizing Committee
5:30 pm-6:30 pm	Cocktail	Ushers

Appendix 13: HED Project Presentation, 3rd All African Congress On Environmental Health

Durban, SA. 12th-14th November 2012

Water, Sanitation and Hygiene status of 2 urban slums in Uganda

David Musoke
Department of Disease Control and Environmental Health
Makerere University School of Public Health
College of Health Sciences
Kampala, Uganda

3rd All Africa Congress on Environmental Health, Durban, SA. 12th – 14th November 2012

Background - 1

- Worldwide, low-income populations inhabit the fringes of cities and often these settlements transform into slum settings.
- Rapid growth of slums has become a global concern.
- As cities continue to expand and the economic situation deteriorates, the poor are pushed to the outskirts which are congested, unplanned and inadequately provide infrastructure and services.

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Background - 2

- Sub-saharan Africa has the largest proportion of the urban population resident in slums.
- In urban slum settlements in Uganda, the major risk factor for water borne diseases such as diarrhoea is contaminated drinking water due to poor latrine status, low safe water coverage, and poor domestic and personal hygiene practices.

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Aim of the study

To assess the water, sanitation and hygiene status in 2 urban slums in Uganda.

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Methods

- **Survey area:** Kampala and Mukono
- **Sample size:** 213 households
- **Data collection methods:** Questionnaires, key informant interviews, focus group discussions, observational checklists, water sampling and analysis
- **Ethical considerations:** Ethical approval, informed consent, voluntary participation

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Results

Main sources of water for households

- Piped water – 38%
- Protected springs – 30%
- Unprotected springs – 20%

Other sources

- Boreholes
- Wells
- Streams

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Drinking water safety

- Households boiling water for drinking – 94%

- Drinking water storage

- Plastic jerrycans with covers – 62%
- Plastic jerrycans without covers – 17%
- Pots with cover – 10%

- Frequency of cleaning water storage containers

- Daily – 16%
- Twice a week – 39%
- Weekly – 13%
- Did not know – 31%

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Drinking water quality

CFU*/50ml of water	Frequency (n = 213)	Percentage (%)
0	84	40
< 10	24	11
11 - 50	31	15
51 - 100	9	4
101 - 200	3	1
TNTC**	62	29

* CFU – Colony Forming Unit

** TNTC – Too Numerous To Count

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Latrine availability and status

Households with excreta disposal facilities including latrines – 86%

State of latrines

- Lacked hole covers – 84%
- Lacked hand washing facilities – 70%
- Slab soiled – 52%
- Foul odour – 59%
- Fly infestation – 35%

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Waste disposal practices

- Open pit and burnt – 55%
- Buried – 11%
- Indiscriminately – 18%

Other methods

- Skips
- Trenches

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Household sanitary inspection

- Poor drainage – 43%
- No drying rack – 55%
- Compound littered – 42%
- No rubbish bin – 48%
- Drinking water container kept on the floor – 54%

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Other aspects assessed

- Presence and state of bathrooms
- Access to sanitation information
- Amount of water used per day
- Occurrence and management of diarrhoea
- Drainage

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Summary

- The water, sanitation and hygiene status in the slum communities was inadequate.
- Effort is therefore needed by environmental health practitioners and other health workers to put in place measures to improve the situation.

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Major project interventions

- Community sensitization on Water, Sanitation and Hygiene (WASH)
- Promotion of handwashing using the *tippy tap* technology
- Supporting clean-up exercises in the community
- Providing advisory roles in WASH
- Supporting health clubs in primary schools
- Training community members in a short course in WASH
- Analysis of water from community water sources
- Capacity building of youth in WASH
- Promoting drinking safe water through household chlorination
- Home improvement campaigns

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Keep
our Environment
clean
Personal hygiene
is good for your
health
Wash hands
before meal

Acknowledgements

- Higher Education for Development (HED)
- Research team
- Community members

- AuthorAID at International Network for the Availability of Scientific Publications (INASP) http://www.authoraid.info/

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Thank you

http://www.authoraid.info/

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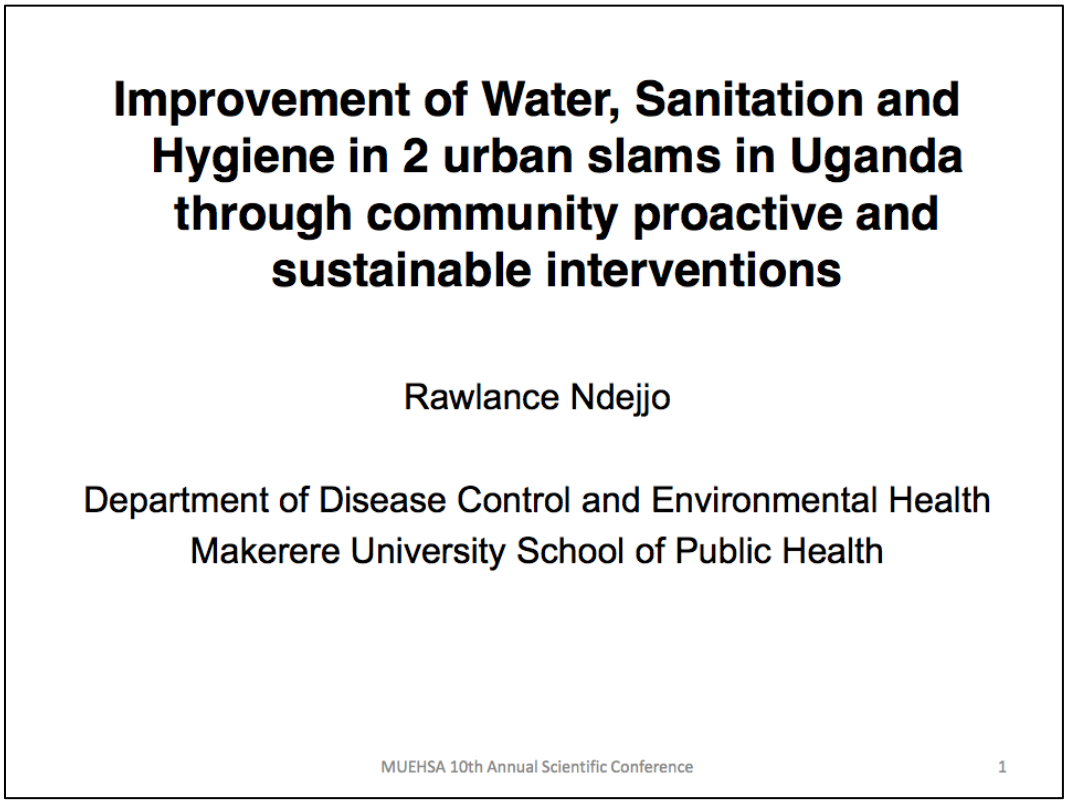
Appendix 14: HED Project Presentation, 10th Makerere University Environmental Health Students' Association (Muehsa) Conference

Kampala, SA. April 2013



Background - 1

- In urban slum settlements in Uganda, major risk factors for water borne diseases include contaminated drinking water.
- Water, sanitation and health are all closely interconnected.
- About 2.3 billion people in the world suffer from diseases that are linked to water. According to the WHO, 80% of all disease is linked to unsafe water supplies.

Background - 2

- Human beings and animals can act as hosts to the bacterial, viral or protozoal organisms that cause water borne diseases.
- Several species of micro-organisms from human and animal faeces and from environmental sources, including water, have been confirmed as pathogens.
- Several studies have confirmed that the spectrum of water-related diseases is expanding & the incidence of many water-related microbial diseases is increasing).

Project aim

- To improve the health status of the inhabitants of the two communities through implementation of strategies targeting two priority problem areas: access to safe water and improved sanitation facilities through community pro-active and sustainable interventions.

- **Project areas**
  - Kikulu zone in Kawempe division
  - Kizooza zone in Mukono.

- **Project partners**
  - MakSPH
  - University at Albany, State University of New York, USA
  - Tuskegee University, Alabama, USA.

Baseline survey

- To establish the WASH status of the communities before project implementation, a baseline survey was carried out among 213 households.

- **Data collection methods**
  - qualitative
  - quantitative

Results of the baseline survey

Main sources of water for households

- Piped water – 38%
- Protected springs – 30%
- Unprotected springs – 20%

Other sources

- Boreholes
- Wells
- Streams

Households with excreta disposal facilities including latrines – 86%

State of latrines

- Lacked hole covers – 84%
- Lacked hand washing facilities – 70%
- Slab soiled – 52%
- Foul odour – 59%
- Fly infestation – 35%

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Results of the baseline survey cont'd

Waste disposal methods

- Open pit and burnt – 55%
- Buried – 11%
- Indiscriminately – 18%

Other methods

- Skips
- Trenches

Household sanitary inspection

- Poor drainage – 43%
- No drying rack – 55%
- Compound littered – 42%
- No rubbish bin – 48%
- Drinking water container kept on the floor – 54%

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PROJECT ACTIVITIES

Community sensitization on WASH

- Sensitization on pertinent WASH issues.
- 8 sensitization sessions were held.
- Over 200 community members attended these sessions.

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Promotion of hand washing using the *tippy tap* technology

- A tippy tap is a simple hand washing technology that utilizes a jerry can, a string and poles.
- Special training on hand washing and the use of the *tippy tap* technology.
- Supported over 200 households to construct hand washing facilities at their latrine.

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Supporting clean-up exercises

- Support and Participation in clean up exercises.
- Reduction of plastic materials through a community socio - entrepreneurship project.

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Supporting health clubs in schools

- 2 primary schools are involved.
- Over 500 pupils have so far been reached.
- Support for Health clubs in the schools
- Development of 'talking compound' messages to promote sanitation and hygiene.

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Training community members

- 20 community members were trained in a short course in WASH.
- They include community health workers and youth involved in promoting WASH.
- Youth were also trained how to inspect water sources and sanitation facilities within their communities.

Providing advisory roles in WASH

- Advise to the community on water related issues

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Analysis of water from community water sources

- Sanitary inspection of water sources.
- Periodic analysis of water.
- Appropriate interventions are taken together with the community.

Promotion of drinking safe water

- Promoting household water treatment through boiling and use of chlorination tablets.
- The community now uses chlorination tablets to treat drinking water.

Home improvement campaigns

- House to house visits carried out.
- Health education of community members.
- Advise on observed sanitary issues that require improvement.

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Support for MUEHSA conferences

Exposure for students

- Field work for BEHS students.
- BEHS students' attachments for 6 weeks.
- International students' involvement.
- Provision of microscopes and water testing kits.

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Other project activities

- Developing a curriculum for a short course in WASH. The first intake of this 8 weeks course will be in June 2013.
- Exchange visits between project sites.
- Exhibition of project work at several fora.
- Conference presentations about the project work.

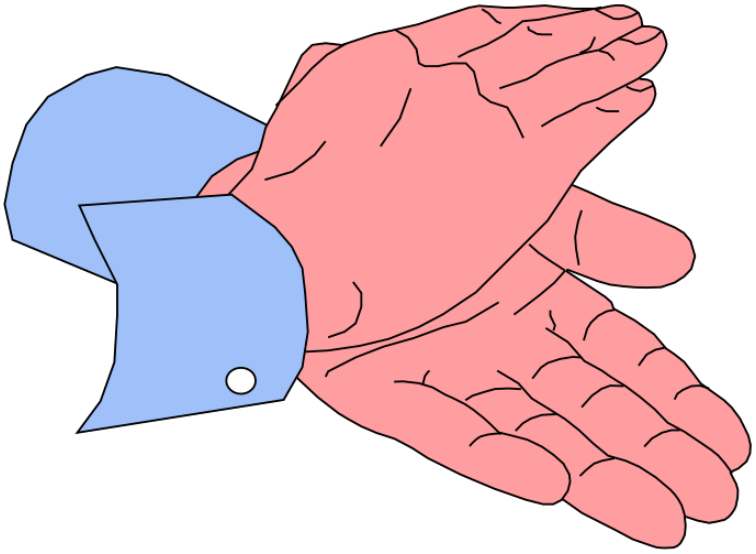
Conclusion

- Preliminary evaluation of project interventions has shown an improvement in state of WASH.
- The implementation of several multi-faceted interventions improves the health status of the slum inhabitants.
- This project demonstrates how urban slums can benefit from WASH interventions when communities are fully involved and with a focus on capacity building.

Acknowledgements

- Higher Education for Development (HED)
- USAID
- Research team
  - Dr John Ssempebwa
  - Prof David Carpenter
  - Mr David Musoke
  - Dr Simon Kasasa
  - Dr William Bazeyo
  - Mr Rawlance Ndejjo
- Community members
- Community mobilisers
  - Roger Ssemakula
  - Daniel Kabirigo

Thank you for your attention!



Appendix 15: 9TH JASH Conference Participants, September 11-13, 2013

S/NO.	NAME	AFFILIATED INSTITUTION
1	Abbey Mukasa	Mu-JHU
2	Abdullah Ali Halage	MakSPH
3	Aber Janet Okello	IHSU
4	Acan Jane	
5	Ajayi Jeeoluwa Elizabeth	KIU - Western Campus
6	Aleem Mirani	
7	Alengo Alex	
8	Alow Florence	Reach Out Mbuya
9	Amagoro Mary Clare	UNACOH Pallisa
10	Ampaire Anne	
11	Amusugut Toppy	UNACOH Pallisa
12	Andrew Ssenyonga	
13	Angol Denish Calmax	
14	Ankunda Racheal	
15	Anyama Norbert	
16	Aono Mary	MakCHS
17	Aono Mary	
18	Apunyo Paul	MakCHS
19	Arao Cholet	IHSU
20	Arinaitwe Moses	UHSSP- MoH
21	Asaba Linda	UHCA
22	Asaloa Linda	Uganda Health Communications Alliance
23	Asekenye Gorreti	UNACOH
24	Asekenye Gorreti	
25	Asio Alice	IHSU
26	Atukunda Esther Cathyln	
27	Atwine Cissy T.	MakCHS
28	Ayazika Kirabo Tess	MakCHS
29	Ayebale Lilian	
30	Azoru Luchio Mua	Agakhan University
31	Babiiha Julius	NDA
32	Babikako Harriet	
33	Balungi Kanywa Jacqueline	Baylor Uganda
34	Basata Robert	MakCHS
35	Batenga Mary Bernadette	UNACOH - Secretariat

36	Brenda Kharono	MakCHS
37	Budowoke Peter	New Vision
38	Bunalema Lydia	
39	Buwembo William	MakCHS
40	Bwanga Freddie	MakCHS
41	Chemuro Mastura	Baylor Uganda
42	Dan Lansum	UNACOH
43	Ddiba Margaret	UNACOH
44	Eberu Daniel	
45	Ego Maurice	MAKCHS
46	Elizabeth Ekiringo	MakSPH
47	Emorut Francis	New Vision
48	Enyeelu Andron S.	MakCHS
49	Erieza Martin	MakSPH
50	Eriki Peter	UNACOH
51	Esele Brian Atubu	MAKCHS
52	Galukande Moses	MakCHS
53	Githu A. Rose	IHSU
54	Gitta Said H.	
55	Gloria Irilezi	
56	Gyezaho Mary	MakCHS
57	Harbat N.	
58	Ibingira Charles	MakCHS
59	Izudi Jonathan	TASO, Soroti
60	J.C. Ssempebwa	MakSPH
61	Jane Ruth Acheng	MoH
62	Jannat Nanyonga	
63	Judith Apio Allsaints	MakCHS
64	Juwambo Ach	
65	Kabaseera Ainomugitha	Mubende Regional R. Hosp.
66	Kabayambi Joan	MakSPH/CDC Fellowship
67	Kabera Prudence	UNACOH
68	Kaffoko Denis	AMREF
69	Kaggwa Margeret	UNACOH
70	Kagoda Joshua	MU-JHU
71	Kajumba Annah	
72	Kaleeba Christine	Baylor Uganda
73	Kalungi Richard	MakCHS

74	Kamba Pakoyo	MakCHS
75	Kampi Rebeccah	
76	Kamugisha Africano	MUJHU
77	Kamya Samu	Mu-JHU
78	Kanyesigye Longino	Makerere University
79	Kasirye Elizabeth	UNACOH
80	Kasozi Daniel	Baylor Uganda
81	Kasube Maria Linda	UNACOH
82	Kasyaba Ronald	
83	Katende Godfrey	MakCHS
84	Kato Mastura	UNACOH
85	Katureebe Charles	WHO
86	Katusabe Maua Linda	
87	Kavuma Peter	MakCHS
88	Kazooba Kairumba Rita	DHMO - Kabarole District
89	Kharono Brenda	
90	Kiguba Ronald	MakCHS
91	Kiiza Daniel	Student MakCHS
92	Kirima Andrew	MakCHS
93	Kirimuhuzya Claude	KIU - Western Campus
94	Kiruma Andrew	
95	Kisa Rose	
96	Kisuule Ivan	
97	Kisuze Geofrey	MakCHS
98	Kiwanuka Paul	UNACOH
99	Kiyingi Godfrey	
100	Kizza Irene Betty	MakCHS
101	Kuodi Otiku Paul	MakCHS
102	Kolo Mastura	Mulago Hospital
103	Korutaro Violet	Baylor Uganda
104	Kunihira Rehema	
105	Kusasira Christine	MakCHS
106	Kuteesa Mary	MakCHS
107	Kutesa Annet	MakCHS
108	Kwarisiima Dalsone	MJAP
109	Kyeyune Monicah A.	
110	Kyomugisa Beatrice	MakCHS
111	Kyotalengerire Agnes	New Vision

112	Lashu Dan	UNACOH
113	Lubega Irene	MakCHS
114	Lubwama Joseph	
115	Lukwasa Margaret	
116	Lwanga Edward	Driver
117	Makumbi Geraldna	UNACOH
118	Mandu Rogers	MUSPH - Equipment Project
119	Maseke Edne	MJAP
120	Mashurah Chemisto	Baylor Uganda
121	Matovu Ahmed	UNACOH
122	Matsiko Nicholas	MJAP/Makerere University
123	Mbabali Speciosa	Dept of Nursing - MakCHS
124	Mbooge LC	
125	Mboowa Gerald	MakCHS
126	Mbusa Mutalinga	UNACOH
127	Mirembe Madrine	
128	Monicah A. Kyeyune	Baylor Uganda
129	Monicah Aturinda Kyeyune	Baylor Uganda
130	Mubiru Daniel	UNACOH
131	Muddu Martin	MUK-Dept of Medicine
132	Mudusu J.S.K	
133	Mudusu JSK	Kabasa Medical Hospital
134	Mugabi Benedicto	MakCHS
135	Mugenyi Margaret	MUJHU
136	Mugisha Lawrence	MakCOVAB
137	Muhire Martin	USAID
138	Muhumuza Christine	MakCHS
139	Mukama John Patrick	
140	Mukasa Abbey	MUJHU Research Collaboration
141	Mukisa John	UNACOH
142	Mukubi Jane	Mulago Hospital
143	Mukulu Mush	
144	Mulekwa Godfrey	Pallisa District Local Govt.
145	Mulumba Linda Gertrude	MakCHS
146	Musha Stella E.	
147	Mushi P. Martha	MakCHS
148	Mushy Stella E.	MakCHS
149	Musika Anne	MUK-SOM

150	Musinguzi Daniel	UNACOH
151	Musinguzi Florence	Makerere school of Statistics
152	Musinguzi Jotham	PPD ARO
153	Mutebi Aloysius	Mak-SPH
154	Mutonyi Mary Rose	
155	Mutumba Linda Gertrude	
156	Muwagi Louis	
157	Muwazi L.M	MakCHS
158	Muwesa Ruth	MakCHS – (Rapporteur)
159	Muwonge Mathias Mulumba	MAKCHS
160	Muyende Paul	
161	Muyenje Hannington	MakCHS
162	Mwaka Erisa	MakCHS
163	Mwangwa Cathy	Mak-SHS
164	Mwati Jane	
165	Mwazi Batuh	Makerere Palliative Care Unit
166	Mwebaze	Baylor Uganda
167	Mwesige Nerthan	UNACOH
168	Mwesigire Doris	MakCHS
169	Nabatte Violet	New Vision
170	Nabayunga Maria	MUK-Vet
171	Nabirye Rose Chalo	MakCHS
172	Nabisere Ruth	MakCHS
173	Nagujja Voila	NDA - Exhibitor
174	Nakalanzi Sarah	Baylor Uganda
175	Nakanwagi Agnes	Reach Out Mbuya
176	Nakatudde Fatuma	MakCHS
177	Nakimuli Jane	Baylor Uganda
178	Nakiyingi Lydia	MakCHS
179	Nakyajjwe Sumayya	
180	Nalugo Mbalinda Scovia	MakCHS
181	Nalukenge Caroline	MakCHS
182	Nalwoga Fatuma	Urban TV
183	Nalwoga Joannah S.	MakCHS
184	Namara Kettie	
185	Namiiro Sharon Miriam	MakCHS
186	Namubiru Sarah	
187	Namuddu Kikabi Rachel	Baylor Uganda

188	Namugerwa Cissy	
189	Namusoke Joyce	MakCHS
190	Namwanje Angella Sandra	Reach Out Mbuya
191	Namwanje RoseMary	MUJHU
192	Namwase Angella Sandra	
193	Namyalo Barbra I.	IHSU
194	Namyalo Elizabeth	
195	Nangonzi Patricia	MakCHS
196	Nankanja Justine	Rapporteur
197	Nankwanga Annet	MakCHS
198	Nansunga Miriam	KIU - Western Campus
199	Nantale Jakie	Journalist
200	Nantale Robinah	
201	Nanyonga Margaret	UNACOH
202	Nassuna Edith Jane	
203	Nasta Buganzi	
204	Natukwatsa Edwini Wamala	UNACOH
205	Naualo Elizabeth	UNACOH
206	Nawagi Faith	MAKCHS Nursing Dept.
207	Nawangwe Barnabas	Rep. VC Male
208	Nazarius M. Tumwesigye	MakSPH
209	Ndejjo Rawlance	MakCHS
210	Ndzi Agnes	MakCHS
211	Ngabirano Tom	MakCHS
212	Ninsiima Herbert	KIU Western Compus
213	Ninsiima James	Mak-CHS
214	Niwagaba Peter	MakCHS
215	Nshimye N. Edith	MakCHS
216	Nyero Lukwiya s. Peter	
217	Obua Celestino	MakCHS
218	Ochieng Steve Joe	IHSU
219	Odokonyero Tonny	
220	Okello Aber Janet	IHSU
221	Okello Hellen	Mulago Hospital
222	Okiror Emmanuel	MakCHS
223	Okoboi Stephen	
224	Okone Patrick	MoH
225	Okot Bodo Richard	UNACOH - Pallisa

226	Okure Gildo	MakSPH
227	Okullo Isaac	MakCHS
228	Olengo Alex	Makerere Faculty of Science
229	Olivia Katumba	Makerere
230	Olobo Joseph	MakCHS
231	Olwenyi Moses	VSO Uganda
232	Onyai Pitua Patrick Patho	MakCHS
233	Opio Sandra	
234	Opiyo Lukwiya S. Paul	Dr. Lukwiya's Family member
235	Opolot Samuel	Kampala University
236	Oteba O. Martin	MoH
237	Otiku Paul	MakCHS
238	Otim Fredrick	UNACOH
239	Otto Robert	MakCHS
240	Picho Pauline Keronyai	
241	Robinah A.	
242	Ruberwa Joseph	MakCHS
243	Rukundo Anna Maria	MakCHS
244	Rutebwa Alex	MakCHS
245	Rwenyoyi Charles	Makerere
246	Sam Okware	
247	Sara Groves	Mu -JHU
248	Segane Ivan	MakCHS-SHS
249	Seguya Abdul	MakCHS
250	Sekimpi Deogratious	UNACOH
251	Semakula Jerome Roy	MakCHS
252	Semusu Moses	
253	Sendagire Hakim	MakCHS
254	Shabibibah Nakirigyo	Daily Monitor
255	Sigiria Hadson	UNACOH
256	Sinyeela Andrew	
257	Ssali David	
258	Ssali Emmanuel	
259	Ssanyu Hanifah	UNACOH - Mukono
260	Ssebambulidde Kenneth	MakCHS
261	Ssemanda Madrine	UNACOH
262	Ssettimba Michael	UNACOH
263	Stefan Peterson	Leorolindaer Instutute

264	Tukei Cathy	MakCHS
265	Tukei Vincent	Baylor Uganda
266	Tumuhairwe Juliet	MUK-MoH
267	Tumuhamye Josephine	
268	Tumuheire Erud Glorius	
269	Turinawe Sylivia	IHSU
270	Tusingwire Colline	MoH
271	Udho Samson	MakCHS
272	Violet Nabatanzi	
273	Waako Paul	MakCHS
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Appendix 17: Baseline Survey Report

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

Baseline Survey Report

Kikulu Zone, Kawempe Division, Kampala City

Prepared by:

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June, 2011

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ABBREVIATIONS

FGD	Focus Group Discussion
HED	Higher Education for Development
HH	Household
HHH	Household Head
KCC	Kampala City Council
KIs	Key Informants
MakSPH	Makerere University School of Public Health
MOH	Ministry of Health
MWLE	Ministry of Water, Lands and Environment
SPSS	Statistical Package for Social Scientists
UNDP	United Nations Development Program

KEY CONCEPTS

Access to safe water: the number of people who have a reasonable means of getting an adequate amount of water that is safe for drinking, washing, and essential household activities, expressed as a percentage of the total population.

Morbidity rates: the proportion of patients with a particular disease during a given year per given unit of population.

Mortality rates: number of deaths (in general, or due to a specific cause) in some population, scaled to the size of that population, per unit time. Mortality rate is typically expressed in units of deaths per 1000 individuals per year.

EXECUTIVE SUMMARY

Introduction and background

In slum settlements of Kampala and Mukono, the major risk factor for diarrheal diseases is contaminated drinking water due to poor latrine status, low safe water coverage, and poor domestic and personal hygiene practices. The majority of community members have insufficient knowledge on the link between water, sanitation, hygiene and health evidenced by the frequent epidemics of cholera and a high incidence of diarrheal diseases particularly in children under 5 years. To address these challenges, Makerere University School of Public Health in partnership with University at Albany, State University of New York, USA and Tuskegee University, Alabama, USA are implementing this project to promote safe drinking water supply, sanitation and hygiene among two urban slum areas in Kampala district and Mukono municipality.

Objectives

The general objective of the project is to improve the health status of the inhabitants of the two communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities through community pro-active and sustainable interventions.

This baseline survey aimed at examining the socio-economic and cultural factors and practices that result into the current environment and community health status; analyzing the linkages between the bio-physical factors and health status.

Survey methods

The survey was cross-sectional in nature involving both qualitative and quantitative data collection methods. It was conducted in Kikulu Zone, Kawempe Division, Kampala City. A total of 102 households were involved in the survey. 12 key informant interviews and 4 FDGs were also held. Drinking water, soil and stool samples from children with diarrhea were collected from the households and analysed.

Summary of findings

- Public taps were the most used water sources among the households (67.6%). Over three quarters of the respondents paid 100 or 150 Uganda shillings per 20 liter jerrycan of piped water.
- Almost all the households (96%) boiled their water in order to render it safe for drinking. The majority of households (69.9%) stored their drinking water in plastic jerrycans with covers. About a quarter of the households (27.5%) had drinking water with no coliforms therefore making it safe for consumption. However, almost a third of the households (39.4%) had drinking water with too numerous to count colony forming units.
- The majority of households (73.5%) owned latrines. Most of the households which did not have latrines used community ones which they shared among 1 – 5 households. Large proportions (82.3% and 85.3%) of the latrines lacked hole covers and vent pipes respectively.
- Over half of the households (58.8% and 53.9%) lacked dustbins and utensil drying racks respectively.
- There was poor solid waste management noted in the area with a significant number of households (47.1%) disposing of refuse in open pits where it eventually got burnt. No skip was available in the community for storage of waste.
- Private clinics were the first choice health facility for households seeking healthcare. The prevalence of diarrheal diseases and fever among children was low. A significant number of children (41.4%) did not have their immunization cards available.
- Mass media (radio and television) were the primary source of health, hygiene and sanitation information. The most preferred language by the respondents for health education was *Luganda*.

Conclusions

- Public taps were the commonest source of water.
- Boiling water was the commonest practice by households to render it safe for drinking.

- From bacteriological analysis, most of the drinking water of the households was contaminated with fecal coliforms therefore unsafe for human consumption.
- Households in the area mostly use shared latrines. Majority of the latrines lacked hole covers, ventilation pipes, handwashing facilities and soap for washing hands.
- There was poor solid waste management with majority of households disposing of refuse in open pits.
- Private clinics were the first choice health facility for the households seeking healthcare.
- Mass media was the primary source of health, hygiene and sanitation information.
- The most preferred language for health education was *Luganda*.

Recommendations

1. The project should health educate the community on the best practices in safe water, sanitation and hygiene at household levels.
2. *Luganda* should predominantly be used while carrying out health education among the community.
3. The project can explore the use of mass media particularly radio to pass on health information to the community.
4. The project should sensitize parents to always keep the immunisation cards of their children.
5. Kampala City Council should endeavour to provide a skip in the community to improve refuse management in the area.

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CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1. Introduction

Between 1900 and 1930 total mortality in the US fell from 17.5 to 8 deaths per 1,000 population (McKinlay and McKinlay, 1977). This was a period prior to there being any effective antibiotics, prior to most immunizations and certainly prior to the current excellent but expensive modern medicine. The reason is almost entirely the provision of clean drinking water and improved general sanitation. The decline in total mortality in the US in this 30 year period is greater than any proportional improvement at any time since, even with the development of high-tech medicine. Thus access to clean drinking water is one of the most important factors in determining the health of a population.

Drinking water can come from only two natural sources: ground water and surface water. Whereas ground water is usually less contaminated than surface water, primarily because of the natural filtration through soil, both are vulnerable to contamination with infectious organisms as well as chemical contaminants. Therefore, one cannot discuss safe drinking water without considering the sources of contamination.

Although internationally recognized, the term "sanitation" is usually used in the narrow sense of excreta disposal, excluding other environmental health interventions such as solid waste management and surface water drainage. In this study, solid waste management and surface water drainage are considered as components of sanitation and as being relevant in the efforts to deliver clean drinking water.

Worldwide, low-income populations inhabit the fringes of cities and often these settlements transform into slum settings. Rapid growth of slums has become a global concern (UN-HABITAT, 2003; UNDP, 2003). In particular goal 7, target 11 of the millennium development goals, aims at significantly improving the lives of at least 100

million slum dwellers by the year 2020 (UNDP, 2003). The majority of this population resides in low income countries, accounting for 43% of the urban population, in contrast to 6% in high income countries. Sub-Saharan Africa had the largest proportion of the urban population resident in slums, which reached 71.9% in 2001 (UN-HABITAT, 2003). The worldwide number of slum dwellers increased by 36% in the 1990s to 923 million people. At its current pace, the number could double to 2 billion by 2030 (Beth, 2009).

As cities continue to expand and the economic situation deteriorates, the poor are pushed to the outskirts which are congested, unplanned and inadequately provide infrastructure and services. This is particularly true of Sub-Saharan Africa cities. Furthermore, the continued rural-to-urban migration of a predominantly poor population, the bulk of who are engaged in informal economic activities, has accelerated the growth of slums. The government of Uganda has launched a national Urban Campaign with a pledge to promote policies that would provide more access to housing and services for the urban poor.

Slums are characterized by problems that only vary in magnitude from one place to another. Slums are conspicuous for environmental decay, giving rise to unprecedented health risks to communities. Clear manifestations of the fast declining health status triggered by the degradation in the ecosystem in slums in Uganda, and especially in Kampala, are evidenced by the epidemics of cholera and typhoid, and a high incidence of diarrheal diseases with a case fatality rate of 2.5% and causing 19% of infant deaths (Alajo et al., 2006). Other ill health conditions common in slums which affect mostly children under 5 years include malnutrition, malaria and pneumonia.

Slum dwellings are characterized by the following problems: poor solid waste management, inadequate excreta management, insufficient drinking water management, unsatisfactory wastewater management, unequipped drainage especially of stormwater, poor housing conditions, unsafe food safety and nutrition, undesirable vector and vermin control, and unhealthy personal and general hygiene.

According to the Uganda Demographic and Health Survey (2006), only 15% of the households in urban areas have improved and non-shared toilet facilities. This leaves most of the households in urban areas using non-improved facilities such as pit latrines without slabs and are shared facilities with other households that very often are unhygienic and foul smelling. According to the Sanitation Strategy and Master Plan for Kampala City (2004), between 3 to 7 households in Kampala use shared toilets because of large number of people living in these areas.

Water is an important component of sanitation and it impacts the health status of the population. Unsafe drinking water causes diseases which can be classified as water or excreta related. Many are both. Diseases such as cholera, typhoid, dysentery, diarrhea, guinea worm and hookworm infestations commonly occur in Kampala. In the past decade, cholera epidemics have been experienced almost every year. In 2008, there were 101 reported cholera cases and 8 deaths in Kampala. Cholera is almost always caused by consumption of contaminated drinking water. The major factors leading to contamination of the drinking water are low latrine coverage, low safe water coverage and poor domestic and personal hygiene practices (MoH, 2004/05).

1.2 Background

While there has been rapid growth of a poor population in the slums in Africa, and in Uganda in particular, slums lack adequate safe drinking water and sanitation services, leading to poor personal and general hygiene. The situation is aggravated by the fact that urban authorities lack the resources to satisfactorily provide the required services and infrastructure. As a result slums have become breeding grounds for disease, making the search for solutions to improve health in slums an utmost urgency. In addition to poor environmental health in Ugandan slums, worsening poverty has led to poor nutrition which particularly affects children, making the control of diseases related to poor nutrition difficult. In response to this, temporary clinics are often established to handle immediate cases. These clinics, however, are far from satisfactory in terms of resources, facilities, and health personnel and cannot be sustained for a reasonable

1.2.1 The Water Situation at Present

The communities of Kikulu zone, and those in Mukono municipality rely on piped and/or non-piped drinking water sources. The water sources include springs, some of which are unprotected, boreholes, wells and streams. Some of these are liable to flooding during rains. In addition, access to water at some points is limited because there are user fees associated with drawing water, and many poor people cannot afford to pay these fees. This forces some people, especially the very poor, to continue to use alternative traditional sources which are of poor quality. Some people are not within easy distance to the water sources, often being beyond 1.5 kilometers, the maximum distance set in the National Water Policy. Studies have shown that the distance to the source is a major factor determining the quantity of water used in a household (MWLE, 2003).

At some water points, physical access is also a problem both at the exact points and/or the foot paths leading to the point. Community members with physical disabilities as well as children are most likely given the role of fetching water and may not be able to collect water without assistance. Women and children may feel insecure when traveling to isolated locations which limit them from gaining access as much as they would like, and consequently reducing the amount of water used or being driven to alternative unsafe water sources.

Some of the water points, particularly the piped water supply, have an irregular supply, sometimes for a limited number of hours in a day. There is also the problem of crowding at water points, which leads to extended collection times that reduces time for tending to other tasks. Both of these circumstances affect the quantity of water used for domestic purpose. The construction of some water points is substandard, and the poor hygienic conditions in surrounding areas can easily cause contamination of water sources.

period of time. This further worsens the condition as these illnesses are poorly managed, contributing to the high infant mortality rate. The envisaged plausible solution to which this project is targeted is to seek solutions within the affected communities in order to improve the prevailing poor environment in slums as a deliberate effort to improve community health.

This project is targeting Kikulu zone, Kawempe division, Kampala city; and Basiima Kikooza, Kitega, Lweza and Ngandu wards in Mukono municipality. The goal of the project is to improve the health status of the inhabitants of these communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities.

Both study areas in Kampala and Mukono (more so Kampala) are characterized by floods after every heavy rain downpour. The inadequacy of drainage channels coupled with blockage of those in existence creates ideal conditions for flooding. Flood waters in Kikulu zone have been reported to wash excreta material into water and food intended for human consumption. Disease outbreaks have been reported in both areas. Kalerwe, which is a nearby community to the Kampala study area, has registered cases every rainy season when cholera epidemics are reported in Uganda. These include: 1978, 1982, 1991, 1992, 1997, 1998 and 2002 (Wandiga, 2006). Globally the most severe cholera outbreak was reported in 1998, with 72% of the cases in Africa, and with Uganda being among the most affected countries (Alajo et al., 2006; EPI/IDS, 2000). The major health risk factors among the project communities in Kampala and Mukono are low latrine coverage, low safe drinking water coverage, and poor domestic and personal hygiene practices. The situation is life threatening to the extent that the word cholera or typhoid in Kampala district is synonymous with some areas such as Kalerwe.

In these settlements where piped water is available, it is not regularly or properly tested. This situation could be improved if more hard data were available on the quality of drinking water sources. However, the cost and technical complexity of water testing and treatment has presented real barriers to the wider and more systematic use of these tools in the detection and prevention of water-borne bacteriological health risks.

1.2.2 Sanitation in Kampala and Mukono

In both slum settlements of the study areas in Kampala and Mukono in Uganda, the major risk factor for diarrheal diseases is contaminated drinking water due to low latrine coverage, low safe water coverage, and poor domestic and personal hygiene practices. As a result of poor planning, often the location of pit latrines and other sanitary facilities is such that they end up contaminating the drinking water sources. The majority of pit latrine facility users have insufficient knowledge of the link between fecal matter and health, making the utilization and maintenance of such facilities poor.

There are very few latrines, with many being shared between families in tenements. Many pit latrines are not constructed to recommended standards and this predisposes them to collapse and / or quick filling and infestation with flies, cockroaches and mosquitoes. In some areas of these slum settlements, "flying toilets "are used. Flying toilet is a practice that involves defecation in a plastic bag, which then gets thrown away indiscriminately at night.

While the linkage between water quality and disease is not well appreciated at the community and household levels, waterborne diseases constitute a major public health burden for communities in Uganda, often leading to serious epidemics of diarrhea, typhoid and cholera. Inadequate training, lack of appropriate equipment and facilities for water quality testing and treatment at the source and at household levels, inadequate budget allocations for water quality testing and management, low levels of public awareness and poor enforcement of legislation regarding safeguarding water

quality and source protection all contribute to the poor state of water quality management.

Poor infrastructure and poor urban services in urban settlements often result in a poor environment and poor community health. Diarrheal diseases, especially among children below 5 years, are among the major diseases identified.

These factors direct the project and are the focus of the environment and health improvement interventions at the study sites. By enabling these communities to achieve safer drinking water and sanitation, this project will contribute to a more equitable and sustainable development – economic, social and environmental.

1.3 Statement of the problem and justification

In both slum settlements of Kampala and Mukono, the major risk factor for diarrheal diseases is contaminated drinking water and food due to low latrine coverage, low safe water coverage, and poor domestic and personal hygiene practices. The majority of the community members have insufficient knowledge of the link between water, sanitation, hygiene and health, evidenced by the epidemics of cholera and typhoid, and a high incidence of diarrheal diseases particularly in children under 5 years.

The project is enhancing the human and institutional capacity building at Makerere University while targeting improvements in both the environment and the health of the selected communities.

The project is focused on providing education and local empowerment in these communities by helping residents understand the causes of disease.

By enabling these communities to achieve safer drinking water and sanitation, the project is contributing to a more equitable and sustainable development – economic, social and environmental.

CHAPTER TWO

BASELINE SURVEY METHODS

2.1. Survey area

The survey was conducted in Kikulu zone which is located in Kisaasi parish, Kawempe Division, Kampala city. It has an estimated area of 6 square kilometres with a population of 6,576 people (Kawempe Division, 2008). There are three (3) primary schools and one (1) secondary school in this zone. There are no government health units in the area with the nearest health unit located 1 ½ Kms from the zone. The area is predominantly residential with several small businesses managed by residents.

2.2. Survey design

It was cross-sectional in nature involving both qualitative and quantitative data collection methods.

2.3. Survey population

The Kikulu zone population was the survey population.

2.4. Survey units

The survey units were the households in Kikulu zone.

2.5. Sample size

2.5.1. Household sample size

The sample size of households that were involved in the survey was calculated using the formula of cross–sectional studies. The formula was derived by Kish Leslie (1965); however it was modified to incorporate a power calculation. The formula is as follows.

$$n = \frac{z^2 pq}{d^2} = \frac{z^2 p(1-p)}{d^2}$$

Where;

$q = 1 - p$

Z^2 = standard critical value at 95% confidence (1.96)

1.4 General Objective

To improve the health status of the inhabitants of the two communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities through community pro-active and sustainable interventions.

1.5 Specific objectives

Baseline phase

- Examine the socio-economic and cultural factors and practices that result into the current environment and community health status in the two study sites.
- Analyze the linkages between the bio-physical factors and health status in the two study sites with a focus on diarrheal diseases.

Intervention phase

- Initiate and pilot community based health interventions for reducing morbidity due to ill health with specific emphasis on diarrheal diseases.

1.6 Performance Objectives

1. To survey the water sources and sanitation facilities available in the study areas.
2. To estimate the current incidence of selected water-borne and excreta diseases in the population with an emphasis on children.
3. To identify risk factors associated with identified water and excreta related diseases in these specific communities.
4. To determine constraints limiting access and proper utilization of water and sanitation facilities which impede hygiene conditions in the study areas.
5. To use the information obtained to promote policies that will address the infrastructural and educational issues within the governments of Uganda and other nations.

n = sample size

p = since there was no accurate data on sanitary facility coverage specific to Kawempe division, a prevalence of 50% was assumed

d = level of precision; for the study we selected a precision of 10%.

$$\frac{(1.96^2 \times 0.5 \times 0.5)}{0.1^2}$$

= 96 households

A total of 102 households were considered for the survey.

2.5.2. Key informants' sample size

A total of 12 key informants were considered for the baseline survey.

2.5.3. Focus group discussion sample size

A total of four (4) FGDs were conducted for different categories of populations in the community. The categories were male adult, female adult, male youth and female youth. Each FGD had between 7 – 9 participants.

2.6. Sampling procedure

2.6.1. Household interviews

Kikulu zone was divided into five (5) geographical clusters since there were five pairs of data collectors. In each of the clusters, an average of 20 households was sampled. In each cluster, the relative central point was the starting point and moved spirally outwards skipping one household. Only households with children below five years were eligible to participate in the survey. In the event that a household did not have a child under five years, the next household which met that criterion was selected.

2.6.2. Key informants

These were chosen from a cross section of persons who were well informed about the different aspects that the survey looked at. The categories among which these key informants were selected included local leaders, religious leaders, teachers and health workers.

2.6.3. Focus group discussion participants

The different FGDs for adult men, adult female and youths had various participants who were chosen with regards to their geographical location to ensure that the entire zone was well represented in each FGD.

2.7. Data and data collection

2.7.1. Data types

Primary data was collected from the field while secondary data was obtained from review of documents. Primary data was both qualitative and qualitative. Quantitative data was collected from the household questionnaires and observational checklists while qualitative data was got from key informant interviews and focus group discussions.

2.7.2. Data collection tools

Household questionnaires were used to collect data from households. Key informant interview and focus group discussion guides were used to gather information from key informants and FGD participants respectively. Observational checklists for different aspects including environmental sanitation, status of sanitary facilities and cleanliness of water storage facilities were used to make key observations relevant to the study.

2.7.3. Data collection procedure

2.7.3.1. Questionnaire administration

Household questionnaires were administered to household heads or the adult next of kin found at the household at time of data collection. The interviewers asked questions and recorded responses as mentioned by the respondent.

2.7.3.2. Focus group discussions

For the FGDs, there was a Chairperson and two Secretaries. The Chairperson moderated the discussions while the Secretaries took notes which they later compared and merged. The discussions were also tape recorded and later transcribed for inclusion in the report.

2.7.3.3. Observations

The observation checklists used entailed the data collectors making key observations using their senses majorly sight and smell.

2.7.4. Water sample collection

Water samples were collected from all sampled households. Specifically, water samples were obtained from drinking water storage facilities that each household used.

Equipment for water sample collection included:

1. Sterile water sample collection bottles (300 ml)
2. Cooling box for the collected water samples
3. Sample labels

Procedure:

- The sterile sample collection bottles were kept in a cooling box.
- At the point of collection of the water sample, the data collector carefully opened the sterile water sample bottle and collected the sample.
- The sample was coded with a number corresponding with that of the household where it was obtained then placed in the cooling box.
- The source of the water sample (household drinking water storage facility) was then recorded on the household questionnaire.

2.7.5. Stool sample collection

Stool samples were collected from only children under five years who had diarrhea at the time of the survey.

Materials and equipment for stool sample collection included:

1. Stool sample collection bottles (50ml) (with a scooping spoon)
2. Cooling box for the collected stool sample
3. Sample labels
4. Hand gloves
5. Polythene bags

Procedure:

- After establishing that the child had an episode of diarrhea in the past 24 hours, the mother was requested to give the child his or her usual defecation facility (potty, paper or any other material) for the child to defecate while other interviews continued.
- After the child had defecated, the data collector then put on gloves, opened the stool sample bottle and scooped at least ten (10) spoonfuls of the stool. The data collector then closed the stool sample bottle tightly, sealed it in transparent polythene then put the sample in the cooling box.
- The gloves were then removed carefully and place in a black polythene. The data collector then washed hands thoroughly with soap before proceeding with any other activity.

2.7.6. Soil sample collection procedure

Soil samples were got from all households that were sampled. The choice of the specific location where the soil samples were obtained was on the basis of the information about the place where children mostly played from within the compound. This information was got from the respondent.

Materials and equipment for soil sample collection were:

1. Meter rule
2. Trowel
3. Polythene bags for sample collection
4. Sample labels
5. Gloves

Procedure:

- At the identified location within the household compound where children play from, the data collector measured a 60 cm sq. on the ground using the meter rule with gloves on.
- The data collector then clearly demarcated the square using the trowel and removed any big materials of more than 5 cm^3.
- Using the trowel, the top soil was scraped from all the corners of the demarcated square towards its center.
- The collected soil was then placed in the small polythene bag and labeled.
- The soil samples were put in a lager polythene bag for transportation to the laboratory for analysis.
- The data collectors then removed the gloves and washed their hands with soap before proceeding with any other activity.

2.8. Data analysis

2.8.1. Household questionnaires

Data from questionnaires was cleaned and entered in Epidata software. The entered data was cleaned and transferred to SPSS for Windows version 17.0 for analysis using stata transfer version 10.

2.8.2. Water sample analysis

Standard bacteriological procedures for water quality testing were adopted. The parameters that were examined for were colony forming units (CFU/50ml).

2.8.3. Stool sample analysis

Ethical approval was also obtained from Makerere University School of Public Health Higher Degrees, Research and Ethics Committee. Research clearance was also obtained from Uganda National Council for Science and Technology.

Several meetings were held with community local leaders informing them about the project and the baseline survey activities.

All the respondents only participated in the survey after understanding the purpose of the survey and giving a written consent. For the children who were involved in the survey especially those who gave the stool samples, an assent form was signed by the parents before the providing the sample.

Standard procedures for stool sample analysis were adopted. The analysis techniques of the stool samples included macroscopy, microscopy, modified ZN stains and culture and antibiotics sensitivity testing. The organisms investigated for in the stool sample analysis included ova, cysts, yeast cells and oocysts.

2.8.4. Soil sample analysis

Standard procedures for soil sample analysis were adopted. The organisms investigated for in the soil sample analysis included ova, cyst or larvae of any pathogenic organism.

2.9. Quality control and assurance

A team of ten (10) competent and experienced data collectors was used in this survey. These were trained for four days to ensure that they were well versed with the data collection process. Experienced trainers from MakSPH for the different data collection aspects including stool, water and soil sample collection were used to train the data collectors.

During data collection, the data collectors were paired to increase efficiency in the data collection process.

The survey supervisors closely followed the work of the data collectors throughout the entire process and at the end of each day, held debriefing meetings to share experiences to improve on the process whenever there was need.

2.10. Ethical considerations

The project got approval from University at Albany, State University of New York Institutional Review Board (IRB Protocol Number: 10-138).

Ethical approval was also obtained from Makerere University School of Public Health Higher Degrees, Research and Ethics Committee. Research clearance was also obtained from Uganda National Council for Science and Technology.

Several meetings were held with community local leaders informing them about the project and the baseline survey activities.

All the respondents only participated in the survey after understanding the purpose of the survey and giving a written consent. For the children who were involved in the survey especially those who gave the stool samples, an assent form was signed by the parents before the providing the sample.

CHAPTER THREE

RESULTS AND DISCUSSION

3.1. Socio demographic characteristics

3.1.1. Socio demographic characteristics of respondents

The socio-demographic characteristics of respondents are shown in Table 3.1.

Table 3.1: Socio demographic characteristics of the respondents

Variable	Particulars	Frequency (N = 102)	Percentage (%)
Sex	Male	10	9.8
	Female	92	90.2
Marital status	Singe (never married)	7	6.9
	Married / cohabiting	89	87.3
	Divorced / separated	6	5.8
Age group (years)	19 - 24	25	24.5
	25 - 34	55	53.9
	35 - 44	19	18.6
	45 - 54	1	1.0
	55 and above	2	2.0
Religion	Catholic	23	22.5
	Anglican	18	17.6
	Pentecostal	17	16.7
	Muslim	43	42.2
	Others	1	1.0
Highest education level attained by respondent	None	5	4.9
	Primary 1 – Primary 7	38	37.3
	Senior 1 – Senior 4	43	42.2
	Senior 5 – Senior 6	4	3.9
	College (post Senior 4)	3	2.9
	College (post Senior 6)	6	5.9
	University	3	2.9
Region of origin	Kampala	7	6.9
	Central	48	47.1
	Eastern	24	23.5
	Northern	3	2.9
	West Nile	2	2.0
	Western	18	17.6
Duration spent in the area	Less than 1 year	11	10.8
	1 – 3 years	30	29.4
	3 – 5 years	21	20.6
	More than 5 years	38	37.3
	Do not remember	2	2.0
Respondent status	Household head	24	23.5
	Not household head	78	76.5
Respondent's Relationship to household head (n = 78)	Spouse	70	89.7
	Son/daughter	5	6.4
	Sister/brother	2	2.9
	Other relative	1	1.3

The majority of respondents (90.2%) were females. A large proportion of the respondents (87.3 %) were married / cohabiting. Over half of the respondents (53.9%) were in the age group of 25 – 34 years of age. Over 40% of the respondents were Muslims. This is higher than national statistics that put the percentage of the Muslim community below 30%. This implies that Islamic values and traditions with regard to hygiene and sanitation will be more dominant in this area as compared to other areas where the percentage of Muslim community is low. Only 4.9% of the respondents had never been to school. However, the majority had dropped out in either primary (37.3%) or lower secondary (42.2%) levels. Nevertheless, this is a relatively high literacy level in the community which can be explored during health promotion. Over half of the respondents originated from the central region including Kampala. However, a certain proportion of respondents (23.5%) migrated from the eastern part of the country. Rural – urban migration is a common phenomenon where people move to urban centres looking for means of earning a living. Indeed, their only starting point is getting shelter in low cost areas where they can afford accommodation among other needs. More than half of the respondents had stayed in the area for at least three years. It is therefore likely that they were familiar with their environment and could provide adequate information about the water, hygiene and sanitation situation in the area.

3.1.2. Socio demographic characteristics of household heads

The socio-demographic characteristics of the household heads who were not respondents in the survey are shown in Table 3.2.

Table 3.2: Socio demographic characteristics of household heads

Variable	Particulars	Frequency (N = 78)	Percentage (%)
Sex	Male	69	88.5
	Female	9	11.5
Marital status	Single (never married)	2	2.6
	Married/cohabiting	71	91.0
	Widowed	2	2.6
	Divorced/separated	3	3.9
Age group (years)	19-24	2	2.6
	25-34	34	43.6
	35-44	28	35.9
	45-54	8	10.1
	55-64	2	2.6
	65 and above	2	2.6
	Don't know	2	2.6
Religion	Catholic	23	29.5
	Protestant	15	19.2
	Pentecostal	7	10.3
	Muslim	32	41.0
Education level	None	5	6.4
	Primary 1-Primary 7	17	21.8
	Senior 1-Senior 4	29	37.2
	Senior 5-Senior 6	12	15.4
	College (post senior 4)	5	6.4
	College (post senior 6)	3	3.8
	University	7	9.0
Region of origin	Kampala	6	7.7
	Central	38	48.7
	Eastern	14	17.9
	Northern	5	6.4
	West Nile	3	3.8
	Western	12	15.4
Duration stayed in the zone (years)	Less 1	6	7.7
	1-3	19	24.4
	3-5	16	20.5
	More than 5	34	43.6
	Don't know	3	3.8

The majority of household heads who were not respondents (89.6%) were males. The majority of household heads were married, from central region, in the age bracket of 25 – 44 years and had a relatively high literacy level. In water, hygiene and sanitation programs, it is important to involve household heads as much as possible since these are the decision makers at family level who also determine household expenditure.

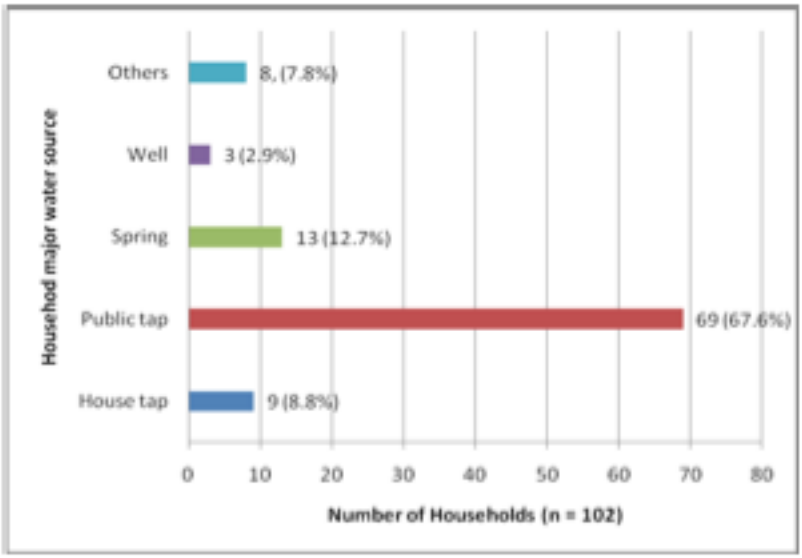
3.2. Water, Hygiene and Sanitation situation

3.2.1. Water

3.2.1.1. Water sources

The main water sources for domestic use in the area are summarized in Figure 1.

Figure 1: Water sources of water for domestic use



Public taps were the commonest water sources used by the community. However, residents had to pay for each jerrycan of water. This was also noted in one FGD that:

> *"……. we have taps, boreholes and a spring that are used by community but access to the spring was cut off by the northern by pass. Not all the water sources are functioning; some broke down and have never been repaired like the borehole. Most people use tap water as they buy it from people who own taps in their households".* (Adult male FGD)

The sources of water used by the community are important since water sources have different water qualities due to the various risks that they may be exposed to. Generally, water sources like streams are more prone to contamination as opposed to underground water sources like boreholes. Piped water systems are normally of better water quality compared to surface water as long as the entire piped water system is not compromised for example by leakages in the piping system.

Residents collecting water from an unsafe source in Kikulu zone

3.2.1.2. Distance of water sources from households

The distance of different water sources from households is shown in Table 3.3.

Table 3.3: Distance of the main water sources from households

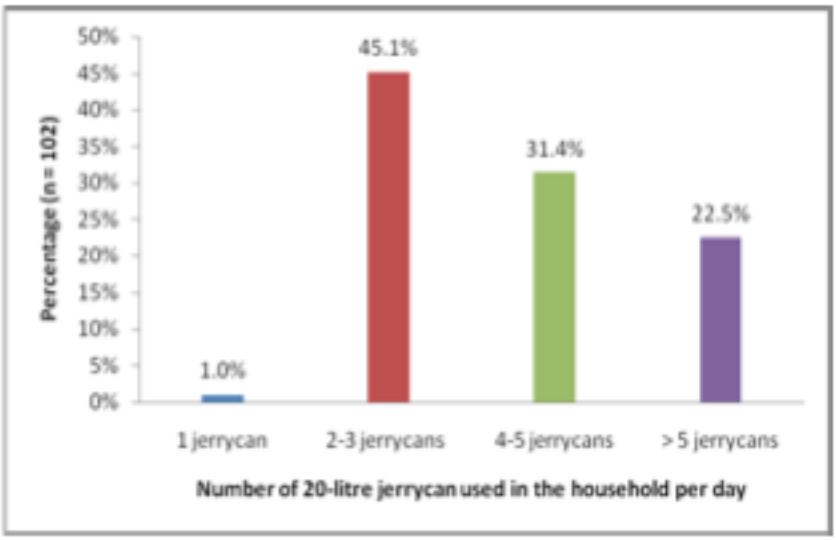
Type of water source	Distance of water source from household			Total
	Less than 1km	1-3km	More than 3km	
Protected spring	9	1	4	**14**
Public tap	0	2	1	**3**
Un protected Spring	31	1	51	**83**
River/Stream	0	0	2	**2**
Total	**40**	**4**	**58**	**102**

Only 39.2% (40/102) of the households had their water sources with a distance of 1km. This is an indication that water is generally not accessible in the community as according to national guidelines, safe water sources should be within a distance of 200 meters from households (DWD, 2010).

3.2.1.3. Amount of water used per day

It is important for all household members to get adequate water for use every day. The amount of water used per day per household is summarized in Figure 2.

Figure 2: Amount of water used per day in households

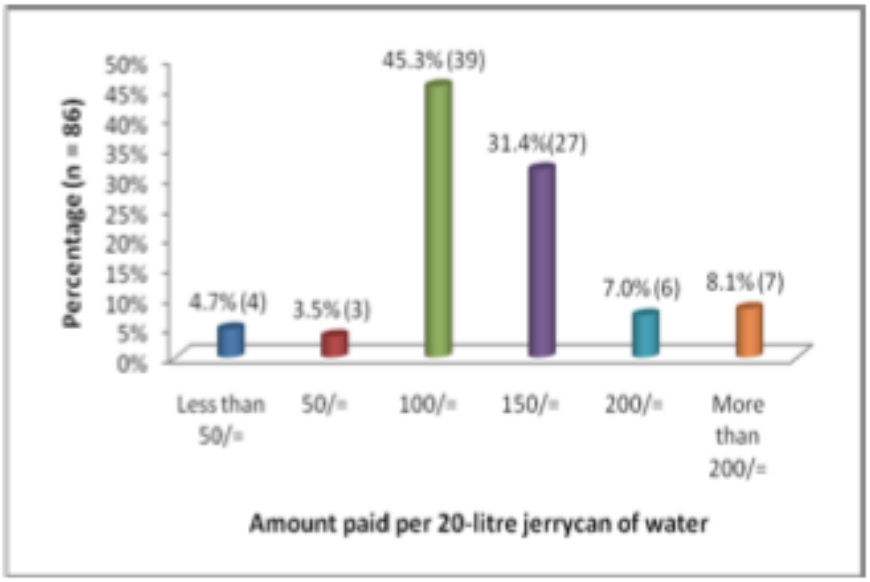


Nearly half of the households (45.1%) used 2 – 3 twenty liter jerrycans (40 – 60 liters) of water per day. The amount of water used in a day per household is normally influenced by household size, age categories of household members and household activities. On average, per capita consumption of water per day per person is at least 15 liters. This therefore implies that 2 – 3 twenty liter jerrycans of water per day can only be sufficient for a household size of 3 - 4 people beyond which it would not be adequate.

3.2.1.4. Payment for water used

The majority of households (84.3%) paid for the water they used. The amount paid per household per twenty liters of water is shown in Figure 3.

Figure 3: Amount paid by households per 20 liters of water



Over three quarters of the respondents paid 100 or 150 shillings (approximately 4 US cents) per twenty liter jerrycan of water. It was also noted that the water prices were not stable and varied from one seller to another and from season to season. However, the higher the cost of water, the less the number of households that may afford to buy the water.

3.2.1.4. Household expenditure on water per day

Household expenditure on water per day is shown in Table 3.4.

Table 3.4: Household expenditure of water per day

Amount paid (UGX)	Amount of water used per day (20 liter jerrycan)				Total
	1	2-3	4-5	More than 5	
Less than 50/=	0	1	0	3	**4**
50/=	0	0	3	0	**3**
100/=	0	**18**	**13**	8	**39**
150/=	0	**14**	**9**	4	**27**
200/=	1	3	2	0	**6**
More than 200/=	0	4	0	3	**7**
Total	**1**	**40**	**27**	**18**	**86**

Most of the households used between 2 and 5 twenty liter jerrycans of water per day each costing 100 or 150 Uganda shillings. Considering the socio-economic status of slum dwellers, this may not be affordable by all households and can lead to the use of inferior water sources such as the stream that existed in the area.

There were several socio-economic challenges that were faced by the residents as stated in the FGDs:

Socio-economic challenges faced by residents:

- *Lack of accommodation leading to over congestion*
- *Poor family planning and budgeting*
- *Poor health*
- *Poor hygiene*
- *Inadequate education, immorality, drug and substance abuse*
- *Unreliable*
- *95% of the youth do not have what to do (unemployment)*
- *Inadequate education facilities in form of schools*
- *Lack of awareness and education about nutrition for children*
- *Mothers lack information about how to properly raise their children.*

(Male, female and youth FGDs)

The causes of these challenges were outlined as follows:

Identified causes of the socio-economic problems included:

- *Poverty*
- *Laziness*
- *Lack of awareness and carelessness*
- *Ignorance*
- *Low level of education*
- *Lack of jobs*
- *High population*
- *Wrangles / conflicts such as religious ones*
- *Selfishness*
- *Discrimination and traditional / cultural beliefs.*

(Male, female and youth FGDs)

3.2.1.5. Person responsible for collecting water

The person responsible for collecting water for domestic use in households is shown in Table 3.5.

Table 3.5: Person responsible for collecting water for domestic use

Person who fetches water	Frequency (N = 102)	Percentage (%)
Female spouse	78	76.5
Male spouse	3	2.9
Female children	8	7.8
Male children	4	3.9
Female relative	5	4.9
Other	4	3.9

Female spouses (76.5%) were the ones who mostly collected water. While addressing issues relating to the quality and safety of water at household level, females should mainly be targeted because of their increased involvement in water issues.

Female spouses were also noted to use most water at home (75.4%) followed by female children (9.8%). This is probably because females are more involved in household activities including those that involve the use of water. In addition, women are the ones who are mostly responsible for cleanliness of children as well as sanitation in households.

3.2.1.6. Sources of water for different purposes in the household

The sources of water for different uses in the household are shown in Table 3.6.

Table 3.6: Sources of water for different purposes in households

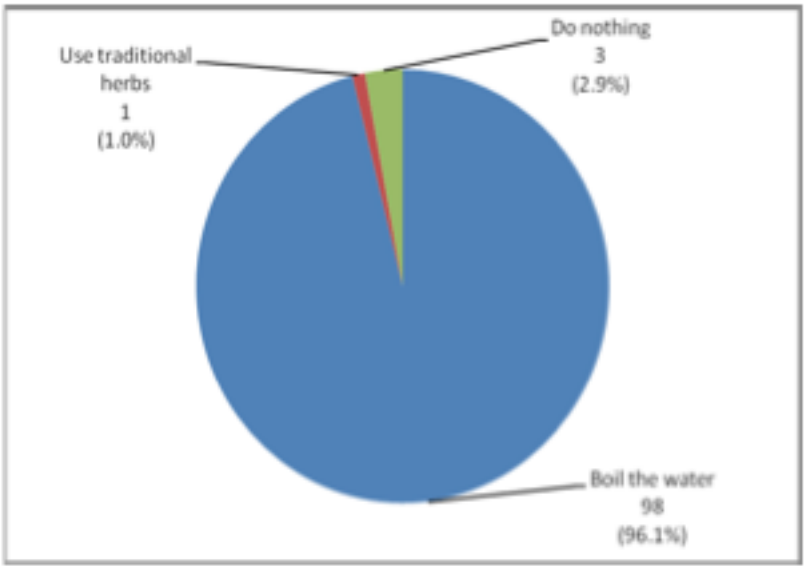
Source of water	Use of water									
	Drinking		Cooking		Bathing		Laundry		Dish washing	
	n=102	%	n=102	%	n=102	%	n=102	%	n=102	%
House tap	9	8.8	9	8.8	9	8.8	8	7.8	9	8.8
Public tap	67	65.7	71	69.6	71	69.6	67	65.7	69	67.6
Spring	14	13.7	11	10.8	11	10.8	15	14.7	13	12.7
Well	3	2.9	3	2.9	3	2.9	1	1.0	3	2.9
Other	9	8.8	8	7.8	8	7.8	11	10.5	8	7.8

Public taps were the commonest source of water for the different uses in households. Generally, there was not much difference in the sources of water for different uses. The community may not perceive the significance of using water from different sources for specific purposes such as tap water for only drinking and cooking.

3.2.1.7. Drinking water chain

The action taken by respondents to render their drinking water safe are shown in Figure 4.

Figure 4: Actions taken by households to render water safe



Almost all the respondents (96%) indicated they boiled their water for drinking. This method of water treatment renders water safe for consumption. Boiling water is an ideal way of treating it due to the fact that most pathogens are killed at high temperatures.

3.2.1.8. Drinking water storage facilities

The drinking water storage facilities used by respondents are shown in Table 3.7.

Table 3.7: Drinking water storage facilities

Storage facility	Frequency (n = 102)	Percentage (%)
Traditional pot with cover	9	8.8
Plastic jerrycan with cover	71	69.6
Plastic jerrycan without cover	17	16.7
Others	5	4.9

The majority of respondents (69.9%) stored drinking water in plastic jerrycans that had covers. These are normally good water storage facilities as long as they are kept clean

at all times and no contamination is allowed to occur. Water storage facilities are one of the major contamination sites therefore they should be taken into consideration while emphasizing safety aspects of the safe water chain. A good water storage facility should always be covered to prevent contamination. Since nearly a quarter of the households used undesirable water storage containers such as jerrycans without covers, the entire community would benefit from sensitization on ideal water storage facilities.

3.2.1.9. Cleaning of drinking water storage containers

The frequency of cleaning drinking water storage containers is shown in Table 3.8.

Table 3.8: Frequency of cleaning drinking water storage containers

Cleaning period	Drinking water storage containers				Total
	Traditional pot with cover	Plastic jerrycan with cover	Plastic jerrycan without cover	Others	
Every day	0	9	2	3	**14**
Twice a week	4	32	6	0	**42**
Weekly	3	9	4	0	**16**
Every two weeks	0	2	0	0	**2**
Every month	0	0	1	0	**1**
Rarely	0	2	0	1	**3**
Do not know	2	17	4	1	**24**
Total	**9**	**71**	**17**	**5**	**102**

The majority of respondents (57%) washed their water storage containers once or twice a week. Regular cleaning of water storage containers is an important component in the safe water chain. This is because if water is stored in a container for a long time, dirt may accumulate in it which favours the growth of micro organisms. Accumulated dirt may also change the taste, odour and colour of water rendering it unsafe for human consumption. It is therefore important to emphasize that before refilling the water storage containers, they should be washed thoroughly.

3.2.1.10. Methods of cleaning drinking water storage containers

The methods of cleaning drinking water storage facilities are shown in Table 3.9.

Table 3.9: Methods of cleaning the drinking water storage facilities

Cleaning methods	Drinking water storage containers				Total
	Traditional pot with cover	Covered plastic jerrycan	Plastic jerrycan without cover	Others	
Rinsed with water only	2	0	0	0	**2**
Rinsed with soapy water	2	22	2	1	**27**
Scrubbed and rinsed with water only	0	3	2	1	**6**
Scrubbed and rinsed with soap water	2	44	13	2	**61**
Others	3	2	0	1	**6**
Total	**9**	**71**	**17**	**5**	**102**

The majority of respondents (60%) cleaned their drinking water storage containers by scrubbing and rinsing them with soapy water. The use of soap in washing water storage containers should be promoted among the community as it has properties that kill microorganisms.

3.2.1.11. Bacteriological quality of drinking water

The bacteriological quality of the drinking water as sampled from the 102 households is shown in Table 3.10.

Table 3.10: Bacteriological quality of drinking water

CFU*/50ml of water	Frequency (n = 102)	Percentage (%)
0 CFU/50ml**	28	27.5
< 10 CFU/50ml	17	16.7
11 - 50 CFU/50ml	20	19.6
51 - 100 CFU/50ml	5	4.9
101 - 200 CFU/50ml	2	2.0
TNTC***	30	29.4
Total	**102**	**100.0**

* CFU – Colony Forming Unit

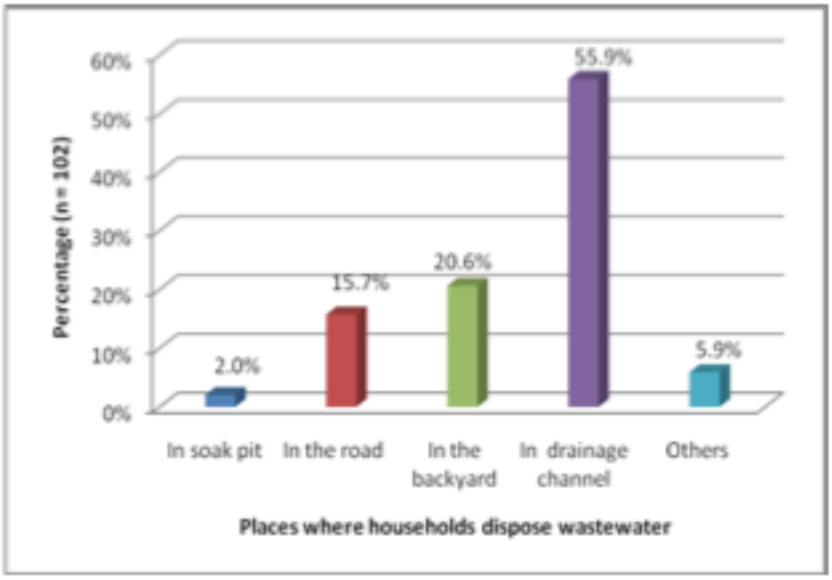
*** TNTC – Too Numerous To Count

Nearly a third of the households (29.4%) had drinking water with too numerous to count levels of contamination. National guidelines state that drinking water should have at most 10 CFU/100ml of water (MWE, 2007) although water with zero (0) CFU is recommended. Only 27.5% of the households had drinking water with no coliforms hence safe for drinking. Whereas the majority of respondents indicated to boil their drinking water, there may have been recontamination due to several factors such as poor storage facilities and unsafe water handling practices. It is therefore important to emphasize to the community all the points in the water chain where contamination can occur such as during storage.

3.2.2. Management of wastewater from households

The methods of disposal of wastewater from households are shown in Figure 5.

Figure 5: Disposal of wastewater from households



More than half of the households (55.9%) disposed their wastewater in drainage channels while only 2% used soak pits. Disposal of wastewater is a very important

aspect of environmental sanitation as poorly drained sites are unsightly and pools of water can be used for mosquito breeding.

A poorly maintained wastewater pit in Kikulu zone

3.2.3. Presence, type, location and use of bathrooms

3.2.3.1. Presence and location of bathrooms

The presence and location of bathrooms in households is shown in Table 3.11.

Table 3.11: Presence and location of bathrooms

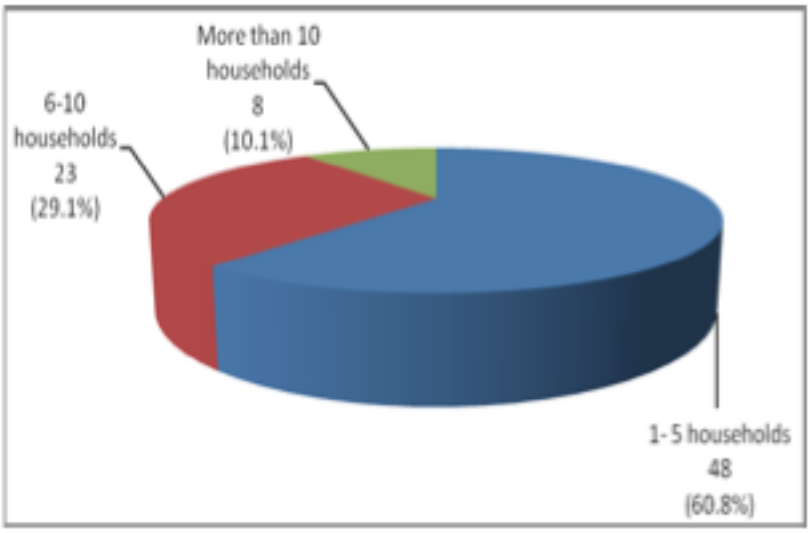
Type of bathroom	Frequency (n = 102)	Percentage (%)
Inside the house	24	23.5
Outside the house and permanent	67	65.7
Outside and makeshift in nature	8	7.8
None	3	2.9
Total	**102**	**100.0**

Nearly two thirds of the households (65.7%) used bathrooms located outside the houses and were permanent structures. Bathrooms are an important sanitation facility that every household should have. Proper management of wastewater from bathrooms should be emphasized to the community including having well maintained soak pits.

3.2.3.1. Number of households using shared bathrooms

The number of households sharing bathrooms that were located outside houses is shown in Figure 6.

Figure 6: Households sharing bathrooms



The majority of households (60.8%) shared their bath shelters among 1 – 5 households. Sharing bathrooms among several households has a challenge of maintaining the cleanliness of the facility as some households may not contribute towards this shared responsibility. It should also be noted that the more the number of households using a bathroom, the more waster water that is likely to be generated. This calls for adequate wastewater management facilities for such bathrooms. However, in terms of raising capital for improvement of the facility, it would be easier to have more households

contribute a small amount as compared to fewer households contributing more to effect similar developments.

3.2.4. Presence, location and use of latrines

3.2.4.1. Presence of latrines

The majority of households (73.5%) owned latrines. For households that did not have their own latrines (26.5%), the type of facility and number of households with which they shared with are shown in Table 3.12.

Table 3.12: Number of households using shared latrines

Type of latrine	Number of households sharing latrines		Total
	1-5	6-10	
Community latrine	24	3	**27**
Neighbor's latrine	1	0	**1**
Dispose excreta indiscriminately	0	1	**1**
Total	**25**	**4**	**29**

Most of the households (86%) which did not have latrines used community latrines which they shared with 1 – 5 households. Households that did to own latrines used those of the community / neighbours as opposed to disposing of their excreta indiscriminately.

3.2.4.2. Sanitary situation of latrines

For all households that were involved in the survey, a sanitary inspection of the latrines was done and the findings are indicated in Table 3.13.

Table 3.13: Sanitary situation of the latrines

No.	Aspect	Frequency (n = 102)	Percentage (%)
1.	Latrine more than 5 metres from the house	45	44.1
2.	Latrine had no proper access leading to it	34	33.3
3.	Latrine lacked a door	17	16.7
4.	Latrine lacked a roof	7	6.9
5.	Latrine lacked a hole cover	84	82.3
6.	Latrine lacked a ventilation pipe	87	85.3
7.	Fecal matter/urine present on the slab	53	52.0
8.	Latrine smelly	73	71.6
9.	Latrine infested with flies	41	40.2
10.	Latrine walls smeared with fecal matter	43	42.2
11.	No handwashing facility at latrine	79	77.5
12.	No soap near latrine handwashing facility	78	76.5

Several unsanitary conditions were found at latrines of the households. These were lack of hole covers (82.3%), lack of ventilation pipes (85.3%), smelly (71.6%), fecal matter / urine on slab (52%), no handwashing facility (77.5%) and no soap for washing hands (76.5%). The community therefore needs sensitization to maintain their latrines in a good state. The number of latrines without handwashing facilities was very high therefore sensitization in this area is needed. The *tippy tap* technology (which uses a small jerrycan and string) for handwashing can be explored by the project so as to improve on handwashing practices in the community.

3.2.4.3. Score of contamination risks

The total score of contamination risks of the different latrines are summarized in Table 3.14.

Table 3.14: Total score of contamination risks

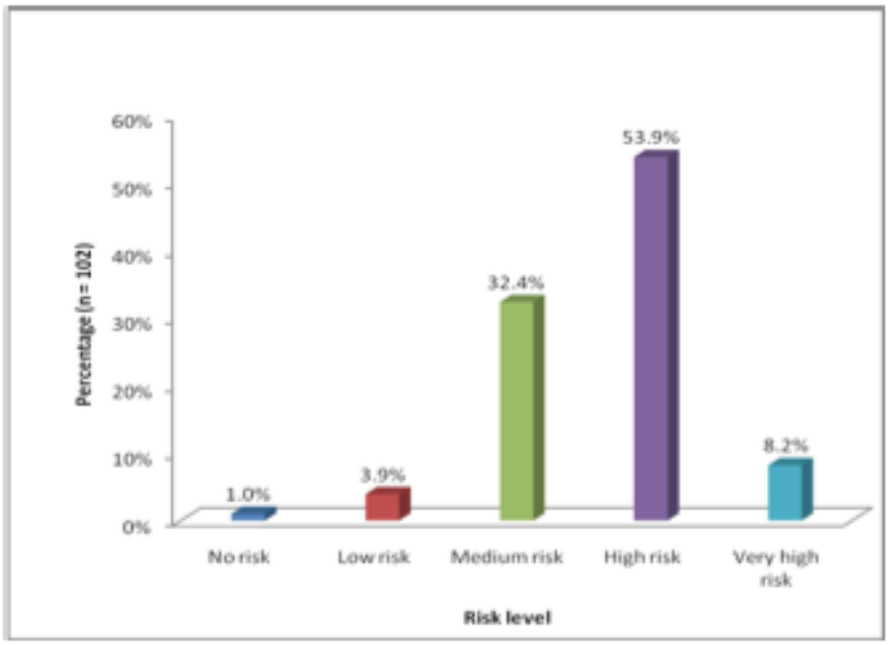
Score	Frequency	Percentage
0	1	1.0
2	3	2.9
4	12	11.8
5	13	11.7
6	11	10.8
7	15	14.7
8	19	18.6
9	21	20.6
10	4	3.9
11	4	3.9
Total	**102**	**100.0**

These contamination risk scores were used to compute the sanitary risk levels shown in section 3.2.4.4.

3.2.4.4. Sanitary risk levels of latrines

The risk levels of the inspected latrines are summarized in Figure 7 below. The sanitary risks scores were categorized as follows: 0 = No risk; 1 - 3 = Low risk; 3 - 5 = Medium risk; 6 - 8 = High risk; 9 - 10 = Very high risk.

Figure 7: Sanitary risk levels of the inspected latrines



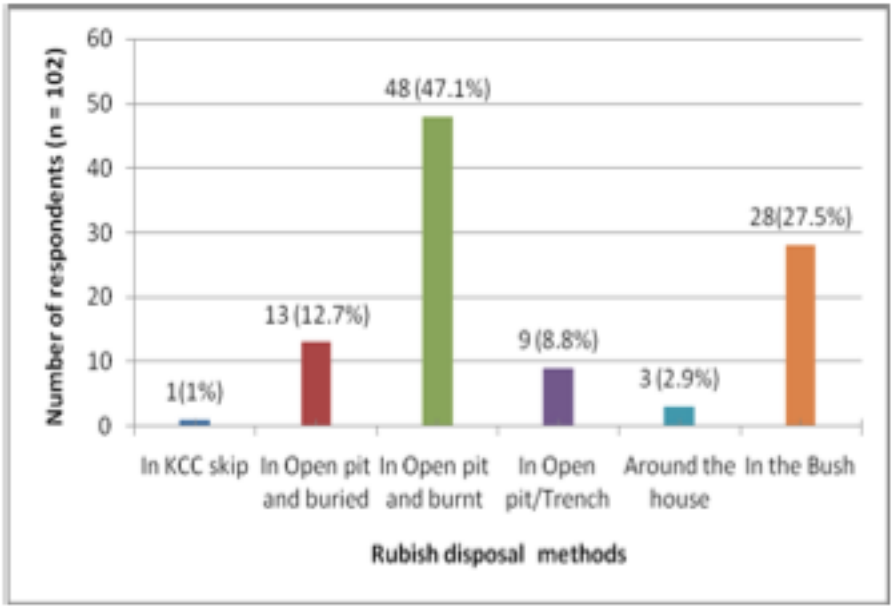
More than half (53.9%) of the sanitary facilities were of high risk. This is a worrying sanitary situation that puts households at risk of diarrheal diseases among others. It is therefore important to promote proper maintenance of latrine facilities among the community. This can mainly be achieved through health education of the population.

3.2.5. Collection and disposal of rubbish

3.2.5.1. Disposal methods

The methods of disposal of rubbish in households are shown in Figure 8.

Figure 8: Household rubbish disposal methods



Nearly half of the respondents (47.1%) disposed of their rubbish in open pits and burnt it. This method of waste disposal is not recommended as burning of waste is likely to lead to air pollution which can affect the health of the community. Although disposal of waste in skips is popular in urban communities, this was not the case in this area as no skip was provided by the local authority. This was confirmed by several key informants including local leaders. Lack of skips may lead to indiscriminate disposal of rubbish by residents.

Indiscriminate disposal of rubbish near a stream in Kikulu zone

3.2.5.2. Person responsible for rubbish collection

The person responsible for collection of rubbish at household level is shown in Table 3.15.

Table 3.15: Person responsible for refuse collection

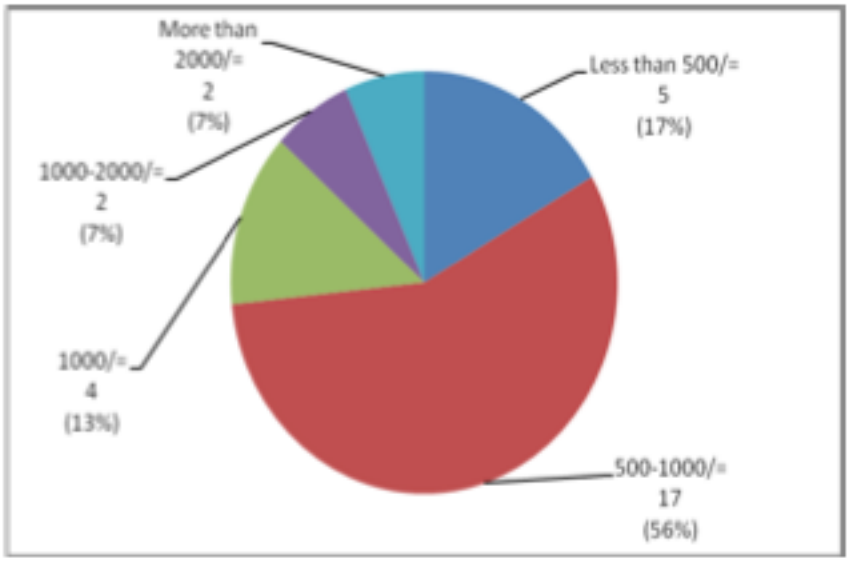
Person responsible	Frequency(n = 102)	Percentage (%)
Female spouse	83	81.4
Male spouse	1	1.0
Female children	8	7.8
Male children	2	2.0
Female relative	5	4.9
Other (specify)	3	3.0
Total	**102**	**100.0**

Female spouses in the majority of households (81.4%) were responsible for rubbish collection. When carrying out programmes to improve household sanitation, special emphasis should therefore be given to women.

3.2.5.3. Payment for rubbish collection

Only 29.4% (30/102) of the households paid for rubbish collection. The amounts paid per week for the households that paid for rubbish collection are shown in Figure 9.

Figure 9: Amount paid for rubbish collection per week



More than half of the households (57%) paid 500 – 1000/= (approximately 20 – 40 US cents) per week for their rubbish collection. This amount may not be easily affordable for many low income families in such urban slums. This may therefore lead to improper disposal of rubbish especially in this community which lacked a skip.

3.2.5.4. Frequency of disposing of rubbish

The frequency of disposing of rubbish by households is shown in Table 3.16.

Table 3.16: Frequency of disposing of rubbish

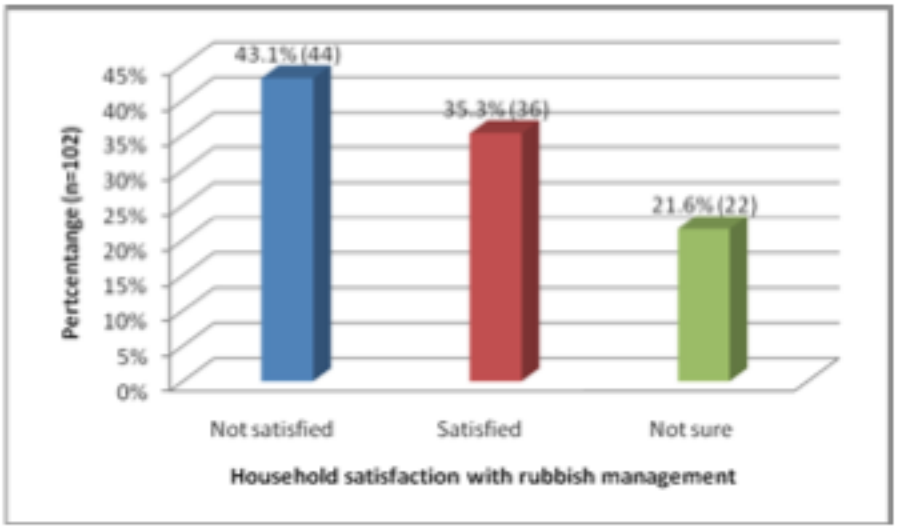
Frequency of disposing of rubbish	Frequency (n = 102)	Percentage (%)
Every day	18	17.6
Twice a week	15	14.7
Weekly	28	27.5
Every two weeks	3	2.9
Every month	2	2.0
Rarely	1	1.0
Others	11	10.8
Irregular	24	23.5
Total	**102**	**100.0**

Over a quarter of the households (27.5%) disposed of their refuse on a weekly basis while 17.6% did so daily. The frequency of disposal of rubbish may depend on the amount generated and the storage facilities used at household level. Households should not leave rubbish to accumulate in their houses which may attract vectors and pests such as flies and rats which can transmit diseases including diarrhea.

3.2.5.5. Household satisfaction with management of solid waste

The level of satisfaction of households regarding refuse management is shown in Figure 10.

Figure 10: Households' satisfaction about refuse management



A high proportion of households (43.1%) were not satisfied with the management of refuse in their area. This shows that solid waste management remains a challenge in this urban slum. Reasons highlighted for the dissatisfaction included:

1. Poor community attitude towards rubbish disposal
2. Lack of proper disposal facilities
3. High costs of refuse collection
4. Lack of specific garbage collection company
5. Lack of skips in the area

Kampala City Council could provide a skip in the area to improve on solid waste collection and disposal from households.

3.2.5.6. Environmental inspection results

In all households sampled, an environmental inspection was conducted and the findings are summarized in Table 3.17.

Table 3.17: Household environmental inspection results

No.	Aspect	Frequency	Percentage
1.	Household environment dirty	48	47.1
2.	No dustbin for household rubbish	60	58.8
3.	Dustbin dirty and overflowing	12	11.8
4.	Fecal matter around the household	16	15.7
5.	Poor drainage around the house	38	37.3
6.	Drainage around the house clogged	36	35.3
7.	No utensil drying rack	55	53.9
8.	Household utensils dirty and left unclean in the open	19	18.6
9.	Drinking water container with wide mouth / opening	8	7.8
10.	Drinking water container with no lid / cover	46	45.1
11.	Drinking water container kept on the floor level	50	49.0
12.	Inside of the container dirty	9	8.8
13.	Outside of the container dirty	21	20.6

Several undesirable conditions were found at the households including lack of dustbins (58.8%), lack of utensil drying racks (53.9%) and keeping drinking water storage containers on floor level (50%). Storing drinking water on the floor makes is prone to contamination from dust and other pollutants. Children may also easily contaminate

drinking water which is in their reach. It is therefore advisable for drinking water to be stored on a raised surface such as in a refrigerator or on a table.

3.2.5.7. Environmental risk scores

The environmental risk scores for the households are shown in Table 3.18.

Table 3.18: Environmental risk scores

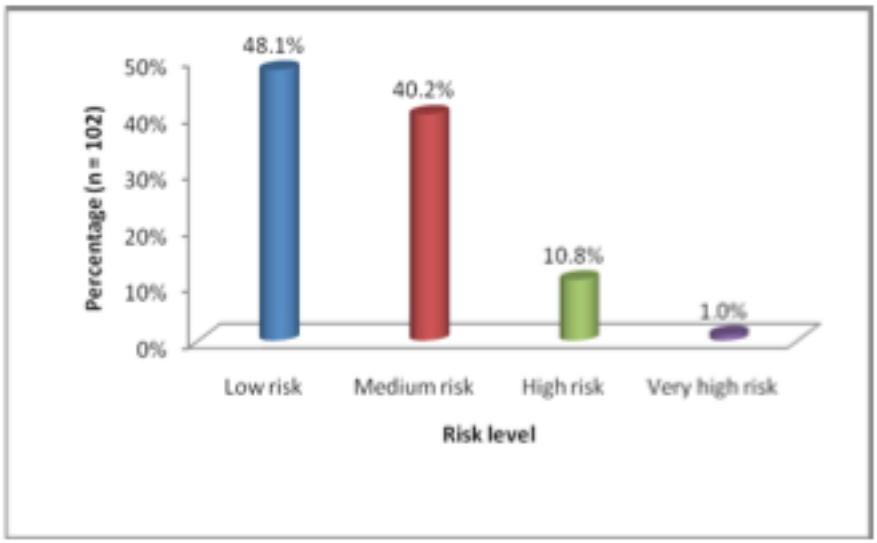
Score (out of 13)	Frequency	Percentage
0	5	4.9
1	3	2.9
2	12	11.8
3	30	29.5
4	18	17.6
5	13	12.7
6	9	8.8
7	7	6.9
8	3	2.9
9	1	1.0
10	1	1.0
Total	**102**	**100.0**

These risk scores were used to compute the household environmental risk levels shown in section 3.2.5.8.

3.2.5.8. Environmental risk levels

The household environmental risk levels are shown in Figure 11 below. These were characterized as follows: 0 = No risk; 1-3 = Low risk; 3-5 = Medium risk; 6-8 = High risk; 9-10 = Very high risk.

Figure 11: Household environmental risk levels



Nearly half of the households (48.1%) were at low risk while 40.2% were at medium risk. Effort is needed to reduce on the specific risks identified so as to maintain proper sanitation and hygiene status within households.

3.2.5.9. Contamination of soils where children play from

The results of soil analysis from samples collected from the places where children played from are shown in Table 3.19.

Table 3.19: Soil sample analysis results

Result	Frequency (n = 102)	Percentage (%)
No ova, cyst or larvae seen	95	93.1
Ascaris ova seen	4	3.9
Hookworm ova seen	3	2.0
Total	**102**	**100.0**

The majority of samples (93.1%) did not have any pathogenic organisms or helminthes. Open defecation especially by children in the communities is likely to be low. Proper

disposal of children's excreta should be encouraged particularly among mothers who are usually responsible for helping their children when they want to excrete.

3.3. Household healthcare seeking behaviour

3.3.1. Place where healthcare is first sought

The place and distance where the households first sought their healthcare is shown in Table 3.20.

Table 3.20: Health facilities where households first sought their healthcare

Distance from household	Health facility			Total
	Hospital	Health centre	Private clinic	
Less than 1km	1	0	53	**54**
1-2km	3	2	17	**22**
2-3km	4	1	9	**14**
3-5km	0	0	3	**3**
More than 5km	3	1	4	**8**
Not sure	0	0	1	**1**
Total	**11**	**4**	**87**	**102**

Private clinics were the most preferred health facility for seeking healthcare (85.3%) majority (60.9%) were within a distance of 1 kilometre of the households. This can be attributed to the many clinics which have been established in urban communities because of public health facilities including hospitals being few in such areas. In addition, these public facilities may be at long distances from many households hence use of clinics becomes the first option for healthcare.

3.3.2. Satisfaction with health care services

Most of the households were satisfied with the healthcare services they received at the different health facilities as shown in Table 3.21.

Table 3.21: Households' satisfaction with healthcare services

Health facility	Healthcare satisfaction		Total
	Satisfied	Not satisfied	
Hospital	7	4	**11**
Health centre	4	0	**4**
Private clinic	81	6	**86**
Total	**92**	**10**	**102**

The majority of respondents (90.2%) were satisfied with the healthcare they received from health facilities. This may be due to the fact that since clinics were mostly used, these normally offer more client friendly services as compared to public facilities. Indeed, several studies have shown dissatisfaction with services offered at government facilities because of the numerous difficulties faced such as regular stock out of drugs, lack of skilled staff, late referral of patients, poor health worker attitudes, and low quality of care (Kiwanuka *et al*, 2008; WHO/AFRO, 2001).

3.4. Household nutrition

3.4.1. Sources of food

The sources of different foods for the households are shown in Table 3.22.

Table 3.22: Household sources of food

Source	Vegetables		Meat / fish		Milk / milk products	
	n = 102	%	n = 102	%	n = 102	%
Main market / Shop	33	32.4	32	31.4	62	60.8
Kikulu road side vendors	38	37.3	47	46.1	10	9.8
Others	31	30.4	23	22.5	30	29.4

Over a third of the households (37.3% and 46.1%) got their vegetables, meat and fish respectively from the main market in the area while milk and milk products were mainly got from grocery shops (60.8%). This pattern justifies that various foodstuffs have different sources depending on their availability within the community.

3.4.2. Storage of food

3.4.2.1. Food storage practices

The methods of food storage at household level are shown in Table 3.23.

Table 3.23: Households' food storage practices

Store foods	Vegetables		Meat / fish		Milk / milk products		Food for children under 5 years	
	n=102	%	n=102	%	n=102	%	n=102	%
Store	39	38.2	20	19.6	23	22.5	27	26.5
Do not store	63	61.8	82	80.4	79	77.5	75	73.5

The majority of respondents (61.8%, 80.4%, 77.5%, and 73.5%) did not store vegetables, meats / fish, milk products and food for children under 5 years respectively. This is a clear indication that food storage is not a common practice among the community.

3.4.2.2. Food storage facilities

For those who stored their food, the storage facilities are shown in Table 3.24.

Table 3.24: Places / facilities where households store foods

Vegetables	Meat / fish	Milk and milk products	Food for children under 5 years
- Anywhere in the open - In cupboard - In fridge - In pail with water - In saucepan - In basket - On food rack	- In covered container - In covered saucepan - In fridge - In container after smoking	- In saucepan after boiling - In covered bucket - In fridge - In kettle - In bottle - In flask	- In food flask - In fridge - In saucepan - Leave on charcoal stove - In bottle - In covered dish

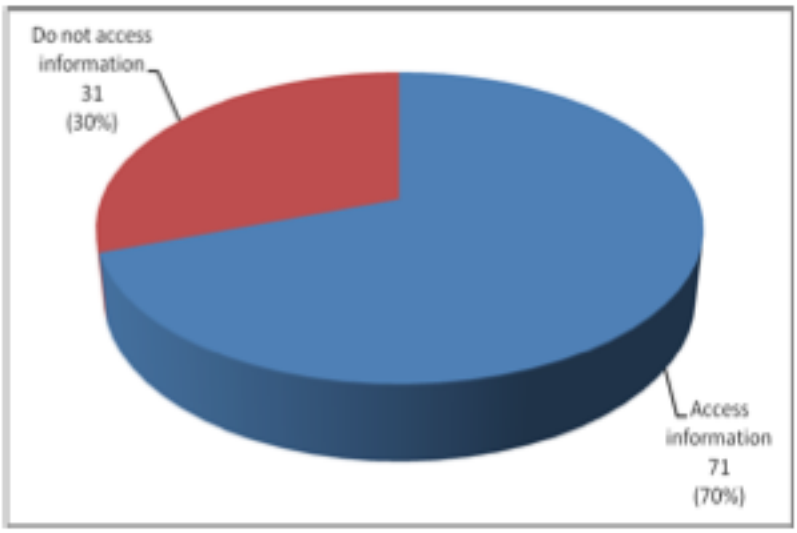
Households that used storage facilities such as sauce pans and buckets endeavoured to cover them. This is a good practice to prevent food contamination and should be encouraged among the community.

3.5. Access to health, hygiene and sanitation information

3.5.1. Access

The respondents who had access to health, hygiene and sanitation information are shown in Figure 12.

Figure 12: Respondents' access to health, hygiene and sanitation information



Although the percentage of those who accessed health information was high (70%), it is important to conduct community sensitization programs. This is necessary to keep the entire community updated with relevant messages in water, sanitation and hygiene.

3.5.2. Information sources and frequency

The source and frequency of accessing the information are shown in Table 3.25.

Table 3.25: Sources and frequency of health, hygiene and sanitation information

Frequency of access	Major source of information					Total
	Radio	TV	Health worker	Seminars	Other	
Every day	19	7	0	0	1	**27**
Twice a week	8	4	0	0	0	**12**
Weekly	8	2	0	0	1	**11**
Twice a month	1	0	1	0	0	**2**
Monthly	2	1	1	0	1	**5**
Rarely	9	1	1	2	0	**13**
Other	1	0	0	0	0	**1**
Total	**48**	**15**	**3**	**2**	**3**	**71**

The majority of respondents that accessed health information (67.6%) mainly got it from radios and at least on a weekly basis. Therefore, the use of radio by the project to sensitize the community may be explored in addition to physical sensitization sessions.

3.5.3. Preferred language for health education

The majority of respondents (79.4%) preferred *Luganda* followed by English (10.7%). Therefore while carrying out sensitization in the community, *Luganda*, which is the most used local language in the central region of the country, should be used.

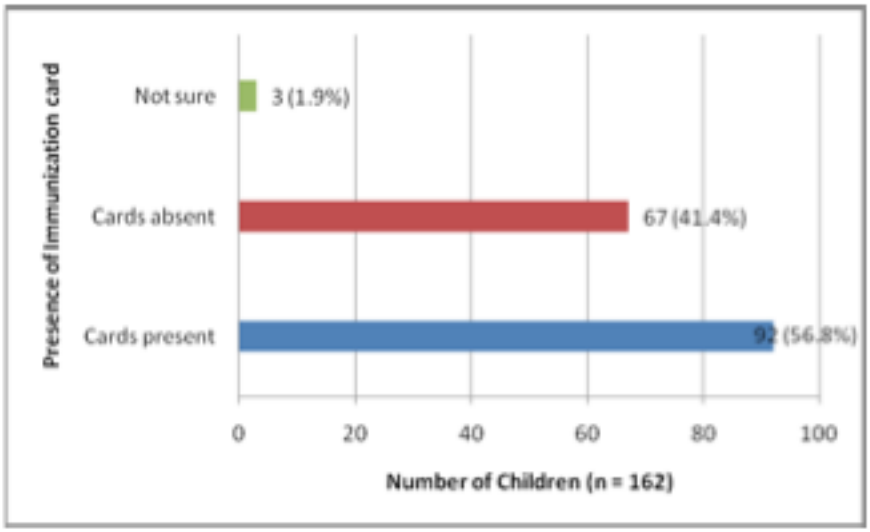
3.6. Child immunization

From the households involved in the baseline survey, a total of 159 children below 5 years of age were involved in the assessment of their immunization status. Among these children, 52.8% were females while 47.2% were males.

3.6.1. Presence of child immunization cards

The presence of child immunization cards among children is shown in Figure 13.

Figure 13: Presence of child immunization cards



The majority of children (56.8%) had their immunization cards. It is easier for parents to follow the immunization schedules of their children when they have these cards as opposed to those without them.

3.6.2. Child immunization status

The child immunization status is shown in Table 3.26.

Table 3.26: Child immunization status

Status	Measles (Left hand side) Child older than 9 months only		De-worming within past 3 months		Vitamin A supplementation within last 6 months		BCG / scar (Right hand) - At birth	
	n = 162	%	n = 162	%	n = 162	%	n = 162	%
Yes with card	66	40.7	37	22.8	39	24.1	81	50.0
Yes without card	53	32.7	46	28.4	30	18.5	64	39.5
No with card	7	4.3	30	18.5	42	25.9	4	2.5
No without card	14	8.6	36	22.2	40	24.7	5	3.1
Not applicable	18	11.1	8	4.9	5	3.1	0	0
No response	4	2.5	5	3.1	6	3.7	8	4.9

Less than half of the children (40.7%) were immunized for measles and had their immunization cards available. However, 32.7% had been immunized for measles but their immunization cards were not available. This finding is similar to BCG immunization status as 50% of the children had been immunized and had their cards present while 39.5% were immunized but had no cards. Parents should be encouraged to keep the immunization cards so as to assist them complete the immunization schedules of their children. Less than a quarter of the children (22.8%) and (24.1%) had received de-worming within the past 3 months and vitamin A supplementation within the last 6 months respectively. This can be addressed by informing parents and the general community the importance of these medications to the health of the children.

3.7. Child morbidity

3.7.1. Presence of mosquito nets

The majority of children (89.3%) were noted to have mosquito nets. Mosquito nets are known to significantly reduce the occurrence of malaria if used effectively. Their use should therefore be promoted.

3.7.2. Children sleeping under mosquito net the previous night

The majority of children (88.1%) were noted to have slept under mosquito nets the night before the baseline survey. Nevertheless, efforts should be strengthened to increase

the use of mosquito nets especially among children under 5 years and pregnant women in the community.

3.7.3. Children suffering from fever

The number of children who had suffered from fever within the past two weeks from the time of data collection is shown in Table 3.27.

Table 3.27: Children suffering from fever in the past two weeks

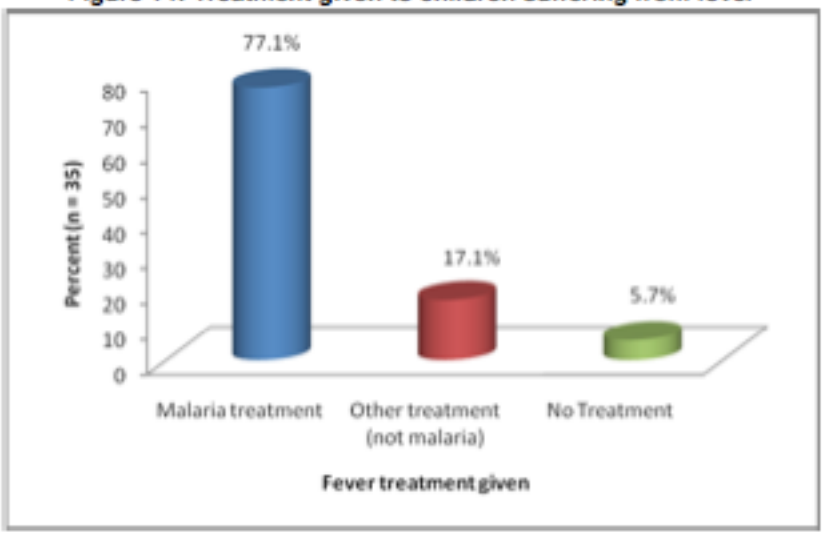
Child suffered fever in past 2 weeks	Frequency (n = 162)	Percentage (%)
Child suffered	35	21.6
Child did not suffer	122	75.3
No response	5	3.1

Only 21.6% of the children had fever in the past 2 weeks prior to data collection. Fever is normally an indication of malaria therefore the occurrence of malaria during that period could have been low. This may be attributed to the high use of mosquito nets by the children.

3.7.4. Treatment of fever

Among the children who suffered from fever, the treatment they received is shown in Figure 14.

Figure 14: Treatment given to children suffering from fever



The majority of children (77.1%) who suffered from malaria were given malaria treatment. The given malaria treatment includes commonly chloroquine, quinine and coartem which are commonly used anti-malarials in Uganda.

3.7.5. Children suffering from diarrhea

The number of children who had suffered from diarrhea in the past two weeks from the time of data collection is shown in Table 3.28.

Table 3.28: Child suffering from diarrhea in the past two weeks

Child suffering from diarrhea in past two weeks	Frequency (n = 159)	Percentage (%)
Child suffered from diarrhea	37	22.8
Child didn't suffer from diarrhea	117	72.2
No response	8	4.9
Total	162	100.0

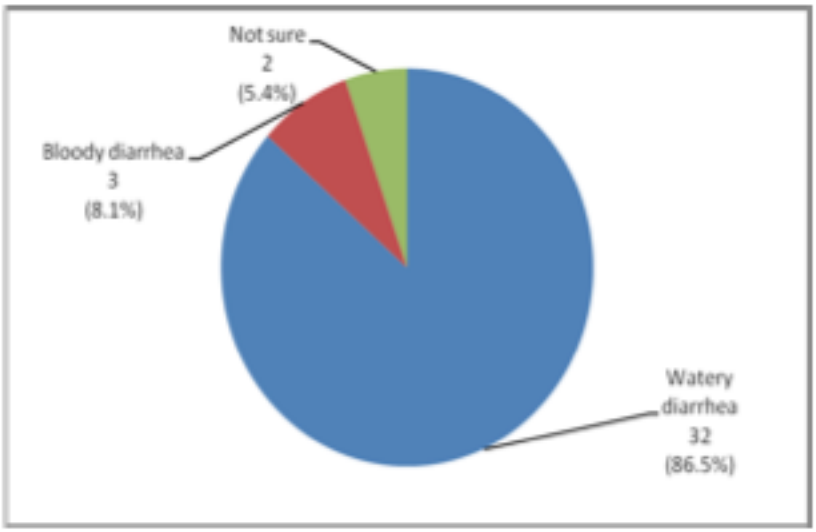
Only 22.8% of the children had suffered from diarrhea in the 2 weeks prior to data collection. It was noted from key informants that during rainy seasons, the occurrence of

diarrheal diseases increases significantly. Therefore, effort to promote safe water, sanitation and hygiene among the community should be strengthened.

3.7.6. Categorization of diarrhea

The categorization of diarrhea that children suffered from is shown in Figure 15.

Figure 15: Categorization of the diarrhea



The majority of diarrhea cases among children (86.5%) were watery as opposed to being bloody (8.1%). Whereas watery diarrhea can be associated to various conditions including many water borne illnesses, the bloody one is normally linked to dysentery which is a bacterial infection.

3.7.7. Stool analysis

For the 4 children who were found with diarrhea at the time of data collection, the results of analysis of their stool samples are shown in Table 3.29.

Table 3.29: Stool analysis results for children with diarrhea

Macroscopy	Microscopy	Modified ZN	Culture
Semi formed	No ova and cysts seen, yeast cells ++	No oocysts seen	*Candida* isolated
Loose stool	No ova and cysts seen	no oocysts seen	*Candida* isolated
Loose stool	No ova and cysts seen, yeast cells +++	No oocysts seen	*Candida* +++ isolated
Semi formed	No ova and cysts seen, yeast cells +	No oocysts seen	*Candida* isolated

Only *Candida* sp. was isolated from culturing while only yeast cells were found from microscopy. Since yeast is a normal inhabitant in intestinal tract of humans, some amount of yeast can almost always be recovered in a stool sample. However, when recovered amounts are abnormally high, then further investigations may be required.

Part of the community appreciated that having a clean environment can prevent the occurrence of diarrheal diseases as highlighted by one key informant that:

> *"…. diarrhea is due to a dirty environment. Children just pick dirty objects and play with them including playing in dirty water which makes them sick. However, such problems could be avoided if the environment is clean. " Key Informant, Kikulu zone*

3.7.8. Other illnesses

Illnesses other than diarrhea and fever noted among the children are shown in Table 3.30.

Table 3.30: Other illnesses among children

Illness	Frequency (n = 90)	Percentage (%)
Respiratory Tract Infections	76	84.4
Skin diseases	6	6.8
Measles	4	4.4
Others	4	4.4

Respiratory Tract Infections were noted to be illnesses that children suffered from most. This was confirmed by participants of one FGD:

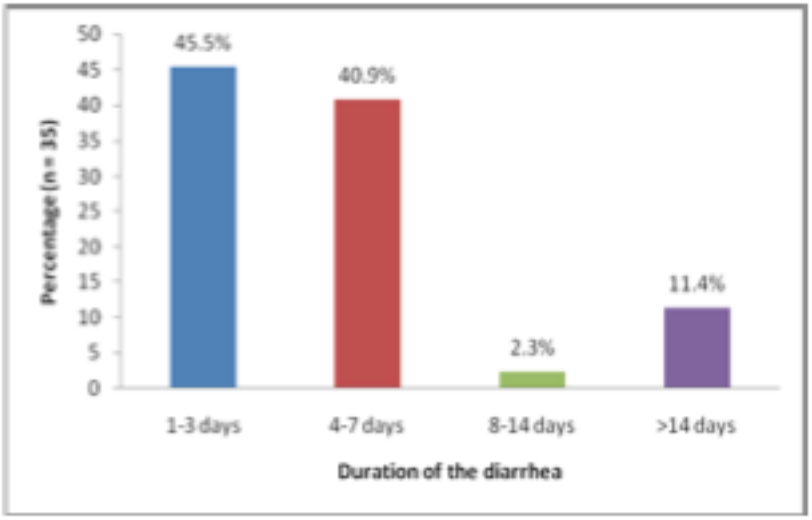
> *"Cough and flu are a very big problem in our area because of the dust. Our roads are not made of tarmac therefore the children are seriously affected by the dust. Even if malaria is a problem here, it has recently reduced as compared to respiratory problems." (Adult male FGD)*

3.8. Management of diarrhea

3.8.1 Duration of the diarrhea

The duration of the diarrhea among children who had suffered it in the 2 weeks prior to data collection is shown in Figure 16.

Figure 16: Duration of diarrhea



Over 80% of the diarrhea cases lasted for at most a week. This may be due to the use of antibiotics from the clinics that the community used frequently when sick. Sometimes, minor diarrhea cases may be self regulating after a few days. However, severe cases may need urgent medical attention.

3.8.2. Treatment of diarrhea

Over three quarters of diarrhea cases (68.6%) were treated. This treatment was probably sought from the clinics within the community. The management of diarrhea at home and health facilities in the community is shown in Table 3.31.

Table 3.31: Management of diarrhea at home and health facility

Treatment	Management in health unit		Management at home	
	n = 25	Percentage (%)	n = 9	Percentage (%)
Oral rehydration fluids	6	24.0	1	11.1
Antibiotics	7	28.0	0	0
Others	6	24.0	7	77.8
Do not know	6	24.0	1	11.1

At the health facility, there was more use of oral rehydration fluids and antibiotics while at home, other treatments such as local herbs were used most. The use of local remedies is very popular among low income earners and for minor conditions which people may think do not need medical attention.

3.9. Child nutritional status

Only 1.3% (2/159) of the children were reported to have been diagnosed with a nutritional problem. Both children were treated for the malnourishment, one in the hospital and another in a private clinic. One of the children was given dietary advice when they sought medical attention.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

Public taps were the commonest source of water for drinking, cooking, bathing, laundry and dish washing among the community. Most households paid for the water they used at a cost ranging between 100 – 150 Uganda shillings per 20 liter jerrycan. However, these prices varied seasonally and between sellers.

Women were the ones who used most water in homes and were also responsible for collecting the water. Women were also responsible for collecting and disposing refuse at households.

Boiling water was the commonest practice by households to render it safe for drinking. However, from bacteriological analysis, most of the drinking water of the households was contaminated with fecal coliforms therefore unsafe for human consumption. Plastic jerrycans were the commonest drinking water storage container.

Most households had latrines that they used for excreta disposal. However, majority of them lacked hole covers, ventilation pipes, handwashing facilities and soap for washing hands. There was indiscriminate disposal of wastewater into drainage channels. There was also poor solid waste management with majority of households disposing of refuse in open pits and burning it. No skip was available in the community for storage of waste.

Private clinics were the first choice health facility for households seeking healthcare. The prevalence of diarrheal diseases and fever among children was low. A significant number of children did not have their immunization cards available.

Mass media (radio and television) were the primary source of health, hygiene and sanitation information. The most preferred language for health education was *Luganda*.

4.2. Recommendations

1. The project should health educate the community on the best practices in safe water, sanitation and hygiene at household levels. Specifically, the following should be considered for health education:
   - safe water chain
   - sanitary condition of latrines
   - handwashing facilities at latrines
   - waste water disposal
   - refuse disposal
   - household environmental conditions

2. The *tippy tap* technology for handwashing can be explored by the project to improve handwashing practices after latrine use among the community.

3. While carrying out health education on sanitation issues among households, the project should give special attention to women who were found to be more involved in water and sanitation activities.

4. *Luganda* should predominantly be used while carrying out health education among the community.

5. The project can explore the use of mass media particularly radio to pass on health information to the community.

6. The project should sensitize parents to always keep the immunization cards of their children.

7. Kampala City Council should endeavour to provide a skip in the community to improve refuse management in the area.

REFERENCES

Alajo et al., (2006): Alajo SO, Nakavuma J, Erume J. Cholera in endemic districts in Uganda during El Nino rains: 2002 - 2003. *Afr Health Sci.* 2006; 6(2): 93 - 97.

Beller Consult and Associates (2004): Sanitation Strategy and Master Plan for Kampala City, Kampala.

Directorate of Water Development (DWD), Ministry of Water and Environment (2010). Water sector guidelines, Final copy, 2010.

Kawempe Division (2008). Kawempe Division 2008/2009 – 2011/2012 Three Year Development Plan.

Kiwanuka S, Ekirapa E, Peterson S, Okui O, Rahman O, Peters D, Pariyo G (2008): Access to and utilization of health services for the poor in Uganda: a systematic review of available evidence. *Trans R Soc Trop Med Hyg.* 2008;102(11): 1067-74.

McKinlay, JB, McKinlay, SM (1977): The Questionable Contribution of Medical Measures t o the Decline of Mortality in the United States in the Twentieth Century. *The Milbank Memorial Fund Quarterly Health and Society, Vol. 55, No. 3 (summer, 1977)*, pp. 405-428.

MWLE (2003): Measuring performance for improved service delivery, Government of Uganda, Ministry of Water, Lands and Environment, September 2003.

UN-HABITAT (2003): The Challenge of Slums Global Report on Human Settlements (2003): United Nations Human Settlements Programme.

UNDP (2003): Slums, Squatter Areas and Informal Settlements – Do They Block or Help Urban Sustainability in Developing Contexts? 9th International conference on Sri Lanka Studies, 28th–30th November 2003, Matara, Sri Lanka

MWE, (2007): Drinking water quality standard.

WHO/AFRO. Uganda. Health Systems. 2001. http://www.afro.who.int/uganda/healthsytems.html [accessed on 15th October 2009].

APPENDICES

Appendix 1: Study Consent Form

Drinking Water Supply, Sanitation, and Hygiene Promotion: Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Study Consent Form

PRINCIPAL INVESTIGATOR
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INFORMED CONSENT NARRATIVE

Good morning / afternoon. My name is _____, and I am working on behalf of Makerere University School of Public Health. We are conducting a survey on **Drinking Water Supply, Sanitation, and Hygiene Promotion in your area.**

Purpose
This research aims at finding out the water supply, sanitation and hygiene status in your area, so as to help identify what things can be done to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene. As residents of this area, we therefore kindly request you to participate in the research and also allow your children to participate in the research.

Duration of the study
The research will last approximately three years.

Procedures
During the research, you will be asked some questions as household head. Stool samples may be taken from members in your household if they have diarrheal diseases. These samples will be tested to find out what has caused the diarrhea, and the results will be explained to you by the staff project team. We request that you continue furnishing us with the progress of the household members in regards to their illnesses, especially diarrhea. To collect this information, you will be visited at the household on a regular basis at 3 to 6 months intervals. This is to help us identify the causes of these diarrheal diseases and therefore be able to take appropriate action.

Household inspection will be done to find out any environmental factors that may increase diarrheal diseases. The sources of the water used in your home will be inspected and where possible water samples taken for microbiological analysis to help establish if your water sources are safe. If they are not safe, the responsible authorities will be informed to take action to make the water source safe for use. Your sanitation status will be assessed, and the present practices will be encouraged or modifications recommended for sustainable hygiene promotion in the community.

The expected duration of the exercise will be approximately 1hr 30min.

Costs/Compensation
All research related procedures and visits will be provided to you at no cost. You will therefore have no added costs from being in this study. There will be no cash incentive from participating in the study.

Benefits
Treatment will be provided for household members found to have diarrhea using the Essential Drug list of the Ministry of Health. Where more costly drugs are needed appropriate referral to health facilities will be done. Where water is found to be unsafe for use, responsible authorities will be informed to take action to make the water source safe for use and appropriate health/hygiene education will be provided. Knowledge will be gained on how to improve the health and living conditions in your area.

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Risks
There will be no risk to you and other household members other than the inconvenience of their providing stool samples if they have diarrhea.

Right to refuse or withdraw
Your participation in this study is entirely voluntary. You may choose not to participate in the study. If you choose to join the study, you are also free to withdraw from the study at anytime should you wish not to continue.

Confidentiality
Details of the household heads and children will be recorded but these will be safely kept and will not be revealed in the report or publication of results of this study. Details are necessary to help the team trace your households and the children in the study for follow up during the three years of the study.
The data collected and the consent form will be securely stored under lock and key with the Principal Investigator.

Questions
In case you have any further questions concerning the research you can contact the project investigators on the project listed on page 1. A signed copy of this form will be provided to you.

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HOUSEHOLD CONSENT

I have been approached to participate in a study to assess the drinking water supply, sanitation, and hygiene promotion. The purpose, procedures, benefits and risks of participating in this study have been explained to me. I understand that during the study the fieldworkers / health workers will:

1. Ask me questions about my household members and the general environmental hygiene.
2. Take stool samples from household member(s) if they have diarrhea. These will be used to test for microorganisms that cause diarrhea and also determine the best drugs to treat these microorganisms. Results of samples collected from my household will be brought to me and explained to me by the staff project team.
3. Visit the household on a regular basis from 3 to 6 months intervals to conduct an environmental and health inspection.
4. Treat household members found to have diarrhea using the Essential Drug list of the Ministry of Health. Where more costly drugs are needed appropriate referral to health facilities will be done.

I also understand that:

1. My household member(s) will not be exposed to any other than the inconvenience of providing stool if they have diarrhea.
2. My participation in the study is voluntary. If I do not participate, I will not be affected in any way and that I can also withdraw from the study at any point during the follow up for the project duration.
3. Information collected during the study will be confidential.
4. There will be no costs related to the study procedures and no cash incentives will be given.
5. The study will last approximately three years.
6. If I have any questions related to the study, I may contact the researchers at anytime.
7. I will be given a copy of this form and that a copy of this form will be kept in the study file.
8. By signing below I agree to participate in this study.

I freely agree to participate in this research and allow my household to join the study.

Name of Interviewee/Guardian.....

Signature.....

Date.....

Name of Interviewer / Health worker.....

Signature.....

Date.....

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If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about

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the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

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Appendix 2: Household questionnaire

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Informed Consent: Go through informed consent as indicated

IF RESPONDENT AGREES TO BE INTERVIEWED 1
Thank her / him for accepting to participate.
CONTINUE ↓

IF RESPONDENT DOES NOT AGREE TO BE INTERVIEWED 2
Thank her / him & go to the next household (i.e. household of the next sampling interval) →**END**

Questionnaire No.
GPS READING: _____ **HOUSE HOLD ID NUMBER**_____

DIVISION:
SUB COUNTY (LCII):
PARISH:
VILLAGE/ZONE (LC1):
TEAM NO:
INTERVIEWER'S NAME: **SIGNATURE & DATE** _____

DATE OF INTERVIEW ...../...../2010
TIME OF INTERVIEW: START _____ **END** _____
SUPERVISOR'S NAME:

ARE ALL QUESTIONS COMPLETED? NO..... 1 YES 2

IF NOT WHY REFUSED..... 1 OTHER (SPECIFY)..... 2

SUPERVISORS NAME _____ **SIGNATURE & DATE** _____

DATA ENTRANT'S NAME _____ **SIGNATURE & DATE** _____

1.0 HOUSEHOLD DATA COLLECTION FORM ☐

1.1 Respondent particulars

Name of respondent: _____

Sex of respondent	Marital status of Head of HH	Age of respondent (years)	Religion of respondent	Education level of respondent	Region (District) of origin/birth of respondent	Period respondent has been living in area (years)	Is respondent the household head?	If respondent is not household the household head, what is the relationship of the respondent to the household head?
1=Male 2=Female	1=Never married 2=Married/cohabiting (monogamy) 3=Married/ cohabiting (polygamy) 4=Widowed 5=Divorced 6=Separated	1=19-24 2=25-34 3=35-44 4=45-54 5=55-64 6=65+ 99=Don't know	1=Catholic 2=Protestant 3=Pentecostal 4=Muslim 5=Other (specify)	1=None 2=P1-P7 3=S1-S4 4=S5-S6 5=College (post S4) 6=College (post S6) 7=University (post S6)	1=Kampala 2=Central 3=Eastern 4=Northern 5=West Nile 6=West 7=Out of Uganda	1=< 1 2= 1 –3 3= 3-5 4=>5 99= Don't know	1=Yes 2=No	1=Spouse; 2=Son/daughter; 3=Step child; 4=Grand child; 5=Sister/brother; 6=Niece/nephew; 7=Other relative; 8=other (specify)

1.2 Household head particulars ☐

1.2.1 Socio-demographic characteristics of household head

Who is head of HH?	Sex of Head of HH	Marital status of Head of HH	Age of Head of HH	Religion of Head of HH	Education level of head of HH	Region (District) of origin/birth of head of HH	Period HH head has been living in Banda (years)
1=Male adult 2=Female adult 3= Male child 4=Female child 5= Other (specify)	1=Male 2=Female	1=Never married 2=Married/cohabiting (monogamy) 3=Married/ cohabiting (polygamy) 4=Widowed 5=Divorced 6=Separated	1=19-24 2=25-34 3=35-44 4=45-54 5=55-64 6=65+ 99=Don't know	1=Catholic 2=Protestant 3=Pentecostal 4=Muslim 5=Other (specify)	1=None 2=P1-P7 3=S1-S4 4=S5-S6 5=College (post S4) 6=College (post S6) 7=University (post S6)	1=Kampala 2=Central 3=Eastern 4=Northern 5=West Nile 6=West 7=Out of Uganda	1=< 1 2= 1 –3 3= 3-5 4=>5 99= Don't know

1.3 Household water/sanitation

1.3.1 Household main water source, cost and usage

What is main source of water for the household? (Give only one)	How far is the main source of water from the HH?	Amount of water used in household per day (Indicate estimated number of 20litre Jerrycans)	Do you pay for this water?	If water is paid for, how much does it cost per jerrycan? (Indicate cost in Ugshs)	Who uses more water in the household?	Who is responsible for collection/fetching water for domestic use?
1=Borehole 2=Protected spring 3=Unprotected pond (river/stream/well) 4=Rain water harvesting 5=Piped water 6=Other (*Specify*)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km	1= 1 2= 2-3 3= 4-5 4= >5	1=No 2=Yes	1=<50 2=50/= 3=75/= 4=100/= 5=150/= 6=200/= 7=>200/=	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)

1.3.2 Household drinking water source, treatment and storage

What is main source of water for drinking? (Give only one)	Do you do anything to your water before drinking?	Where do you store your drinking water?	How often is the container for drinking water cleaned?	How is the container for drinking water cleaned?
1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=Riven/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Boiling 2=Use traditional herbs 3=Use chemicals (water guard tablet/liquid) 4=Filter/Sieve 5=Decant 6=Nothing	1=Traditional pot with cover 2=Traditional pot without cover 3=Plastic jerrycan with cover 4=Plastic jerrycan without cover 5=Other (specify)	1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5=Every month 6=Rarely 7=Other (specify)	1= Rinsed with plain water 2=Rinsed with soapy water 3=Scrubbed and rinsed with plain water 4=Scrubbed and rinsed with soapy water 5=Other (specify)

1.3.3 Household general domestic water source and disposal

What is main source of water for cooking? (Give only one)	What is main source of water for bathing? (Give only one)	What is main source of water for laundry? (Give only one)	What is main source of water for dishwashing? (Give only one)	How do you dispose of waste water from your house?
1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=In soak pit 2=On the road 3=In the backyard 4=In the drainage 5=Other (specify)

1.3.4 Household bathroom and latrine

What type of bathroom does this household use?	If the household bathroom is outside, how many households use the bathroom?	Has your household got a latrine?	If you do not have a latrine, where does the household dispose off their feces?	If community latrine is used, how many households use the latrine?
1=Inside the house 2=Outside (built with blocks) 3=Outside makeshift 4=None	1=1-5 2=6-10 3=11-20 4=21=30 5=>30	1=No 2=Yes	1=Community latrine 2=Neighbor's latrine 3=Bush 4=Bury in the yard 5=Throw outside yard/dwelling 6=Not disposed off 7=Other (specify)	1=1-5 2=6-10 3=11-20 4=21=30 5=>30

1.3.5 Household rubbish disposal

Where do you dispose of your rubbish? (List all)	At household level, who is responsible for disposing off the rubbish?	If rubbish collection is paid for, how much does it cost per week? (Indicate cost in Ug.Shs)	Which company/Whom do you pay to collect your rubbish?(specify)	How often is the rubbish collected?	Are you satisfied with the rubbish collection services in the area?	If no, why are you not satisfied with the rubbish collection services in the area?
1=In KCC skip 2= Open pit (Communal/personal) and buried 3=Open pit and burnt 4=Open pit/trench 5=Any where around the house 6= Bush 7=Pay for rubbish collection 7=Other (Specify)	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)	1=<500 2=500-1,000 3=1,000-2,000 4=2,000-3,000 5=3,000-4,000 6=4,000-5,000 7=>5,000		1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5=Every month 6=Rarely 7=Other (specify)	1=No 2=Yes	

1.4 Household health seeking behavior

Health care services: Generally, if household members are sick, where is treatment sought first?	If first source of treatment is health facility (1-3), how far is this health facility from your household	Are you satisfied with the services at the health facility?	If no, why are you not satisfied with the services at the health facility?	If first source of treatment is other health care service (4-5), how far is this service from your household?
1. Hospital 2. Health center 3. Private Clinic 4. Traditional healer/herbalist 5. Others (indicate)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km	1=No 2=Yes	1=Inadequate medicines 2=Staff unavailable 3=Wait long in lines 4=Others (specify)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km

1.5 Household food sources and storage

Household food sources	Household food storage	Child food storage

Where do you normally get the household vegetables and fruits?	Where do you normally get the household meat/fish?	Where do you normally get the household milk products?	Where are the household vegetables and fruits stored?	How is the household meat stored?	How are the household milk products stored?	How is the food for the child less than five years stored?
1= Vendors at main market in area 2=Kikulu road side vendors 3= Other (specify)	1= Vendors at main market in area 2=Area road side vendors 3= Other (specify)	1= Grocery shops in area 2=Area road side vendors 3= Other (specify)				

1.6 Information accessibility

Do you have any access health, hygiene and sanitation information?	If yes, what is your major source of health, hygiene and sanitation information?	How often do you access health, hygiene and sanitation information?	What language do you prefer access health, hygiene and sanitation information?
1=No 2=Yes	1=Radio 2=Newspaper 3=TV 4=Health worker 5=Seminars/meetings 6=Other	1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5= Monthly 6=Rarely 7=Other (specify)	

1.7 Mortality information

In the past three months, have you lost any child aged less than **5** years? 1=No 2=Yes	If yes, how many children aged less than five have you lost?		Cause* of death for children aged less than 5 years (0-59 months)(Verbal autopsy)
	Number female	Number male	
			Child 1-
			Child 2-
			Child 3-
			Child 4-
			Child 5-

*1=Watery diarrhea; 2= Bloody diarrhea; 3= Measles; 4= Malaria/fever; 5= Cough/ARI; 6=Malnutrition; 7= Accident ; 8= Delivery complications; 9= Others (specify); 10= Unknown

2.0 INDIVIDUAL QUESTIONNAIRE

2.1 Child immunization , supplementation and de-worming information (Children 6-59 months)

HH No.	Child No.	Child Sex	*Ask for Child's Health Card* Is child health card present?	Has the child received any of the following: (Check child health card)			
				Measles immunisation (Left hand side)	De-worming	Vitamin A Supplementation	BCG/Scar (Right hand)
				1=Yes with card 2=Yes without card 3=No with card 4=No without card 5=Not applicable			
		1=Male 2=Female	1=No 2=Yes	Child>=9 months only	Within past 3 months	Within last 6 months	At birth

2.2 Child morbidity information

2.2.1 Morbidity in past 2 weeks

HH No.	Child No.	Child Sex	Does the household have a mosquito net (s)?	Did the child sleep under a mosquito net last night?	Recent illness (last 2 weeks)

		1=Male 2=Female	1=No 2=Yes	1=No 2=Yes	**Has child suffered fever in past two weeks?** 1=No 2=Yes	**If child has suffered from fever, what treatment was given?** 1= Chloroquine, Quinine, Coartem (Malaria treatment) 2=Other treatment (not malaria) 3=No treatment	**Has child suffered diarrhea in past two weeks?** 1=No 2=Yes	**If child suffered diarrhea in past two weeks, what was the nature of diarrhea?** 1=Watery diarrhea 2=Bloody diarrhea 3=other (specify)	**Other illness experienced in past two weeks** 1=measles 2=Malnutrition 3=Cough/RTI/Difficulty in breathing 4=Skin diseases 5=Vomiting 6=Eye infection 7=Intestinal parasites 8=Other (specify) 9=No illness

Diarrhea= any episode of more than three stools per day; **Bloody diarrhea** = any episode of more than three stools per day in which there is presence of blood in stool; **Measles** = Any episode of fever accompanied by cutaneous eruption, rhino-pharyngitis or conjunctivitis;

Fever= Elevated body temperature; **Respiratory Tract infection** = any episode with associated fever & cough with signs of; sputum, thoracicpain, dyspnoea , or wheezing

2.2.2 Health seeking behavior for diarrhea

HH. No	Child No.	If child had diarrhea in past two weeks, how long did the diarrhea last?	Was the diarrhea treated?	If diarrhea was treated, where was treatment sought?	If treatment was sought at a health facility (1-3), what type of treatment was given for the diarrhea?	If diarrhea was managed at home, (4), what type of treatment was given for the diarrhea?
		1=1-3 days 2=4-7 days 3=8-14 days 4=> 14 days 5= don't know	1=No 2=Yes	1= Hospital 2= Health center 3= Private Clinic 4= Managed at home 5= Traditional healer/herbalist 6= Others (specify)	1= Oral rehydration fluids 2= Antibiotics (specify) 3=Intravenous fluids (specify) 4=Other (specify) 99= Don't know treatment given	1= Oral rehydration fluids 2 = Home based fluids (specify) 3=Other (specify)

2.2.3 Malnutrition diagnosis and health seeking behavior

HH. No	Child No.	Has the child ever been diagnosed to be malnourished or have illnesses related to malnutrition?	If child has ever been diagnosed to have malnutrition, was the malnutrition treated?	If malnutrition was treated, where was treatment sought?	What type of treatment was given for the malnutrition?
		1=No 2=Yes	1=No 2=Yes	1= Hospital 2= Health center 3= Private Clinic 4= Managed at home 5= Traditional healer/herbalist 6= Others (specify)	1= Medication 2= Dietary advise 3=Other (specify) 99= Don't know treatment given

STOOL EXAMINATION TABLE

HH No.	Child No.	Birth Date (Day/Month/Year)	Age (Months)	Sex 1= M 2= F	**Stool analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

SOIL ANALYSIS TABLE

VILLAGE/ZONE (LC1):	SOIL SAMPLE SOURCE:	**Soil analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

WATER ANALYSIS FORM

VILLAGE/ZONE (LC1):	WATER SAMPLE SOURCE:	**Water analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

Appendix 3: Consent form for Key Informants

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MAKERERE UNIVERSITY
P.O. Box 7072 Kampala Uganda
Website: http://www.musph.ac.ug
Tel: 256-41-532207/543872/5[illegible]
Fax: 256-41-531807

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF DISEASE CONTROL AND ENVIRONMENTAL HEALTH

CONSENT FORM FOR KEY INFORMANTS

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074.

INTRODUCTION AND WHAT WE ARE DOING

I am _____, and I work at Makerere University School of Public Health. We are conducting a research on Drinking Water Supply, Sanitation, and Hygiene Promotion in your area. This survey is being conducted in two urban communities of Kampala and Mukono districts.
Your contribution during our discussion will be appreciated and helpful in highlighting issues that only a person of your experience can bring forth.

PURPOSE
This research aims at finding out the water supply, sanitation and hygiene status in urban communities, so as to help identify what approaches could be instituted to reduce the incidence of specific illnesses among such communities that are associated with water, sanitation and hygiene. As a person who is engaged in the water/sanitation/hygiene promotion/health and with good working knowledge, we therefore kindly request you to participate as a Key informant.

PROCEDURES
During the interview, you will be asked questions and have an opportunity to share your opinions on issues of socio economic, water, sanitation and hygiene promotion, environmental and health issues in relation to your work and the study area.

The expected duration of the interview will be 1hour. The answers and opinions from the interview will be kept confidential.

RISKS, STRESS, OR DISCOMFORT
We do not anticipate any risk in your participation in the interview.

BENEFITS

There may not be direct benefit to you, but your participation is likely to help us understand the water and sanitation status in these communities, and consequently enable us contribute to the improvement of the community members health and well being.

CONFIDENTIALITY

The information that we collect from this interview will be kept confidential. Information from the interview will be stored in a file that will not have your name on it, but numbers assigned to it instead. No names will be collected from you during this interview.
The information collected will only be used for research purposes.

CONTACT INFORMATION

_____ (Research Assistant) has described to you what is going to be done, and can be contacted at telephone number _____. If you have any other questions or concerns about this study, you may contact the Principal Investigator Dr. John C. Ssempebwa at telephone 0772-963074.

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

VOLUNTARY PARTICIPATION

You do not have to take part in this interview if you do not wish to do so, and refusing to participate will not affect you in any way.
Your participation in this survey is voluntary. Even after you agree to participate, or sign the consent document, you may decide to stop the interview at any time.

SIGNATURES

I have read, or been informed of the information about this research. I have had the opportunity to ask questions about it and any questions I had have been answered to my satisfaction. I hereby consent voluntarily to participate in the interview and understand that I have the right to withdraw at any time without any consequences.

_____ Date _____ _____
Participants signature Participants Code

_____ Date _____ _____
Signature of Research Ass. Name of Research Ass.

_____ Date _____ _____
Signature of Principal Investigator Name of Principal Investigator

Appendix 4: Key Informant Interview guide

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

KEY INFORMANTS INTERVIEW GUIDES

Sub-county..... Parish..... Zone .....

Title of Respondent .....

Name of interviewer..... Date of the interview.....

1. What water sources are available in your community?
.....
.....
.....
.....
.....

2. Is the community able to tell whether water is safe / unsafe for drinking or home use? Explain.....
.....
.....
.....

3. Mention any common dangers associated with consumption of unclean water in the community.
.....
.....
.....

4. What sanitation facilities are available in your community? (shared/ unshared)
.....
.....
.....

.....

.....

5. Is the community able to tell whether a sanitary facility is hygienic or not? Explain.....

.....

.....

6. Mention any common dangers associated with use of unsanitary facilities in the community.

.....

.....

.....

7. What is involved in water quality surveillance?

.....

.....

.....

8. Do you think community involvement in Water Quality surveillance and sanitary inspections of excreta facilities is necessary? Explain.

.....

.....

.....

.....

9. Do you think the present water quality surveillance system is adequate? Why?

.....

.....

.....

10. Do you think the current hygiene inspections on excreta facility inspection are adequate? Why?

.....

.....

.....

11. How do you rate the involvement of the District leaders, NGOs/CBOs, Communities and Women in the safe water provision, sanitation and hygiene promotion in your area?

.....

.....

.....

.....

.....

12. Do you have water user committees in your area? What is the composition of these committees? How long ago in months was this committee created? Are you a member of the water use committee?

.....

.....

.....

13. Has the community had any health talks/workshops/seminars on water, sanitation and hygiene promotion?

.....

.....

.....

14a. What factors might influence the community participation in safe water, sanitation and hygiene promotion activities in your area?

.....

.....

.....

14b. How can these challenges be overcome?

.....

.....

.....

.....

Thank you!

Appendix 5: Consent form for Focus Group Discussions

MAKERERE UNIVERSITY
P.O. Box 7072 Kampala Uganda
Website: http://www.musph.ac.ug
Tel: 256-41-532207/543872/543437
Fax: 256-41-531807

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF DISEASE CONTROL AND ENVIRONMENTAL HEALTH

CONSENT FORM FOR FOCUS GROUP

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074

INTRODUCTION AND WHAT WE ARE DOING

I am _____, and I work at Makerere University School of Public Health. We are conducting a research on Drinking Water Supply, Sanitation, and Hygiene Promotion in your area. This survey is being conducted in two urban communities of Kampala and Mukono districts.

PURPOSE
This research aims at finding out the water supply, sanitation and hygiene status in your area, so as to help identify what things can be done to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene. As residents of this area, we therefore kindly request you to participate in the focused discussion.

PROCEDURES
During the discussion, you will be asked questions and have an opportunity to share your opinions on issues of socio economic, water and sanitation, environmental and health issues in relation to your area with other members in your area. The discussion will be audio and video recorded. If you so wish not to have any part of the video or audio recording be done, you can ask for that part to be erased.

The expected duration of the discussion will be 1hr 30min. There will be two sessions of such discussions, one at the beginning of the study, and the second during the third (last) year of the study. The answers and opinions from the focus discussions will be kept confidential.

RISKS, STRESS, OR DISCOMFORT
We do not anticipate any risk in your participation in the discussions.

BENEFITS
There may not be direct benefit to you, but your participation is likely to help us understand the water and sanitation state in your community, and consequently enable us improve health in your community.

CONFIDENTIALITY
The information that we collect from this discussion will be kept confidential. Information from the discussion will be stored in a file that will not have your name on it, but numbers assigned to it instead. No names will be collected from you during this interview,and you should not mention any ones names or identifying information about another individual.
The information collected will only be used for research purposes.

CONTACT INFORMATION

_____ (Research Assistant) has described to you what is going to be done, and can be contacted at telephone number _____. If you have any other questions or concerns about this study, you may contact the Principal Investigator Dr. John C. Ssempebwa at telephone 0772-963074.

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

VOLUNTARY PARTICIPATION
You do not have to take part in this discussion if you do not wish to do so, and refusing to participate will not affect you in any way.
Your participation in this survey is voluntary. Even after you agree to participate in the discussion or sign the informed consent document, you may decide to leave the discussion at any time without penalty or loss of benefits to which you may otherwise have been entitled.

SIGNATURES
I have read, or been informed of the information about this research. I have had the opportunity to ask questions about it and any questions I had have been answered to my satisfaction. I hereby consent voluntarily to participate in the discussion and understand that I have the right to withdraw at any time without any consequences.

_____ Date _____ _____
Participants signature Participants Code
_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____
Signature of Research Ass. Name of Research Ass.

_____ Date _____ _____
Signature of P.I Name of P.I.

10-138

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The University at Albany

Appendix 6: Focus Group Discussion guide

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

FOCUS GROUP DISCUSSION GUIDE

Group Composition……..
Facilitator……

Date of Discussion…….. Venue of Discussion……..

INTRODUCTION:

Good morning/afternoon/evening Sir/Madam. Our names are ……..(mention your names). We are a team from Makerere University School of Public Health and would like to discuss with you about Water, Sanitation and Hygiene promotion in yout area. The purpose of our discussion is to help identify what interventions can be put in place to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene promotion status in your area.

Please feel free to ask for clarifications where needed. You do not have to reveal any personal information if you do not want to. All information given will be used develop community interventions only. Your name will be strictly confidential and will not be directly quoted in the report.

Before we begin I ask that we all introduce ourselves. I request that you speak one at a time as well as loudly and clearly when answering a question so that all your views are understood and written down. When making a point during the discussion, you may choose either to use your name or not. To help us capture the whole discussion and ensure that we do not miss anything that you say, I kindly request that we use this tape recorder here. May I use the tape recorder? May I continue with the interview? Thank-you

Moderator requests all participants to introduce themselves

GUIDE QUESTIONS:

A. Overview (Socio economic, environmental and health issues in area)

A1. Socio-economic issues

A1.1 What are the main socio-economic problems faced by people in this area?

A1.2. What categories of people in the community are affected most by these socio-economic problems? (Probe children, adults, boys, girls, males, females)

A1.3. What do you think are the causes of these socio-economic problems?

A1.4. In your opinion what are the main signs/manifestations of socio-economic problems in the area?

A1.5. In your opinion, during the last five years, do you think socio-economic problems in this area have decreased, remained stable of worsened?

- Give reasons why you think socio-economic problems have decreased, remained stable of worsened?

A1.6. What do you think should be done to improve the socio-economic situation of the affected people in this area. (Probe for best means for alleviating proverty)

A2. Environmental issues

A2.1 What are the main environmental problems faced by people in this area?

A2.2. What categories of people in the community are affected most by these environmental problems? (Probe children, adults, boys, girls, males, females)

A2.3. What do you think are the causes of these environmental problems?

A2.4. In your opinion what are the main signs/manifestations of these environmental problems in the area?

A2.5. In your opinion, during the last five years, do you think these environmental problems have decreased, remained stable of worsened?

- Give reasons why you think socio-economic problems have decreased, remained stable of worsened?

A2.6. What do you think should be done to alleviate the environmental problems of the affected people in this area.

A3. Health issues

A3.1 What are the main health issues/diseases faced by people in this area?

A3.2. What categories of people in the community are affected most by these health issues/diseases? (Probe children, adults, boys, girls, males, females)

A3.3. What do you think are the causes of these health issues?

A3.4. In your opinion what are the main signs/manifestations of health problems in the area?

A3.5. In your opinion, during the last five years, do you think these health problems in the area have decreased, remained stable of worsened?

- Give reasons why you think these health problems have decreased, remained stable of worsened?

A3.6. What do you think should be done to improve the health status of the affected people in this area?

B. Diarrhoea

B1. Would you say diarrhoea is a big problem in this area? Yes/No

- If yes, why?
- If no, why do you say diarrhea is not a big problem in this area?

B2. What are the common types of diarrhea you have seen in this area? (Probe watery/bloody diarrhea)

B3. Do the residents normally seek treatment for diarrhea? Yes/No

- If yes, where do community members normally seek treatment for diarrhea?
  - In your opinion, why do you think they seek treatment in this place?

- What is the common type of treatment given for diarrhea?
- If no, why do you think they do not seek treatment for diarrhea?

B4. In your opinion, what do you think is the cause of diarrhea in this area? (Probe for water, sanitation, and hygiene conditions)

B5. What are some of the factors influencing community members to adopt good water, sanitation and environmental hygiene practices?

B6. What are some of the barriers hindering community members from adopting good water, sanitation and environmental hygiene practices?

B7. Are you aware of any organisations who have been working in this area to address the issue of diarrhea? Yes/No

- If yes which are these Organisations?
- What were these Organisations doing?

B8. Are you aware of any community efforts in the area to address the issue of diarrhea? Yes/No

- If yes, what are the community efforts in place?
- If no, what community efforts do you think should be done to reduce the incidences of diarrhea in this area?

B9. Who do you think should put into place these interventions to reduce diarrhea and why?

C. Water

C1. What water sources are available in your community?

a) Are all of them functioning? If no why?
b) Which ones are used most by the community? Why?

C2. What is involved in water quality surveillance?

a) Do you think community involvement in Water Quality surveillance is necessary? Explain.
b) Do you think the present water quality surveillance system is adequate? Why?

c) How do you rate the involvement of the District leaders, NGOs/CBOs, Communities and Women in the safe water provision and water quality surveillance processes in your area?
d) Have you had any sensitization workshop/seminar on water quality surveillance?
e) How do you tell that water is not safe for drinking or home use?
f) Discuss any dangers associated with consumption unclean water.
g) How do you think the community and women can be involved in water quality surveillance?

C3. Do you have Water User Committees in your area?

a) What is the composition of these committees?
b) How long ago in months was this committee created?
c) How often do committee members meet?
d) How often do the committees change leadership?
e) Have the committees got any training in Operation & Maintenance of water facilities ?
f) What are the roles and responsibilities of the committees?
g) How do the committees raise funds for running their activities?

D. Do you have any questions or comments regarding our topic of discussion?

THANK YOU FOR YOUR TIME AND COOPERATION

END

Appendix 7: Assent form

Drinking Water Supply, Sanitation, and Hygiene Promotion: Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Assent Form

10-138
Approved by IRB
Valid Thru
JUL 20 2011
The University at Albany

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074

My name is ..... I am trying to learn about Drinking Water, Sanitation, and cleanliness in your area because. This exercise wants to find out the safety of the water consumed in your area, and the cleanliness of the surroundings, so as to help identify what things can be done to reduce the incidence of specific diseases, particularly diarrhea.

If you decide you want to be in my research, I will collect a small amount of your feces when you go for a long call. You will defecate in a potty, from which I will remove a small amount of the feces to take back with me to the laboratory. In the laboratory, we shall look for small organisms that are contained in the feces to find out whether they are the ones causing you to have diarrhea. I might come back after 3 or 6 months to collect another feces sample if you will still be having diarrhea.

If you are found to have organisms that that cause diarrhea, you will be given medicine to make you feel better, so that you can once again play with your friends. Where water is found to be unsafe for use, I will advise your parents on how best to treat the water so that you don't get diarrhea and to also clean around your home. You will experience no pain from this study.

Other people will not know if you are in my research. I will put things I learn about you together with things I learn about other children in your area, so no one can tell what things came from you. When I tell other people about my research, I will not use your name, so no one can tell who I am talking about.

Your parents or guardian have to say it's OK for you to be in the research. After they decide, you get to choose if you want to do it too. If you want to be in the research now and change your mind later, that's OK. It's okay to stop at any time and no one will punish you.

My telephone number is 0772-963074. You can call me if you have questions about the research or if you decide you don't want to be in the research any more.

I will give you a copy of this form in case you want to ask questions later.

Agreement

I have decided to be in the research even though I know that I don't have to do it.

.....(Name of Research Assistant) has answered all my questions.

Code of Study Participant Date

Signature of Research Assistant Date

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

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JUL 20 2011

The University at Albany

Appendix 8: Communal / household latrine observation checklist

Drinking Water Supply, Sanitation, and Hygiene Promotion:

Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

COMMUNAL/HOUSEHOLD LATRINE OBSERVATION CHECKLIST

1. Zone (LC 1):..... 2. Code Number .....

3. Date of Visit .....

1.	Does the household have no latrine?	Y/N
2.	Is the latrine > 5 meters from the house?	Y/N
3.	Has the latrine got no proper access leading to it ?	Y/N
4.	Has the latrine lack a door?	Y/N
5.	Does the latrine lack a roof?	Y/N
6.	Does the latrine lack a hole cover	Y/N
7.	Does the latrine lack a ventilation pipe?	Y/N
8.	Is the bottom of the latrine seen?	Y/N
9.	Is there presence of fecal matter/urine on the slab?	Y/N
10.	Is the latrine smelly?	Y/N
11.	Is the latrine infested with flies?	Y/N
12.	Are the latrine walls smeared with fecal matter?	Y/N
13.	Is there no hand washing facility near the latrine?	Y/N
14.	Is there no soap near latrine hand washing facility?	Y/N

Total Score of Contamination Risks ...../14

Contamination Risk Score: 10-14 = Very high; 7-9 = High; 4-6 = Medium; 1-3 = Low 0 = None

Results and Recommendations:

The following important points of risk were noted:

Name and signature of Research Assistant:

.....

COMMUNAL / HOUSEHOLD ENVIRONMENTAL HYGIENE

OBSERVATION CHECKLIST

1. Zone (LC 1):..... 2. Code Number .....

3. Date of Visit .....

Environmental hygiene

1. Is the household environment dirty? (litter around the house) Y/N
2. Is there no dustbin for household rubbish? Y/N
3. Is the dustbin dirty and overflowing? Y/N
4. Is there fecal matter around the household? Y/N

Drainage

5. Is there no drainage around the house? Y/N
6. Is the drainage around the house clogged? Y/N

Utensils

7. Is there no utensil drying rack present? Y/N
8. Are the household utensils dirty and left unclean in the open? Y/N

Water container

9. Does the drinking water container have a wide mouth/opening? Y/N
10. Has the drinking water container got no lid/cover? Y/N
11. Is the drinking water container kept on the floor level? Y/N
12. Is the inside of the container dirty? Y/N
13. Is the outside of the container dirty? Y/N

Total Score of Contamination Risks ...../12

Contamination Risk Score: 10-12 = Very high; 7-9 = High; 4-6 = Medium; 1-3 = Low 0 = None

Results and Recommendations:

The following important points of risk were noted:

Name and signature of Research Assistant:

.....

How to apply

Application forms and procedure can be obtained from the Department of Disease Control and Environmental Health, Makerere University School of Public Health, Mulago Hospital Complex or from the website: http://musph.mak.ac.ug/

For further details contact:

Course Administrator
Ms. Irene Nassazi
Department of Disease Control and Environmental Health
Room 3, School of Public Health Building, Mulago Hospital Complex
E-mail: inassazi@musph.ac.ug ; Tel. +256771671354

Course Coordinator
Mr. David Musoke
Department of Disease Control and Environmental Health
Room 206, School of Public Health Building, Mulago Hospital Complex
E-mail: dmusoke@musph.ac.ug ; Tel. +256712987736

Makerere University

College of Health Sciences
School of Public Health

Certificate Course in Water, Sanitation and Hygiene

Introduction

There has been an increasing number of people working in the environmental health sector in recent years but do not have the necessary qualifications and expertise. This includes those working in local governments, NGOs and the private sector. This therefore necessitated Makerere University School of Public Health to develop this course to increase the knowledge and skills of such workers particularly those employed in the Water, Sanitation, and Hygiene (WASH) sector. The aim of this short course is to equip practising individuals in WASH with appropriate attitudes, adequate skills and scientific knowledge for handling and managing duties and technical procedures in WASH. Competence areas will include health promotion, disease prevention and control, management and administration of environmental health in community, research, and training in the field of WASH.

Course Objectives

This course is intended to strengthen the capacity of practicing workers to successfully identify and manage WASH opportunities and problems by facilitating the acquisition of adequate knowledge and development of skills and attitudes through understanding and use of the six (6) essential services of WASH. These are to: **1.** Monitor WASH status to identify and solve community environmental health problems **2.** Diagnose and investigate WASH problems and health hazards in the community **3.** Inform, educate and empower people about WASH issues **4.** Mobilize community partnerships and actions to identify and solve WASH problems **5.** Evaluate effectiveness, accessibility and quality of personal and population based WASH services **6.** Research for new insights and innovative solutions to WASH problems.

Course Structure

The course will be an 8 weeks programme of study. The participants will spend 4 weeks (full time) at MakSPH while 4 weeks will be spent at suitable work places / field sites. This is a day programme and examinations will held in the last week of the course. The course will run once every year during the Makerere University semester II recess term (June – August). In 2014, the course will run from 16th June to 8th August 2014.

The programme consists of 7 courses: 1. Water quality and public health 2. Water resources management 3. Waste management 4. Personal hygiene 5. WASH planning and financing 6.WASH policy, legal and institutional framework 7. Field / project work. Mode of delivery of the programme will include lectures, tutorials, seminars, practicals and fieldwork.

Who Should apply?

1. Practicing officers in the WASH sector including those with the following background: Community Development, Social Sciences, Water, Development Studies, Community Health, Urban Planning, Environmental Science and Environmental Management.

2. Environmental Health workers who wish to broaden their knowledge and skills as a form of Continuous Professional Development (CPD) so as to be better equipped to implement WASH activities.

Entry requirements for admission to the programme are Uganda Advanced Certificate of Education (UACE) or its equivalent with at least 1 year working experience in WASH.

Fees

Participants will pay tuition fees of 750,000 Uganda shillings for Ugandans and 350 US dollars for non-Ugandans.

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

Baseline Survey Report

Mukono Municipality

Prepared by:

Department of Disease Control and Environmental Health
Makerere University School of Public Health

June, 2011

Acknowledgments

Makerere University School of Public Health would like to extend its gratitude to the Higher Education for Development (HED) for the commitment and financial support towards this project.

We would also like to acknowledge our partners in implementing this project from University at Albany, State University of New York and Tuskegee University, Alabama, US.

Special thanks go to Mukono District authorities as well as the local community in Mukono Central parish who gave valuable information during the study. We also extend our gratitude to the local council leaders and all the members of local organizations that were consulted during this study.

All other stakeholders including NGOs, government institutions, schools and health facilities that contributed and participated in this study are also greatly appreciated for their support, cooperation and guidance in the entire process.

We are grateful to the entire research team that worked during the entire process of the study including data collection, entry, analysis and report writing. We also greatly appreciate the support from all members who participated in this survey directly or indirectly.

Abbreviations

CBO	Community Based Organization
EPI/IDS	Expanded Program on Immunization/ Infectious Disease Surveillance
FGD	Focus Group Discussion
HED	Higher Education for Development
MakSPH	Makerere University School of Public Health
MoH	Ministry of Health
NGO	Non Governmental Organization
MWLE	Ministry of Water, Lands and Environment
SPSS	Statistical Package for Social Scientists
UNSG	Uganda National Sanitation Guidelines
UN	United Nations
UNICEF	United Nations Children's Fund
UNDP	United Nations Development Program
WHO	World Health Organization

Key Concepts

Sanitation: a process where people demand, develop, and sustain hygienic and healthy environment for themselves by erecting barriers to prevent transmission of diseases (UNSG, 2000).

Environmental hygiene: encompasses the promotion of skills and practices that enable individuals, families and communities to have a clean and healthy environment.

Executive Summary

Introduction and background

In slum settlements of Kampala and Mukono, the major risk factor for diarrheal diseases is contaminated drinking water due to poor latrine status, low safe water coverage, and poor domestic and personal hygiene practices. The majority of community members have insufficient knowledge on the link between water, sanitation, hygiene and health evidenced by the frequent epidemics of cholera and a high incidence of diarrheal diseases particularly in children under 5 years. To address these challenges, Makerere University School of Public Health in partnership with University at Albany, State University of New York, USA and Tuskegee University, Alabama, USA are implementing this project to promote safe drinking water supply, sanitation and hygiene among two urban slum areas in Kampala district and Mukono municipality.

Objectives

The general objective for the project is to improve the health status of the inhabitants of the two communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities through community pro-active and sustainable interventions.

This baseline survey aimed at examining the socio-economic and cultural factors and practices that result into the current environment and community health status; analyzing the linkages between the bio-physical factors and health status.

Survey methods

The survey was cross-sectional in nature involving both qualitative and quantitative data collection methods conducted in Basiima Kikooza, Kiteega, Lweza and Ngandu zones, Mukono Municipality. A total of 111 households were involved in the survey. 12 key informant interviews and 4 FDGs were held. Drinking water, soil and stool samples from children with diarrhea were collected from the households and analysed.

Summary of findings

- Both protected (45.9%) and unprotected springs (38.7%) were the most used water sources by the community.
- Most households (96.4%) had a latrine they used as a household or shared with other households, although the sanitary status found at majority of the latrines was poor. Availability of hand washing facilities at latrines was also extremely low.
- The majority of households (91.9%) boiled their water to ensure that water was safe for drinking. Only approximately 50% of households had water quality that met the bacteriological standards, with some samples (28.8%) having high contamination with too numerous to count colony forming units.
- Female spouses were mainly responsible for household water collection, household rubbish collection and domestic waste disposal.
- The majority of households (61.3%) used open pits for refuse disposal where it eventually got burnt. The use of public garbage skips for waste collection was very low.
- Private clinics and drug shops were the first choice of health facility for the majority of households (71.2%) that sought healthcare.
- Radios were the primary source of health, hygiene and sanitation information. The most preferred language for health education was *Luganda*.

Conclusions

- Most households had latrines although the sanitary status found at majority of them was poor.
- Boiling of water was the method most used by households to ensure that it was safe for drinking. The drinking water from half of the households was to safe to drink.
- Springs (protected and unprotected) were the most commonly used water sources by the community.
- Female spouses were mainly responsible for household water collection, household rubbish collection and domestic waste disposal.

- Solid waste disposal was mainly by use of open pits and thereafter burn the waste. The use of public skips for waste disposal was very low.
- Private clinics were the first choice health facility for households seeking healthcare.
- Radios were the primary source of health, hygiene and sanitation information.

Recommendations

1. The project should health educate the community on the best practices in safe water, sanitation and hygiene at household levels.
2. *Luganda* should predominantly be used while carrying out health education among the community.
3. The project can explore the use of mass media particularly radio to pass on health information to the community.
4. The project should sensitize parents to always keep the immunization cards of their children.

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Chapter One

Introduction and Background

1.1 Introduction

Between 1900 and 1930 total mortality in the US fell from 17.5 to 8 deaths per 1,000 population (McKinlay and McKinlay, 1977). This was a period prior to there being any effective antibiotics, prior to most immunizations and certainly prior to the current excellent but expensive modern medicine. The reason is almost entirely the provision of clean drinking water and improved general sanitation. The decline in total mortality in the US in this 30 year period is greater than any proportional improvement at any time since, even with the development of high-tech medicine. Thus access to clean drinking water is one of the most important factors in determining the health of a population.

Drinking water can come from only two natural sources: ground water and surface water. Whereas ground water is usually less contaminated than surface water, primarily because of the natural filtration through soil, both are vulnerable to contamination with infectious organisms as well as chemical contaminants. Therefore, one cannot discuss safe drinking water without considering the sources of contamination.

Although internationally recognized, the term “sanitation” is usually used in the narrow sense of excreta disposal, excluding other environmental health interventions such as solid waste management and surface water drainage. In this study, solid waste management and surface water drainage are considered as components of sanitation and as being relevant in the efforts to deliver clean drinking water.

Worldwide, low-income populations inhabit the fringes of cities and often these settlements transform into slum settings. Rapid growth of slums has become a global concern (UN-HABITAT, 2003; UNDP, 2003). In particular goal 7, target 11 of the millennium development goals, aims at significantly improving the lives of at least 100

million slum dwellers by the year 2020 (UNDP, 2003). The majority of this population resides in low income countries, accounting for 43% of the urban population, in contrast to 6% in high income countries. Sub-Saharan Africa had the largest proportion of the urban population resident in slums, which reached 71.9% in 2001 (UN-HABITAT, 2003). The worldwide number of slum dwellers increased by 36% in the 1990s to 923 million people. At its current pace, the number could double to 2 billion by 2030 (Beth, 2009).

As cities continue to expand and the economic situation deteriorates, the poor are pushed to the outskirts which are congested, unplanned and inadequately provide infrastructure and services. This is particularly true of Sub-Saharan Africa cities. Furthermore, the continued rural-to-urban migration of a predominantly poor population, the bulk of who are engaged in informal economic activities, has accelerated the growth of slums. The government of Uganda has launched a national Urban Campaign with a pledge to promote policies that would provide more access to housing and services for the urban poor.

Slums are characterized by problems that only vary in magnitude from one place to another. Slums are conspicuous for environmental decay, giving rise to unprecedented health risks to communities. Clear manifestations of the fast declining health status triggered by the degradation in the ecosystem in slums in Uganda, and especially in Kampala, are evidenced by the epidemics of cholera and typhoid, and a high incidence of diarrheal diseases with a case fatality rate of 2.5% and causing 19% of infant deaths (Alajo *et al*., 2006). Other ill health conditions common in slums which affect mostly children under 5 years include malnutrition, malaria and pneumonia.

Slum dwellings are characterized by the following problems: poor solid waste management, inadequate excreta management, insufficient drinking water management, unsatisfactory wastewater management, unequipped drainage especially of storm water, poor housing conditions, unsafe food safety and nutrition, undesirable vector and vermin control, and unhealthy personal and general hygiene.

According to the Uganda Demographic and Health Survey (2006), only 15% of the households in urban areas have improved and non-shared toilet facilities. This leaves most of the households in urban areas using non-improved facilities such as pit latrines without slabs and are shared facilities with other households that are very often unhygienic and foul smelling.

Water is an important component of sanitation and it impacts the health status of the population. Unsafe drinking water causes diseases which can be classified as water or excreta related. Many are both. Diseases such as cholera, typhoid, dysentery, diarrhea, guinea worm and hookworm infestations commonly occur in Mukono. The environmental conditions in slums of Mukono municipality are very similar to those in Kampala where in the past decade, cholera epidemics have been experienced almost every year. In 2008, there were 101 reported cholera cases and 8 deaths in Kampala. Although the figures are low for Mukono, the environmental sanitation conditions have degraded tremendously in the area that risks could relatively be close to those of Kampala. Cholera is almost always caused by consumption of contaminated drinking water. The major factors leading to contamination of the drinking water are low latrine coverage, low safe water coverage and poor domestic and personal hygiene practices (MoH, 2004/05).

1.2 Background

While there has been rapid growth of a poor population in the slums in Africa, and in Uganda in particular, slums lack adequate safe drinking water and sanitation services, leading to poor personal and general hygiene. The situation is aggravated by the fact that urban authorities lack the resources to satisfactorily provide the required services and infrastructure. As a result slums have become breeding grounds for disease, making the search for solutions to improve health in slums an utmost urgency. In addition to poor environmental health in Ugandan slums, worsening poverty has led to poor nutrition which particularly affects children, making the control of diseases related

to poor nutrition difficult. In response to this, temporary clinics are often established to handle immediate cases. These clinics, however, are far from satisfactory in terms of resources, facilities, and health personnel and cannot be sustained for a reasonable period of time. This further worsens the condition as these illnesses are poorly managed, contributing to the high infant mortality rate. The envisaged plausible solution to which this project is targeted is to seek solutions within the affected communities in order to improve the prevailing poor environment in slums as a deliberate effort to improve community health.

This project is targeting Kikulu zone, Kawempe division, Kampala city; and Basiima Kikooza, Kitega Lweza and Ngandu villages in Mukono municipality. The goal of the project is to improve the health status of the inhabitants of these communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities.

Both study areas in Kampala and Mukono (more so Kampala) are characterized by floods after every heavy rain downpour. The inadequacy of drainage channels coupled with blockage of those in existence creates ideal conditions for flooding. The major health risk factors among the project communities in Kampala and Mukono are low latrine coverage, low safe drinking water coverage, and poor domestic and personal hygiene practices.

1.2.1 The Water Situation at Present

The communities of Kikulu zone and those in Mukono Municipality rely on piped and/or non-piped drinking water sources. The water sources include springs, some of which are unprotected, boreholes, wells and streams. Some of these are liable to flooding during rains. In addition, access to water at some points is limited because there are user fees associated with drawing water, and many poor people cannot afford to pay these fees. This forces some people, especially the very poor, to continue to use

alternative traditional sources which are of poor quality. Some people are not within easy distance to the water sources, often being beyond 1.5 kilometers, the maximum distance set in the National Water Policy. Studies have shown that the distance to the source is a major factor determining the quantity of water used in a household (MWLE, 2003).

At some water points, physical access is also a problem both at the exact points and/or the foot paths leading to the point. Community members with physical disabilities as well as children are most likely given the role of fetching water and may not be able to collect water without assistance. Women and children may feel insecure when traveling to isolated locations which limit them from gaining access as much as they would like, and consequently reducing the amount of water used or being driven to alternative unsafe water sources.

Some of the water points, particularly the piped water supply, have an irregular supply, sometimes for a limited number of hours in a day. There is also the problem of crowding at water points, which leads to extended collection times that reduces time for tending to other tasks. Both of these circumstances affect the quantity of water used for domestic purpose. The construction of some water points is substandard, and the poor hygienic conditions in surrounding areas can easily cause contamination of water sources.

In these settlements where piped water is available, it is not regularly or properly tested. This situation could be improved if more hard data were available on the quality of drinking water sources. However, the cost and technical complexity of water testing and treatment has presented real barriers to the wider and more systematic use of these tools in the detection and prevention of water-borne bacteriological health risks.

1.2.2 Sanitation in Kampala and Mukono

In both slum settlements of the study areas in Kampala and Mukono in Uganda, the major risk factor for diarrheal diseases is contaminated drinking water due to low latrine coverage, low safe water coverage, and poor domestic and personal hygiene practices. As a result of poor planning, often the location of pit latrines and other sanitary facilities is such that they end up contaminating the drinking water sources. The majority of pit latrine facility users have insufficient knowledge of the link between fecal matter and health, making the utilization and maintenance of such facilities poor.

There are very few latrines, with many being shared between families in tenements. Many pit latrines are not constructed to recommended standards and this predisposes them to collapse and / or quick filling and infestation with flies, cockroaches and mosquitoes. In some areas of these slum settlements, “flying toilets “are used. Flying toilet is a practice that involves defecation in a plastic bag, which then gets thrown away indiscriminately at night.

While the linkage between water quality and disease is not well appreciated at the community and household levels, waterborne diseases constitute a major public health burden for communities in Uganda, often leading to serious epidemics of diarrhea, typhoid and cholera. Inadequate training, lack of appropriate equipment and facilities for water quality testing and treatment at the source and at household levels, inadequate budget allocations for water quality testing and management, low levels of public awareness and poor enforcement of legislation regarding safeguarding water quality and source protection all contribute to the poor state of water quality management.

Poor infrastructure and poor urban services in urban settlements often result in a poor environment and poor community health. Diarrheal diseases, especially among children below 5 years, are among the major diseases identified.

The factors direct the project and are the focus of the environment and health improvement interventions at the study sites. By enabling these communities to achieve

safer drinking water and sanitation, this project will contribute to a more equitable and sustainable development – economic, social and environmental.

1.3 Statement of the problem and justification

In both slum settlements of Kampala and Mukono, the major risk factor for diarrheal diseases is contaminated drinking water and food, due to low latrine coverage, low safe water coverage, and poor domestic and personal hygiene practices. The majority of the community members have insufficient knowledge of the link between water, sanitation, hygiene and health, evidenced by the epidemics of cholera and typhoid, and a high incidence of diarrheal diseases particularly in children under 5 years.

The project is enhancing the human and institutional capacity building at Makerere University while targeting improvements in both the environment and the health of the selected communities.

The project is focused on providing education and local empowerment in these communities by helping residents understand the causes of disease.

By enabling these communities to achieve safer drinking water and sanitation, the project is contributing to a more equitable and sustainable development – economic, social and environmental.

1.4 General Objective

To improve the health status of the inhabitants of the two communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities through community pro-active and sustainable interventions.

1.5 Specific objectives

Baseline phase

- Examine the socio-economic and cultural factors and practices that result into the current environment and community health status in the two study sites.
- Analyze the linkages between the bio-physical factors and health status in the two study sites with a focus on diarrheal diseases.

Intervention phase

- Initiate and pilot community based health interventions for reducing morbidity due to ill health with specific emphasis on diarrheal diseases.

1.6 Performance Objectives

1. To survey the water sources and sanitation facilities available in the study areas.
2. To estimate the current incidence of selected water-borne and excreta diseases in the population with an emphasis on children.
3. To identify risk factors associated with identified water and excreta related diseases in these specific communities.
4. To determine constraints limiting access and proper utilization of water and sanitation facilities which impede hygiene conditions in the study areas.
5. To use the information obtained to promote policies that will address the infrastructural and educational issues within the governments of Uganda and other nations.

Chapter Two

Baseline survey methods

2.1 Survey area

The baseline survey was conducted in Mukono Municipality which is within Mukono District. Mukono District has a population of 59,000 (Mukono District Plan, 2009/2010).

Four villages from Mukono Municipality were included in the survey. The four villages that qualified as urban slums were Basiima Kikooza, Kiteega, Lweza and Ngandu.

2.2 Survey population

The study population were households in the 4 villages. The respondents for the survey were household heads or the next responsible adult found at home at the time of data collection. Key stakeholders in the areas of water and sanitation including local leaders, NGO/CBOs, and health personnel were also involved in the survey as key informants.

2.3 Survey design

It was a cross-sectional survey that involved collecting both qualitative and quantitative data. Qualitative data was collected from key informant interviews and focus group discussions. Quantitative data was obtained from the household assessment questionnaires and checklists.

2.4 Survey sample size

2.4.1 Household sample size

The sample size of households that were involved in the survey was calculated using the formula of cross–sectional studies. The formula was derived by Kish Leslie (1965); however it was modified to incorporate a power calculation. The formula is as follows.

$$n = \frac{z^2 pq}{d^2} = \frac{z^2 p(1-p)}{d^2}$$

Where;

q = 1-p

z = standard critical value at 95% confidence (1.96)

n = sample size

p = since there is no accurate data on sanitary facility coverage specific to Mukono, a prevalence of 50% was assumed

d = Level of precision; for the study we selected a precision of 10%.

$$\frac{(1.96^2 \times 0.5 \times 0.5)}{0.1^2}$$

= 96 households

A total of 111 households were considered for the survey.

2.4.2 Key informants' sample size

A total of 12 key informants were considered for the baseline survey.

2.4.3 FGD participants sample size

A total of four (4) FGDs were conducted for the different categories of populations in the community. The categories were adult male, adult female, male youth and female youth. Each FGD had 7 – 9 participants.

2.5 Sampling procedure

2.5.1 Household interviews

A total of 111 respondents were involved in the survey. The number of households obtained from each village was proportionate to the slum establishments existing in the areas. In each village, the relative central point was the starting point and data collectors moved spirally outwards skipping one household. Only households with children below five years were eligible to participate in the survey. In the event that a household did not have a child under five years, the next household which met that criterion was selected.

2.5.2 Key informants

These were chosen from a section of people who were well informed about the different aspects of the survey including water, sanitation and hygiene. The categories among which these key informants were selected included local leaders, religious leaders, teachers and health workers.

2.5.3 FGD participants

The FGDs were categorized as adult men, adult female, youth male and youth female. A representative number of FGD participants was chosen within each village while ensuring that the entire village was represented. The ages were all representative in the respective categories of the FGDs

2.6 Data and data collection

2.6.1 Data types

Primary data was collected from the field while secondary data was obtained from document review. Primary data was both qualitative and qualitative. Quantitative data was collected using household questionnaires and observational checklists while qualitative data was collected from key informant interviews and focus group discussions.

2.6.2 Data collection tools

Household questionnaires were used to collect data from the households. Key Informant Interview guides and Focus group discussion guides were used to collect information from key informants and FGD participants respectively. Observational checklists for different aspects were used to make key observations relevant to the study.

2.7 Data collection procedure

2.7.1.1 Questionnaire administration

Household questionnaires were administered to the household heads or the adult next of kin found at the household during the time of the survey. The interviewer asked questions and recorded responses as mentioned by the respondent.

2.7.1.2 Focus group discussions

For the FGDs, there was a Chairperson and two Secretaries. The Chairperson moderated the discussions while the Secretaries took notes which they later compared and merged. The discussions were also tape recorded and later transcribed for inclusion in the report.

2.7.1.3 Observations

The use of observation checklists entailed data collectors making key observations using their senses majorly sight and smell. In this aspect of data collection, the judgment of the data collectors was very crucial.

2.7.2 Water sample collection

Water samples were collected from all the sampled households that were visited. Specifically, the water samples were got from the drinking water storage facilities that each individual household used.

Equipment for water sample collection included:

1. Sterile water sample collection bottles (300ml)
2. Cooling box for storage of the collected water sample.
3. Sample labels

Procedure:

- The sterile sample collection bottles were kept in a cooling box.
- At the point of collection of the water sample, the data collector carefully opened the sample bottle and collected the sample.

- The sample was coded with a number corresponding with that of the household where it was obtained then placed in the cooling box.
- Collected samples were then transported to the laboratory for analysis within 2 hours.

2.7.3 Stool sample collection

Stool samples were collected from only the children under five years who had diarrhea at the time of the survey.

Materials and equipment for stool sample collection were:

1. Stool sample collection bottles (50ml) (with a scooping spoon)
2. Cooling box for storage of the collected stool sample.
3. Sample labels
4. Hand gloves
5. Polythene bags

Procedure:

- After establishing that the child had an episode of diarrhea in the past 24 hours, the mother was requested to give the child his or her usual defecation facility (potty, paper or any other material) for the child to defecate while other interviews continued.
- After the child had defecated, the data collector then put on gloves, opened the sterile stool sample bottle and scooped at least ten (10) spoonfuls of the stool. The data collector then closed the stool sample bottle tightly, sealed it in transparent polythene then put the sample in the cooling box.
- The gloves were then removed carefully and place in a black polythene. The data collector then washed hands thoroughly with soap before proceeding with any other activity.

2.7.4 Soil sample collection procedure

Soil samples were got from all the households that were sampled for the survey. The choice of the specific location where the soil sample was got was on the basis of the

information about the place where children mostly played from within the household compound. This information was obtained from the respondent.

Materials and equipment for soil sample collection were:

1. Meter rule
2. Trowel
3. Polythene bags for sample collection
4. Sample labels
5. Gloves

Procedure:

- At the identified location within the household compound where children play from, the data collector measured a 60 cm sq on the ground using the meter rule with gloves on.
- The data collector then clearly demarcated the square using the trowel and removed any big materials of more than 5 cm^3.
- Using the trowel, the top soil was scraped from all the corners of the demarcated square towards its center.
- The collected soil was then placed in the small polythene bag and labeled.
- The soil samples were put in a lager polythene bag for laboratory analysis.
- The data collectors then removed the gloves and washed their hands with soap before proceeding with any other activity.

2.8 Data analysis

2.8.1 Household questionnaires

Data from questionnaires was edited and entered in Epidata software. The entered data was cleaned and transferred to SPSS for Windows version 17.0 for analysis using Stata transfer version 10.

2.8.2 Water sample analysis

Standard bacteriological procedures for water quality testing were adopted. The parameters that were examined for were colony forming units (CFU/50ml).

2.8.3 Stool sample analysis

Standard procedures for stool sample analysis were adopted. The analysis techniques of the stool samples included macroscopy, microscopy, modified ZN stains and culture and antibiotics sensitivity testing. The organisms investigated for in the stool sample analysis included ova, cysts, yeast cells and oocysts.

2.8.4 Soil sample analysis

Standard procedures for soil sample analysis were adopted. The organisms investigated for in the soil sample analysis included ova, cyst or larvae of any pathogenic organism.

2.9 Quality control and assurance

A team of ten (10) competent and experienced data collectors was involved in this survey. These were trained for four days to ensure that the data collection was done accurately. Experienced trainers for the different data collection aspects including stool, water and soil sample collection were brought to train the data collectors.

During the data collection, the data collectors were paired to ensure that there was efficiency in the data collection process at household level.

The survey supervisors closely followed the work of the data collectors throughout the entire process and at the end of each day, held debriefing meetings to share experiences to improve on the process whenever there was need.

2.10 Ethical considerations

The project got approval from University at Albany, State University of New York Institutional Review Board (IRB Protocol Number: 10-138).

Ethical approval was also obtained from Makerere University School of Public Health Higher Degrees, Research and Ethics Committee. Research clearance was also obtained from the Uganda National Council for Science and Technology.

Several meetings were held with the community local leaders informing them about the project and the baseline survey activities.

All the respondents who participated in the survey did so only after clearly understanding the purpose of the survey and giving a written consent.

For the children who were involved in the survey especially those who gave the stool samples, an assent form was signed by the parents before providing the stool sample.

Chapter Three

3.0 Baseline survey results and discussion

3.1 Socio demographic characteristics of the respondents

The socio-demographic characteristics of the respondents that participated in the survey are summarized in Table 3.1.

Table 3.1: Socio-demographic characteristics of the respondents

Variable	Details	Frequency (N = 111)	Percentage (%)
Village / zone	Basiima Kikooza	63	56.8
	Kiteega	20	18.0
	Lweza	14	12.6
	Ngandu	14	12.6
Sex	Male	6	5.4
	Female	105	94.6
Marital status of Household head	Never married	12	10.8
	Married / cohabiting	94	84.7
	Widowed	2	1.8
	Divorced	1	1.0
	Separated	2	1.8
Age of respondent (years)	19-24	26	23.4
	25-34	66	59.5
	35-44	16	14.4
	45-54	1	1.0
	65+	2	1.8
Religion of respondent	Catholic	32	28.8
	Anglican	42	37.8
	Pentecostal	12	10.8
	Muslim	20	18.0
	Other	5	4.5
Highest education level attained by respondent	None	6	5.4
	P1-P7	45	40.5
	Senior 1-4	51	45.9
	Senior 5-6	3	2.7
	College (post Senior 4)	1	0.9
	College (post Senior 6)	2	1.8
	University	3	2.7
Region (District) of origin/birth of respondent	Kampala	1	0.9
	Central	82	73.9
	Eastern	19	17.1
	Western	9	8.1
Duration of stay in the area (years)	Less than 1 year	11	9.9
	1-3 Years	37	33.3
	3-5 Years	13	11.7
	More than 5 years	50	45.0

A total of 111 respondents participated in this baseline survey of which majority (94.6%) were females. Many of the women were housewives and were found doing domestic work. The majority of respondents (59.5%) were aged between 25-34 years. Nearly half of the respondents (45%) had lived in the area for more than five years. This is an indication that many of the respondents reliably knew about the water and sanitation situation of the area. A high proportion of the respondents (84.7%) were married / cohabiting and the majority were Christians, with Anglicans (37.8%) constituting the biggest portion.

More than half of the respondents had at least attended secondary education. This reflects the relatively high level of literacy in the area. In the Uganda Human Development Report (2007), it was reported that the adult literacy rate for Mukono district stood at 78.8% a figure above the national average of 69%. It is anticipated that the higher the education level, the more an individual is able to make right choices in terms of water and sanitation. For example, the highly educated are expected to be more judgmental and probably know the benefits of hygiene and sanitation within their households.

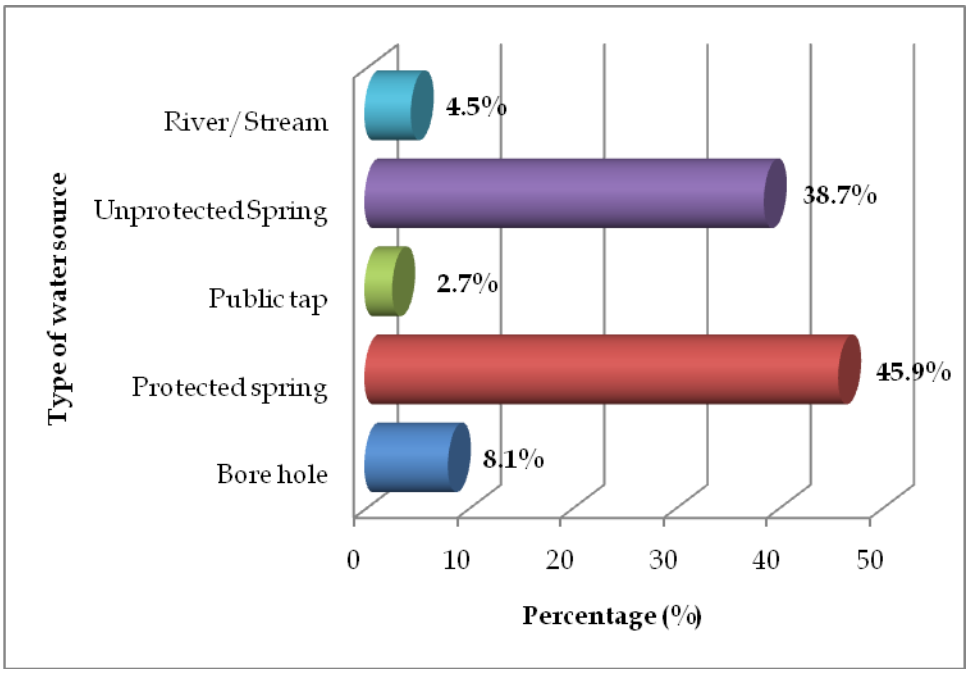
3.2. Water, Hygiene and Sanitation situation

3.2.1. Water Sources

3.2.1.1. The main sources of water for households

The main sources of water used by the respondents are shown in Figure 3.1.

Figure 3.1 Main sources of water for domestic use



Both protected (45.9%) and unprotected (38.7%) springs were the main sources of water in the study area. Only 2.7% utilized public taps as their main source of water. This finding reveals that very few respondents used public taps yet being in an urban setting, it is normally expected that residents have access to piped water supply. The use of unsafe sources such as unprotected springs and streams is associated with high incidences of diarrheal and related diseases. It is therefore important to sensitize the people on the effects that may arise from using unsafe water sources. The local authorities should also use available resources to invest in protecting springs that are not yet protected. Residents should continuously be encouraged to boil all their drinking water before consumption because even the protected springs had defects that predisposed the water to contamination.

From one of the focus group discussions, it was elaborated that:

> *"…… the most used water sources in the community are springs. This is because connecting to piped water is expensive and yet the boreholes are not good yielding with people having to queue for a long time before getting water."* (Female FGD, Lweza village)

According to UNICEF/WHO Joint Monitoring Programme for Water Supply and Sanitation (2004), improved drinking water sources include household connection, public standpipe, borehole, protected well, protected spring and rain water collection. Unprotected springs and streams are categorized as unimproved drinking water sources. The findings show that 43.2% of the respondents were using unimproved water sources. This finding is of public health significance since use of such water sources in many communities has been known to be the commonest channel of spreading diarrhea, dysentery, typhoid, cholera, worm infestation and other hygiene related diseases.

On physical inspection of the protected springs, some had poor drainage of water that led to wastewater collecting at the water collection chamber (see photos below). This could easily lead to contaminating the water during collection from the spring outlet.

Residents drawing water from unsafe springs

3.2.1.2. Distance of water sources from households

The distance of the different water sources used by the community from the households is shown in Table 3.2.

Table 3:2: Distance of the different water sources from the households

Type of water source	Distance of water source from household			Total
	Less than 1km	1-2km	Greater than 2km	
Borehole	9	0	0	9
Protected spring	24	3	24	51
Public tap	1	0	2	3
Unprotected spring	18	0	25	43
Stream	1	0	4	5
Total	53	3	55	111

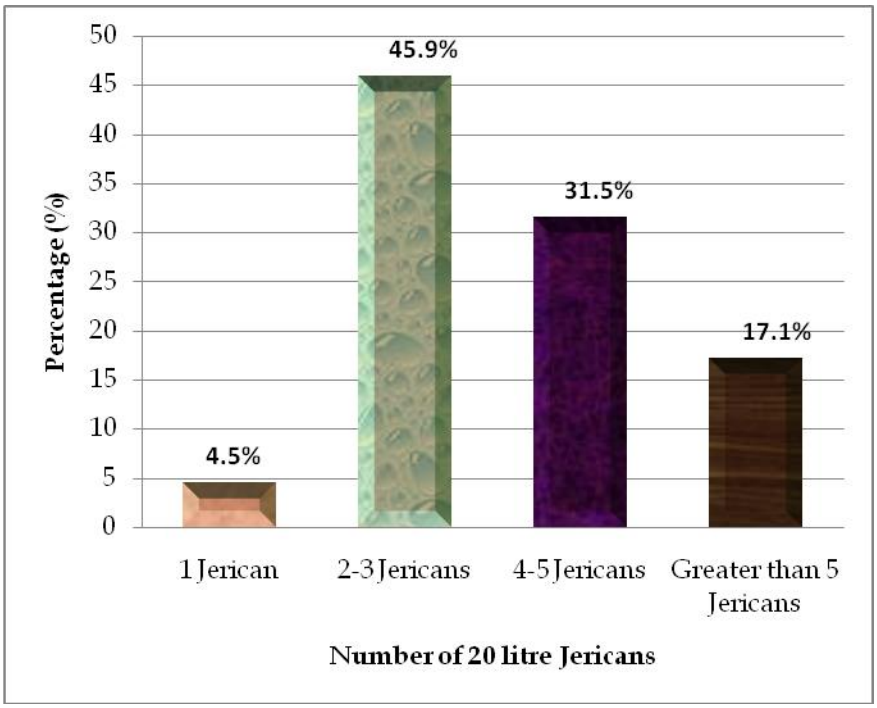
The majority of unprotected springs (58%) and protected springs (47%) were on average located at a distance greater than 2 km from the respondents' households. Studies carried out elsewhere have shown that communities traveling long distances to collect water will reduce their intake, and also resort to use less safe water sources (Water and Sanitation Program, 2007). UNICEF/WHO Joint Monitoring Programme for Water Supply and Sanitation (2004) recommends safe water sources to be located within a radius of 1km or a 30 minute round trip distance from the household. Locating safe water sources within recommended radius from the households makes the safe water sources more accessible and in a way encourages communities to use them instead of reverting to the unsafe water sources.

Some of the unprotected springs used by the community

3.2.1.3 Estimated amount of water used in households per day

The survey established the estimated amount of water used in each household as shown in Figure 3.2.

Figure 3.2: Estimated amount of water used in households per day



Majority of respondents (45.9%) used 2-3 twenty liter jerrycans of water per day. The actual per capita consumption of water per day would depend on the number of people in each household. It is recommended that there should be at least 20 liters per capita per day use of water which is considered to be basic access in the general population (Water and Sanitation Program, 2008).

3.2.1.4 Payment for water

For respondents who paid for water, the amount paid per 20 liters was established as shown in Table 3.3.

Table 3.3 Amount of money paid per 20 liters of water

Amount of money paid per 20 liter jerrycan (UGX)	Frequency (n = 62)	Percentage (%)
50	1	1.6
100	41	66.1
150	12	19.4
200	8	12.9

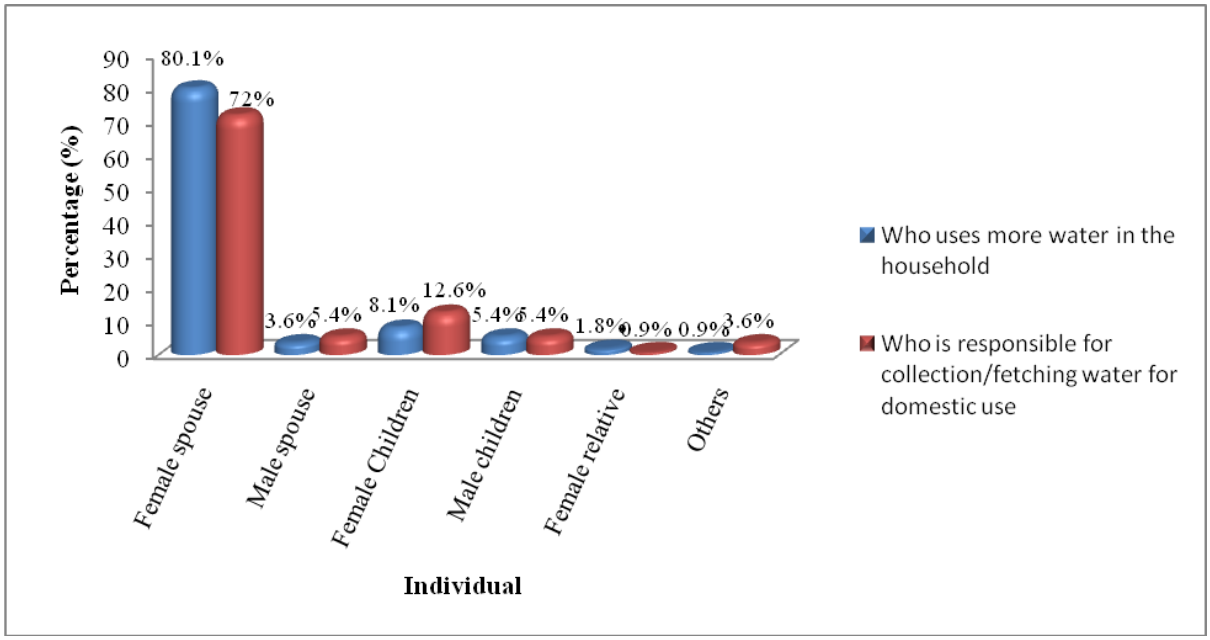
The majority of respondents (66.1%) bought a 20 liter jerrycan of water at 100 Uganda shillings (approximately 4 US cents). Although this seems to be a reasonable charge for a jerrycan of water, many people cannot afford it and may opt to use free sources that are unsafe. Indeed, it was revealed during the FGDs that the water from National Water and Sewerage Corporation (public taps) was very expensive as cited below:-

> "*The cost of water from public taps is really expensive for us. In addition, the public taps are generally few within the community.*" (Male FGD, Basiima Kikooza village)

3.2.1.5 Person responsible for fetching water and using more water in households

The survey established the person who collected water for the household and the one who used more water (Figure 3.3).

Figure 3.3: Person responsible for fetching water and using more water in a household



Female spouses used more water in the household (80%) and were also mainly responsible for its collection. This finding is in agreement with the culture in most African settings where it is usually customary that most household tasks and responsibilities such as fetching water, cooking and washing is the responsibility of a woman and the girl child. It was noted that the girls (12.6%) engaged in fetching water more than the boys (5.4%)

3.2.1.6 Water sources used for domestic purposes

The water sources used by the respondents for various household activities are shown in Table 3.4.

Table 3.4 Water sources used for drinking, cooking, bathing, laundry and dish washing

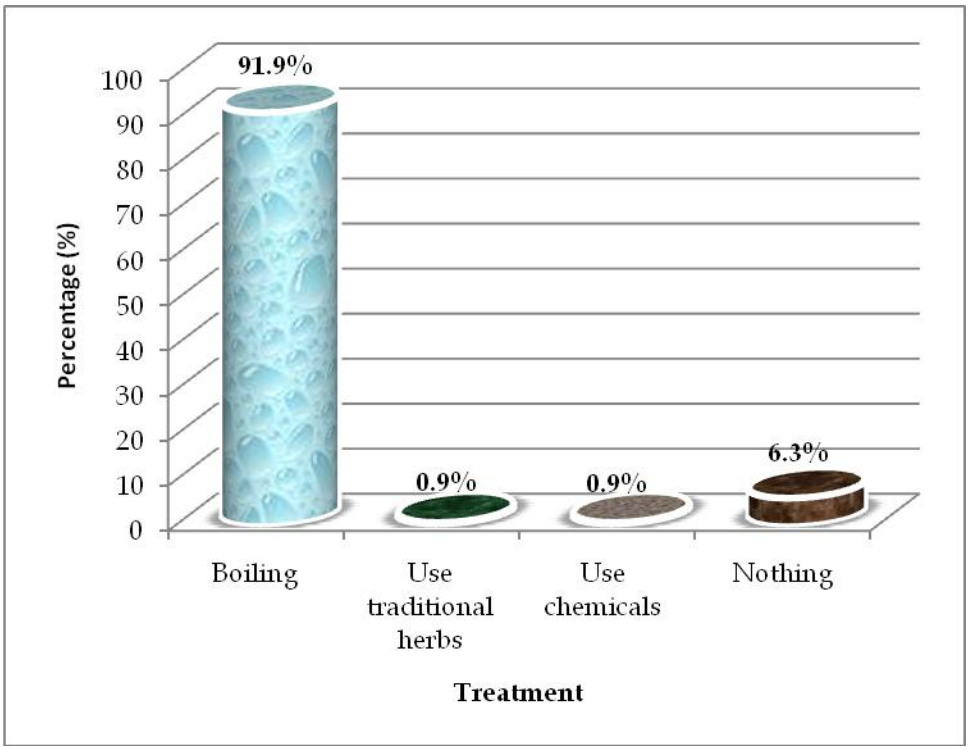
Type of water source	Uses of water									
	Drinking		**Cooking**		**Bathing**		**Laundry**		**Dish washing**	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Borehole	8	7.2	9	8.1	9	8.1	9	8.1	9	8.1
House tap	3	2.7	2	1.8	2	1.8	2	1.8	2	1.8
Public tap	41	36.9	38	34.2	39	35.1	38	34.2	39	35.1
Spring	52	**46.8**	53	**47.7**	52	**46.4**	52	**46.8**	52	**46.4**
Stream	1	0.9	0	0	0	0	2	1.8	0	0
Others	6	5.4	9	8.1	9	8.1	8	7.2	9	8.1
Total	**111**	**100**	**111**	**100**	**111**	**100**	**111**	**100**	**111**	**100**

The highest number of respondents used spring water for drinking, cooking, bathing laundry and dish washing. This was followed by use of public tap water. The springs were the most preferred water source because people do not pay for the water yet springs are available in all the four survey villages.

3.2.1.7 Household water treatment

The measures taken by households to render water safe for drinking were also investigated and results are shown in Figure 3.4.

Figure 3.4 Action taken to make drinking water safe

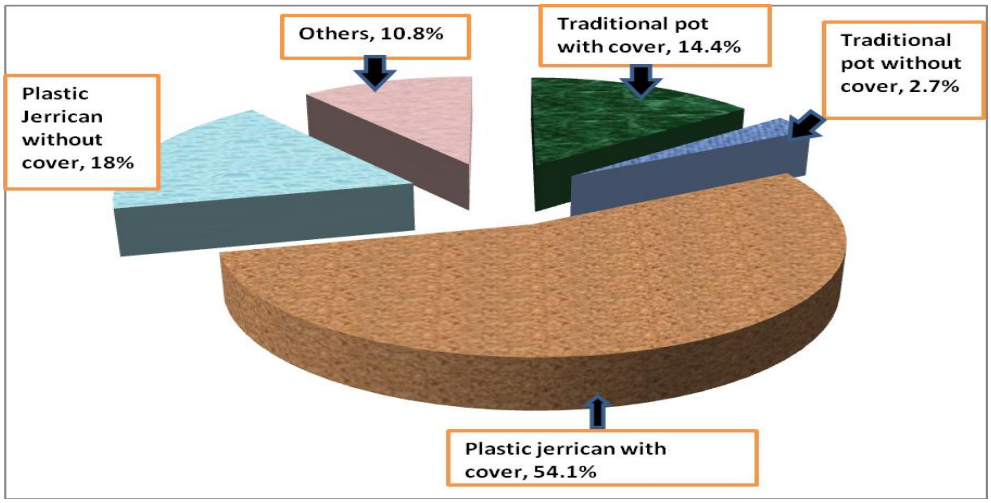


Nearly all the respondents (92%) indicated they boiled water before drinking. Boiling water helps to kill pathogens and makes it safe to drink. Boiling water for drinking is a good practice which should be encouraged among the entire community. The respondents whose households did not treat water before drinking need to be sensitized on the effects of drinking unsafe water which may include but not limited to diarrheal related diseases such as dysentery, cholera, typhoid; socio economic costs including households paying large sums of money for treatment of water and sanitation related diseases; and time lost taking care of the sick household members.

3.2.1.8 Drinking water storage facilities

The drinking water storage facilities of the households were also investigated, and results are shown in Figure 3.5.

Figure 3.5 Drinking water storage facilities



The majority of households (54.1%) stored their water for drinking in plastic jerrycans that had covers. Covering water storage containers is very important because it stops dust and other contaminants from falling into the drinking water. Using plastic containers with narrow openings for storage of drinking water reduces the chances of fingers coming in contact with drinking water.

3.2.1.9 Cleaning of drinking water storage containers

The frequency of cleaning drinking water storage containers is shown in Table 3.5.

Table 3.5 Frequency of cleaning drinking water storage containers

Variable	Frequency	Percentage (%)
Every day	19	17.1
Twice a week	40	36.0
Weekly	11	9.9
Every two weeks	1	0.9
Every month	2	1.8
Rarely	4	3.6
Don't know	34	30.6
Total	**111**	**100**

Although a significant number indicated that they cleaned their containers regularly, ranging from daily (17.1%), two times a week (36%) and weekly (9.9%), it was also noted that a good number (30.6%) did not know how often they cleaned their

containers. The Ministry of Health Sanitation Guidelines of 2000, recommend that drinking water storage containers should be cleaned at least once a week.

3.2.1.10 Methods of cleaning drinking water storage containers

The methods used by households in cleaning their drinking water storage containers are shown in Table 3.6.

Table 3.6 Methods of cleaning the drinking water storage facilities

Cleaning methods	Drinking water storage Container					Total
	Traditional pot with cover	Traditional pot without cover	Plastic jerrycan with cover	Plastic jerrycan without cover	Others	
Rinsed with plain water	2	0	1	0	0	**3**
Rinsed with soapy water	0	2	7	8	1	**18**
Scrubbed and rinsed with plain water	7	0	4	1	0	**12**
Scrubbed and rinsed with soap water	4	0	48	10	9	**71**
Others	3	1	0	1	2	**7**
Total	**16**	**3**	**60**	**20**	**12**	**111**

A high proportion of respondents (63.9%) cleaned the drinking water storage containers by scrubbing and rinsing with soap water. This is a good practice which should be promoted as soap contains properties that can kill microorganisms.

3.2.1.11 Bacteriological quality of drinking water

The bacteriological quality of the water obtained from drinking water sources of the households was investigated and results are shown in Table 3.7.

Table 3.7 Bacteriological quality of drinking water

CFU* / 50mls of water	Frequency	Percentage (%)
0 CFU/50mls	56	50.5
< 10 CFU/50mls	7	6.3
11 - 50 CFU/50mls	11	9.9
51 - 100 CFU/50mls	4	3.6
101 - 200 CFU/50mls	1	0.9
TNTC**	32	28.8
Total	**111**	**100.0**

* CFU – Colony Forming Unit

** TNTC - Too numerous to count

Only slightly over half of the households (50.5%) had safe drinking water free of coliforms, with the rest containing colony forming units ranging from about 10 CFU/50mls to too numerous to count results. This indicates that a significant number of households have their water very contaminated and unsafe for consumption if not boiled. The suggestion of sensitizing the community to boil their drinking water is certainly of paramount importance.

3.3 Sanitation facilities

3.3.1 Presence, type, location and use of bathroom

The types of bathrooms used by the households are shown in Table 3.8.

Table 3.8 Type of bathroom

Type of bathroom	Frequency	Percentage (%)
Inside the house	9	8.1
Outside the house (built with blocks)	87	78.4
Outside and makeshift in nature	13	11.7
None	2	1.8
Total	**111**	**100**

More than three quarters of the households (78.4%) had permanently constructed bathrooms that were located outside their houses. Some were of a “makeshift” nature (12%), being made of materials ranging from plastic sheeting to old metallic plates.

Among the households with outside bathrooms, 84% shared them with 1 to 5 households, 12% with 6-10 households while 2% reported that the bathrooms were being shared by 11-20 household. Sharing of bathrooms can have the challenge of maintaining their cleanliness as some households may not carry out this responsibility.

3.3.2 Presence of latrines

Almost all the respondents (96.4%) reported having a latrine that their household used. This could indicate that the community is aware about the importance of having a latrine for proper disposal of human excreta. However, it must be noted that some studies have shown that latrine construction is easier to achieve than its use. Proper latrine use is a behavior issue which goes beyond existence of a physical structure (Bufardereci *et al*, 1991).

The respondents (3.6%) who had no latrines reported using those of their neighbors. The major hindrance limiting some families to construct latrines is poverty. A similar finding was highlighted during a focus group discussion that:

> *"…. some people don't have latrines because they don't have money to construct them. They end up sharing with neighbours or using the bushes. It's actually very expensive digging a latrine".* (Females FGD, Lweza village)

3.3.2.1 Sanitary situation of the latrines

In all the households that were involved in the baseline survey, a sanitary inspection of the latrine used by the inhabitants was done and the findings are indicated in Table 3.9.

Table 3.9 Sanitary situation of the latrines

No.	Parameter	N = 111	Percentage (%)
1.	Latrine was more than 5 meters from the house	47	42.7
2.	Latrine had no proper access leading to it	42	38.2
3.	Latrine lacked a door	36	32.7
4.	Latrine lacked a roof	16	14.5
5.	Latrine lacked a hole cover	94	85.5
6.	Latrine lacked a ventilation pipe	99	90.0
7.	Fecal matter/urine was found on the slab	58	52.7
8.	Latrine was smelly	53	48.2
9.	Latrine found infested with flies	34	30.9
10.	Latrine walls found smeared with fecal matter	39	35.5
11.	No handwashing facility found near the latrine	70	63.6
12.	No soap found at the latrine	70	63.6

A large proportion (85%) of the latrines lacked hole covers, 90% lacked ventilation pipes and almost half (48.2%) were smelly. More than half (63.6%) had no soap and the same number had no handwashing facility near the latrine. Availability of handwashing facilities near latrines is a factor that promotes people to use them to prevent sanitation related diseases. Handwashing is an effective means of preventing diarrhea when done properly at critical times. Promotion of handwashing with soap after defecation and handling of human or animal feces is therefore very important. Curtis and Cairncross (2003) reported that handwashing with soap, particularly after contact with feces can reduce diarrhea incidence by 42 - 47%. The *tippy tap* technology (which uses a small jerrycan and string) for handwashing can be explored by the project so as to improve on handwashing practices in the community. In addition, 52.7% of the latrines had fecal matter/urine on the slab, 30.9% had flies and 48.2% were smelly. These all suggest that the latrines were not cleaned regularly and the spread of diarrheal diseases could easily occur among households using such latrines.

3.3.2.2 Score of contamination risks

The total score of contamination risks of the latrines of the households are summarized in Table 3.10.

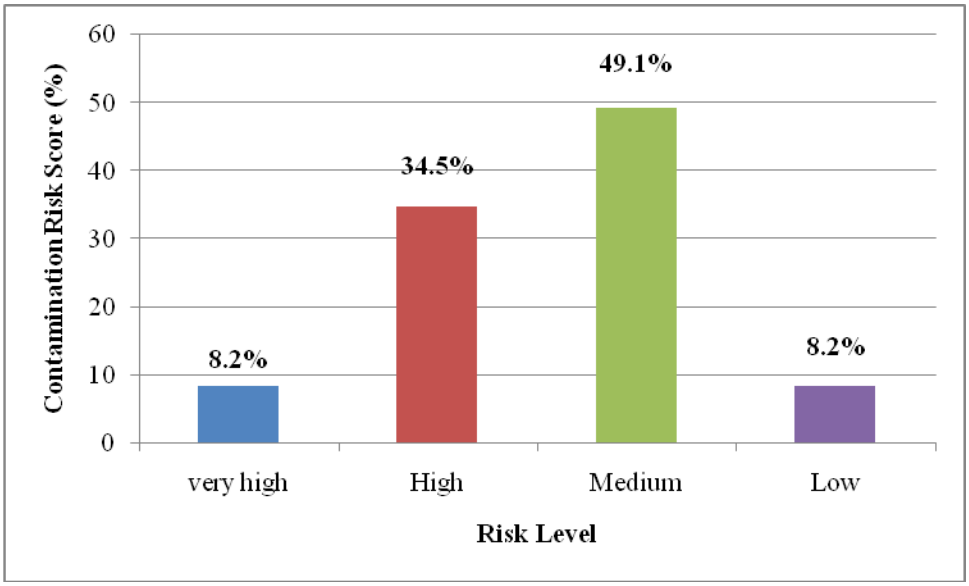
Table 3.10 Score of contamination risks

Score/14	Frequency (n = 111)	Percentage (%)
2	2	1.8
3	8	7.3
4	16	14.5
5	24	21.8
6	14	12.7
7	8	7.3
8	18	16.4
9	12	10.9
10	5	4.5
11	1	0.9
12	2	1.8
14	1	0.9

3.3.2.3 Risk levels

The risk levels of the latrines are summarized in Figure 3.6. The sanitary risks scores were categorized as follows: 0 = No risk; 1 - 3 = Low risk; 3 - 5 = Medium risk; 6 - 8 = High risk; 9 - 10 = Very high risk.

Figure 3.6 Risk levels of latrines



The risk level for exposure to diarrhea diseases among the latrines that were investigated ranged from being very high (8.2%) to medium (49.1%). This shows that

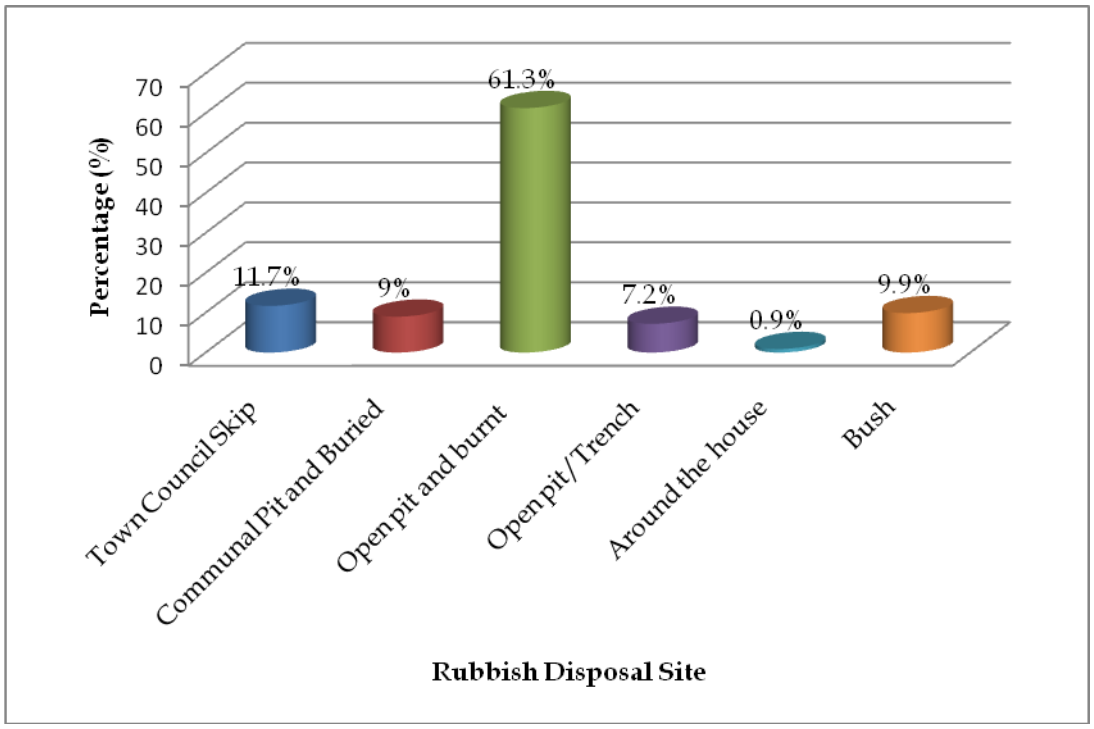
many households were at risk of exposure to diarrhea related diseases due to undesirable conditions at the latrines such as lack of handwashing facilities. The existence of undesirable conditions at latrines including fly infestation and presence of fecal matter on the slab directly increases the risk of diarrheal diseases as the flies from latrines can contaminate food and transmit the disease.

3.4 Household rubbish and wastewater disposal

3.4.1 Household rubbish disposal

The methods of disposal of solid waste by households are shown in Figure 3.7.

Figure 3.7 Household rubbish disposal

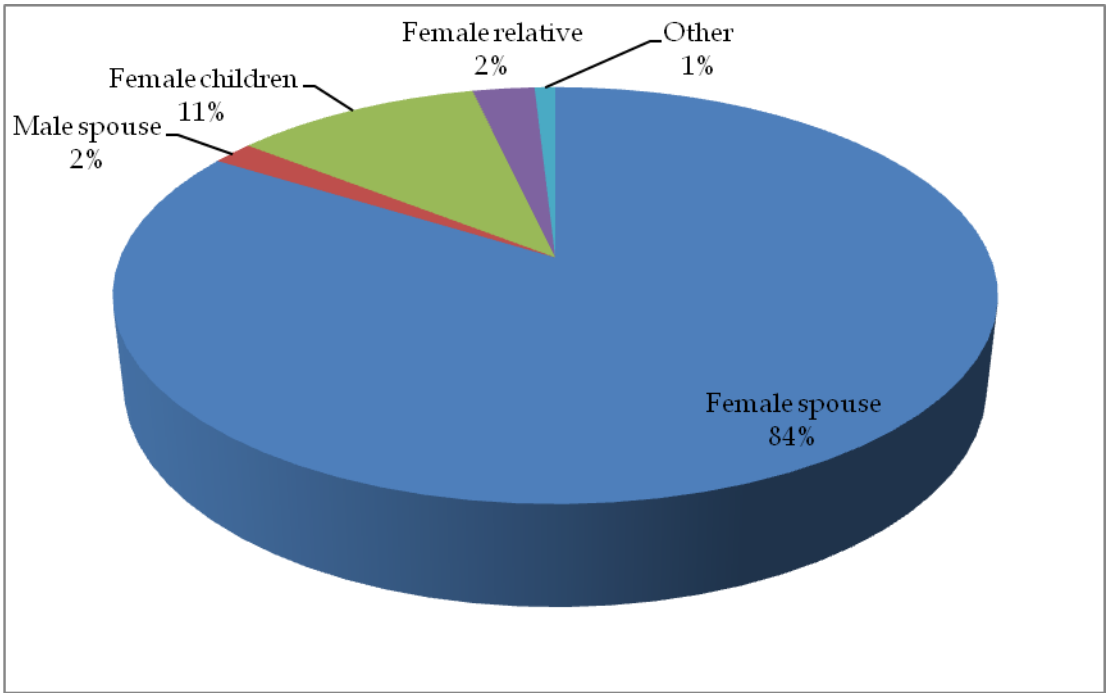


A good proportion (61.3%) of the households disposed of their rubbish in open pits and they later burnt it. Only 11.7% disposed of their waste in public waste collection skips. Improper disposal of waste such as use of open pits and around homes makes the

environment unsightly and can result in foul odor and attract disease vectors such as rats, flies, and cockroaches.

The person responsible for solid waste disposal in the households was also investigated, and the results are shown in Figure 3.8.

Figure 3.8: Person responsible for solid waste disposal at household level



The female spouses (84%) followed by female children (10.8%) did most of the rubbish disposal from the households. This is true in the Ugandan setting where it is customarily believed that household work is usually the responsibility of women and girls.

The frequency of disposal of rubbish from households was also investigated, and results are shown in Table 3.11.

3.4.2 Frequency of rubbish disposal

Table 3.11 Frequency of rubbish disposal

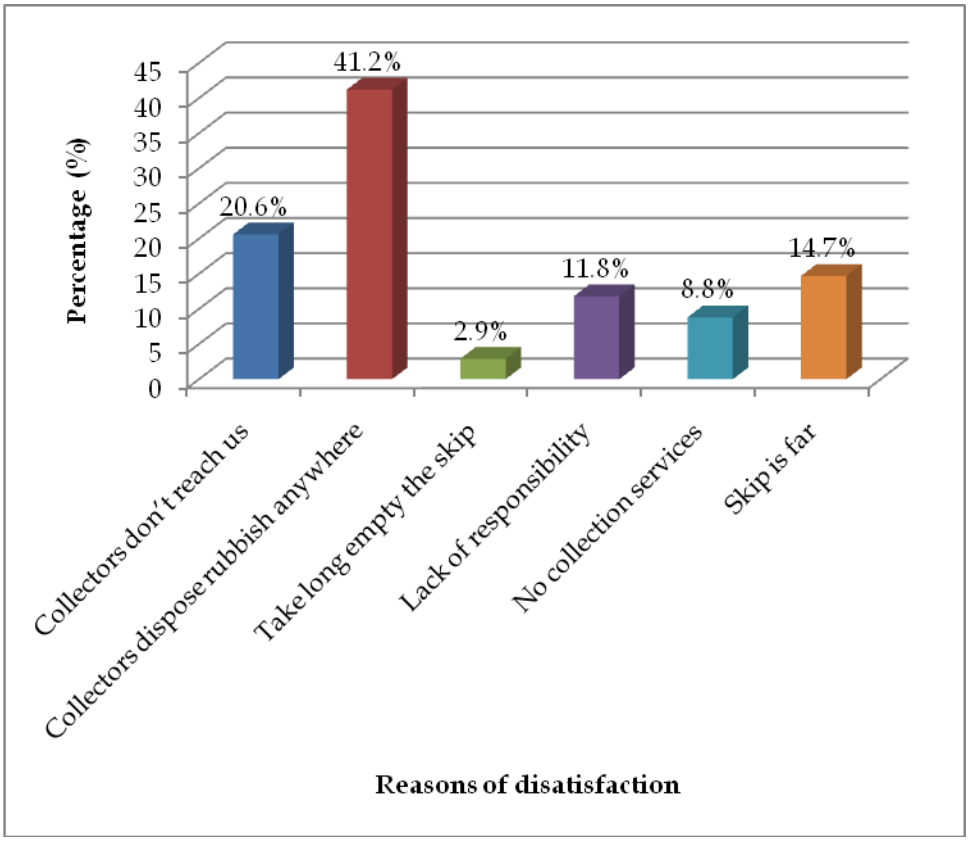
Timing	Frequency	Percentage (%)
Daily	9	8.1
Twice a week	22	19.8
Weekly	13	11.7
Every two weeks	4	3.6
Every month	1	0.9
Rarely	1	0.9
Don't Know	61	55.0
Total	**111**	**100**

The frequency of rubbish disposal from households varied from being done every day, to rarely being done. In the majority of households (55%) they were not sure when it was done.

3.4.3 Satisfaction with rubbish collection services

More than three quarters of the households (77%) were satisfied with the rubbish collection services in the area. The reasons given for the dissatisfaction of rubbish collection services are depicted in Figure 3.9.

Figure 3.9: Reasons for dissatisfaction of rubbish collection services

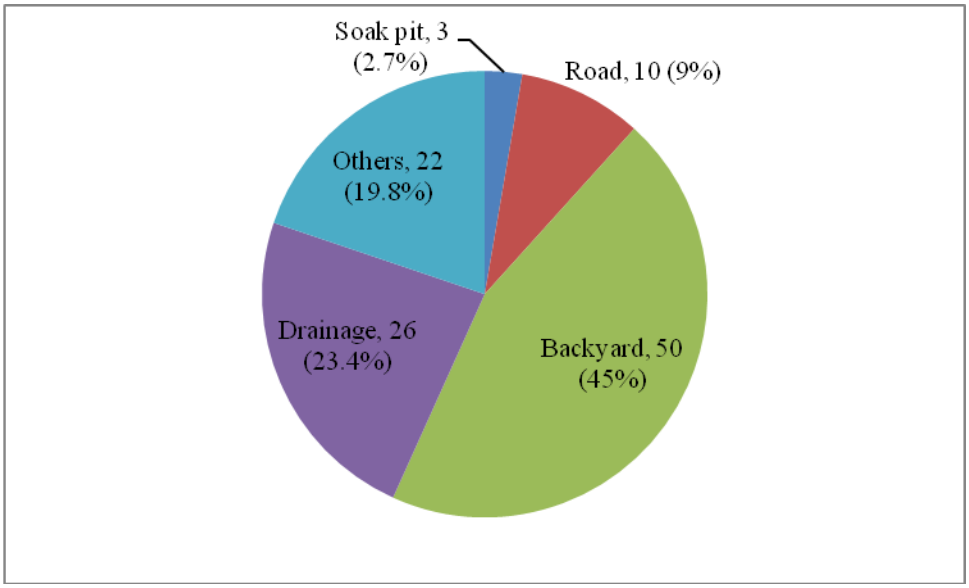


Reasons advanced for being dissatisfied with the rubbish collection services included; rubbish collectors disposing of rubbish anywhere for example in the drainage channels (41.2%). This is a bad practice that should be discouraged by the responsible authorities like the health department of the municipality. The absence of rubbish collection services and taking long to collect the rubbish from the skips are some of the factors that influenced the households to dispose rubbish indiscriminately. When rubbish is not collected in time it makes the surroundings appear unsightly. In addition, offensive odor may result from the rubbish and may provide breeding grounds for vectors such as flies, mosquitoes, cockroaches and rats. As a result, the community may become exposed to sanitation related diseases.

3.4.4 Household wastewater disposal

The wastewater disposal sites for the households are shown in Figure 3.10.

Figure 3.10 Household waste disposal sites



Nearly half of the households (45%) disposed of their wastewater in the backyards, while 23.4% did so in drainage channels. Only 2.7% of the households disposed of their wastewater in soak pits. Disposing household wastewater in backyards may provide breeding grounds for vectors such as mosquitoes which transmit malaria. Disposal of wastewater on road surfaces is also a hazard that may result in slips and falls.

3.4.4.1 Environmental inspection results

Following assessment of the sanitary conditions at the households involved in the study, the results are shown in Table 3.12.

Table 3.12 Environmental inspection results

No.	Aspect	N = 111	Percentage (%)
1.	Household environment dirty (litter around the house)	42	37.8
2.	No dustbin for household rubbish	42	37.8
3.	Dustbin is dirty and overflowing	13	11.7
4.	Fecal matter around the household	6	5.4
5.	No drainage around the house	53	47.7
6.	Drainage around the house clogged	9	8.1
7.	No utensil drying rack	63	56.8
8.	Household utensils dirty and left unclean in the open	25	22.5
9.	Drinking water container with a wide mouth/opening	27	24.3
10.	Drinking water container has got no lid/cover	53	47.7
11.	Drinking water container kept on the floor level	64	57.7
12.	The inside of the container dirty	15	13.5
13.	The outside of the container dirty	27	24.3

3.2.5.7. Environmental assessment risk scores

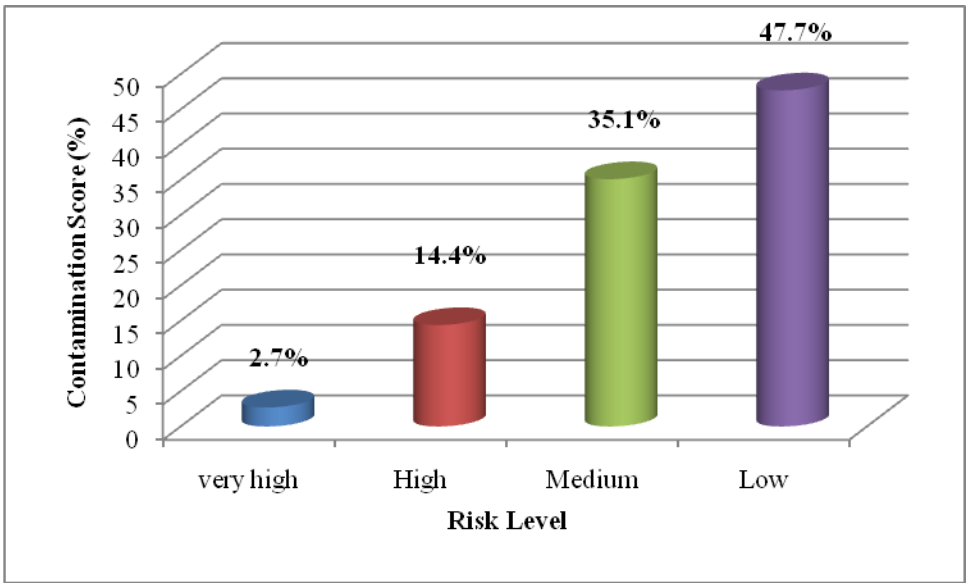
The environmental risk scores (out of 12) for the households are shown in Table 3.13.

Table 3.13 Environmental pollution scores

Score (out of 12)	Frequency	Percentage (%)
1	8	7.2
2	21	18.9
3	25	22.5
4	26	23.4
5	4	3.6
6	8	7.2
7	11	9.9
8	3	2.7
9	2	1.8
10	3	2.7
Total	**111**	**100.0**

The household assessment risk scores are shown in Figure 3.11. These were characterized as follows: 0 = No risk; 1-3 = Low risk; 3-5 = Medium risk; 6-8 = High risk; 9-10 = Very high risk.

Figure 3.11 Environmental assessment risk levels



Although most households were of low (47.7%) or medium (35.1%) risk, effort is needed to reduce on the individual environmental risks identified at the households.

3.2.5.8. Soil contamination

Results from the soil samples analysis are shown in Table 3.14.

Table 3.14 Soil sample analysis results

Result	Frequency (n = 111)	Percentage (%)
No ova, cyst or larvae seen	105	94.6
Ascaris ova seen	2	1.8
Hookworm ova seen	4	3.6
Total	**111**	**100.0**

The majority of soil samples (94.6%) did not have any pathogenic organisms / worms. This could be an indication that parents ensure that children's feces are disposed of in latrines. This practice should be encouraged among the community especially since in some cultures, it is thought that children's fecal matter is safe and cannot transmit diseases.

3.5 Health care seeking behavior

3.5.1 Place where healthcare is first sought

The place where the respondents first sought healthcare when sick is shown in Table 3.15.

Table 3.15 Health facility where healthcare is first sought

Health Facility	Distance from households				Total
	<1km	1-2km	2-3km	3-5km	
Health centre	6	15	6	2	**29**
Private clinic	45	28	6	0	**79**
Hospital	2	1	0	0	**3**
Total	**53**	**44**	**12**	**2**	**111**

The majority of households (71.2%) sought healthcare first from private clinics, many of which were located at a distance of less than 1 km from the households. This is mainly because the public health facilities were located a long distance from the community. Although most healthcare services are offered for free at public facilities, private clinics normally charge clients for all the services they offer.

3.5.2 Households' satisfaction with healthcare services

The majority of respondents (77.5%) were satisfied with the services they received at the health facility. Reasons highlighted for the dissatisfaction included inadequate medicines, unavailable staff, long waiting time to receive services and some health workers being rude.

3.6 Household nutrition

3.6.1 Sources of food

Many households bought their food such as vegetables, meat and fish mainly from the main market while milk and milk products were obtained from the grocery shops in the area. Results are shown in Table 3.16.

Table 3.16 Sources of different foods

Source	Different Foods					
	Vegetables and fruits		Meat / Fish		Milk and milk products	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Main market	63	56.8	61	55.0	0	0
Area road side vendors	35	31.5	39	35.1	25	22.5
Grocery shops in area	0	0	0	0	42	37.8
Others	13	11.7	11	9.9	44	39.6
Total	**111**	**100**	**111**	**100.0**	**111**	**100.0**

3.6.2 Storage of food

There were various places where households stored their foodstuffs as can be shown in Table 3.17.

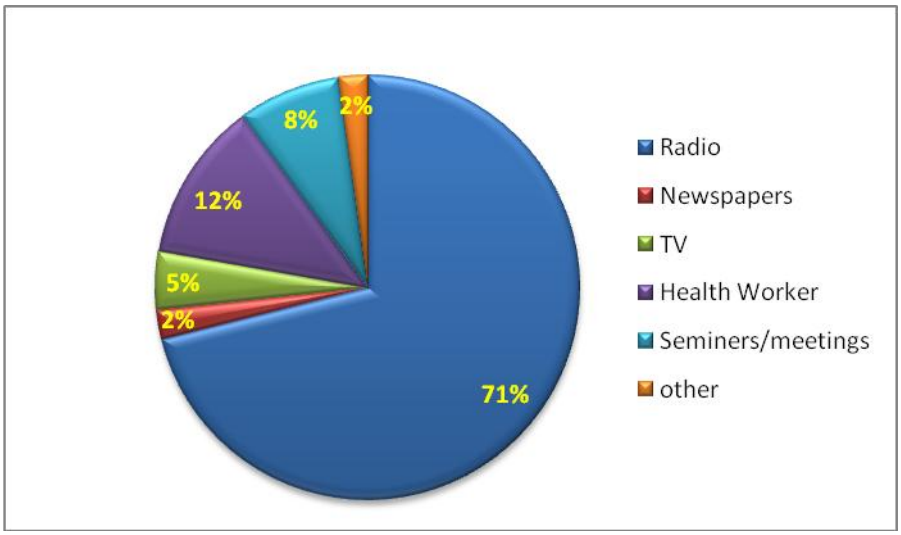
Table 3.17 Storage of food by households

Vegetables and fruits	Meat / fish	Milk and milk products	Food for under 5s
- Anywhere in the house - In cupboard - In fridge - In pail - In sauce pan - In basket - On food rack	- In covered container - Covered in sauce pan - In fridge - In uncovered saucepan - Smoke and put in a container	- Boil and keep in saucepan - Cover in bucket - In fridge - In kettle - In bottles - In flask	- In food flask - In fridge - - Leave on charcoal stove - In bottle - In saucepan - In covered dish

3.6.3 Access to health, hygiene and sanitation information

The majority of respondents (82%) had ever accessed health, hygiene and sanitation information. The common sources of this information are shown in Figure 3.12.

Figure 3.12 Access to health, hygiene and sanitation information



The radio (71%) was the most common source of health, hygiene and sanitation information. Newspapers and other information sources such as posters and banners were stated as the least accessed for this information in the community. Since majority of the community listened to radio, it is important to identify the most frequently listened radio stations to use to pass on information concerning health, hygiene and sanitation. In this community, the most preferred language to receive health information was *Luganda*, the local language. This language preference will be taken into consideration while conducting training among the community.

3.6.4 The source and frequency of accessing health, hygiene and sanitation information

The source and frequency of accessing health, hygiene and sanitation information by the respondents is shown in Table 3.18.

Table 3.18 Source and frequency of accessing the health, hygiene and sanitation information

Frequency of access	Source of health, hygiene and sanitation information						Total
	Radio	Newspapers	TV	Health worker	Seminars/meetings	Others	
Every day	19	0	2	1	1	0	23
Twice a week	9	1	0	0	0	0	10
Weekly	15	1	2	1	0	0	19
Every two weeks	1	0	0	1	0	0	2
Monthly	4	0	0	1	1	2	8
Rarely	13	0	0	7	5	0	25
Other	5	0	0	0	0	0	5
Total	**64**	**2**	**4**	**11**	**7**	**2**	**92**

The majority of respondents (70.3%) frequently accessed health, hygiene and sanitation information through radio. Among these, 67.2% accessed health information through radio at least weekly. This suggests that use of radio may be an effective means of passing behavior change messages to the community.

3.7 Child morbidity and mortality information

3.7.1 Child mortality information

Only two respondents (1.8%) had lost a child under five years in the past three months. This is a low infant mortality rate that may be attributed to the increased use of health facilities to seek healthcare in the area.

3.7.2 Child immunization

The total number of children under five years found in the survey households was 180 of which 48.3% were males and 51.7% were females.

A good proportion of children (60%) had child health cards. This is an indication that many parents endeavor to immunize their children against childhood diseases such as polio, measles, tuberculosis and tetanus. However, the parents who do not keep their children's cards need to be sensitized to do so.

3.7.3 Child immunization status

The immunization status of the children under five years is shown in Table 3.19 .

Table 3.19 Child Immunization status

Status	Measles (Left hand side) Child equal or greater than 9 months only		De-worming (within past 3 months)		Vitamin A supplementation (within past 6 months)		BCG/Scar (Right hand) At birth	
	Freq.	**Percent**	**Freq.**	**Percent**	**Freq.**	**Percent**	**Freq.**	**Percent**
Yes with card	61	34.3	61	20.2	40	22.9	89	49.7
Yes without card	69	38.8	69	33.1	51	29.1	83	46.4
No with card	15	8.4	15	21.3	37	21.1	3	1.7
No without card	16	9.0	16	21.3	39	22.3	3	1.7
Not applicable	17	9.6	17	3.9	8	4.6	1	.6
Total	**178**	**100.0**	**178**	**100.0**	**178**	**100.0**	**178**	**100.0**

Although many parents had indicated that their children had been immunized against the various diseases such as measles, some did not have the children immunization cards. Obtaining and keeping child cards should be encouraged among these parents as this is a requirement from health centres.

Table 3.20 Child morbidity information in the past two weeks

Variable	Details	Frequency	Percentage
Child Sex	Males	87	49.2
	Females	90	50.8
Child Number	1st Born	111	61.3
	2nd Born	56	30.9
	3rd Born	12	6.6
	4th Born	2	1.1
Suffered malaria	Yes	44	24.9
	No	133	75.1
Suffered diarrhoea	Yes	29	16.4
	No	148	83.6
Duration of the diarrhoea	1-3 days	10	34.5
	4-7 days	11	37.9
	8-14 days	4	13.8
	>14 days	4	13.8
Other illnesses suffered	Cough/RTI/Difficulty in breathing	122	-
	Measles	9	-
	Skin diseases	5	-

Only 16.4% of the children under five had suffered diarrhea in the past two weeks from the time of the survey. Among those children who suffered diarrhea, 86.2% suffered watery diarrhea while 6.9% had bloody diarrhea which is normally associated with dysentery.

Chapter Four

Conclusions and Recommendations

4.1. Conclusions

Most households in the study area had a latrine that they used for the family or shared with other neighboring households. The sanitary status existing at majority of the latrines was poor, with availability of hand washing facilities being extremely very low.

Boiling of water was the most prevalent method households used to treat water for drinking. The bacteriological quality of water from half of the households in the study area varied, with only approximately half of the households satisfying the required standards. The water in the containers from many of households was contaminated to varying levels with some having too numerous to count coliform counts.

Springs (protected and unprotected) were the most commonly used water sources by the community for drinking, cooking, bathing, laundry and dish washing. Although public tap water was available in the area, this water source was not used as much because of the cost component of using such water.

Female spouses were mainly responsible for household water collection, household rubbish collection and disposal.

Solid waste disposal was mainly done in open pits, where it was then burnt. The use of public skips for waste collection was very low.

Private clinics were the first choice health facility for the households seeking healthcare. A significant number of children did not have their immunization cards available. The majority of soil samples did not have any eggs, ovas or cysts associated with intestinal worms.

Radios were the primary source of health, hygiene and sanitation information. The most preferred language for health education was *Luganda*.

4.2. Recommendations

1. The project should health educate the community on the best practices in safe water, sanitation and hygiene at household levels. Specifically, the following should be considered for health education:
   - safe water chain
   - sanitary condition of latrines
   - handwashing facilities at latrines
   - wastewater disposal
   - refuse disposal
   - household environmental conditions

2. The *tippy tap* technology for handwashing can be explored by the project to improve handwashing practices after latrine use among the community.

3. While carrying out health education on sanitation issues among households, the project should give special attention to women who were found to be more involved in these activities.

4. The community should be advised to regularly clear the drainage channels at the springs to allow the flow of wastewater.

5. *Luganda* should predominantly be used while carrying out health education among the community.

6. The project can explore the use of mass media particularly radio to pass on health information to the community.

7. The project should sensitize parents to always keep the immunization cards of their children.

References

Alajo et al., (2006): Alajo SO, Nakavuma J, Erume J. Cholera in endemic districts in Uganda during El Nino rains: 2002 - 2003. *Afr Health Sci.* 2006; 6(2): 93 - 97.

Beller Consult and Associates (2004): Sanitation Strategy and Master Plan for Kampala City, Kampala.

Beth, 2009. UN Report - Slum Population Expected to Double. The International Vincentian Family

Bufardereci, G., Geissa, Pariyo GW (1991): Assessment of rural water and sanitation component of AVSI health program in Hoima District, final report ICHM, (International Course for International Health managers) at district level in developing country.

Curtis V and Cairncross (2003): Effects of washing hands with soap on diarrhoea risk in the community. A systematic review and meta analysis', *The Lancet infectious diseases, 542-52*

EPI/IDS, 2003. Uganda Cholera Outbreak Updates as of 2nd JANUARY 2000, EPI/IDS Newsletter: Eastern Africa. March 2000; 1(3)

Manaye Siyoum (2009): Assessment on Water, Sanitation and Hygiene Status among Home Based Care Clients of PLWHA in Addis Ababa.

McKinlay, JB, McKinlay, SM (1977): The Questionable Contribution of Medical Measures t o the Decline of Mortality in the United States in the Twentieth Century. *The Milbank Memorial Fund Quarterly Health and Society, Vol. 55, No. 3 (summer, 1977)*, pp. 405-428.

MoH (2004/05): Ministry of Health, Health Sector Strategic Plan 2000/01 – 2004/05

MWLE (2003): Measuring performance for improved service delivery', Government of Uganda, Ministry of Water, Lands and Environment, September 2003

Uganda Human Development Report (2007): Rediscovering Agriculture for Human Development.

UN-HABITAT (2003): The Challenge of Slums Global Report on Human Settlements (2003): United Nations Human Settlements Programme.

UNDP (2003): Slums, Squatter Areas and Informal Settlements – Do They Block or Help Urban Sustainability in Developing Contexts? 9th International conference on Sri Lanka Studies, 28th–30th November 2003, Matara, Sri Lanka.

UNSG (2000): Ministry of Health Uganda National Sanitation Guidelines.

Wandiga S. O. (2006): Climate Change Induced Vulnerability to Malaria and Cholera in the Lake Victoria Region The International START Secretariat Florida Washington.

Water and Sanitation Program (2007): HIV/AIDS and water/sanitation/hygiene, Environmental Health. Washington DC.

Water and Sanitation Program (2008): HIV- affected families and water and sanitation.WSP. [Updated 2007 July; Cited 2008 December 21]. Available from: www.wsp.org/index.cfm.

WHO/UNICEF Joint Monitoring Program for water supply and Sanitation (2004): Meeting the MDG drinking water and sanitation target: a midterm assessment of program. New York. JMP.

APPENDICES

Appendix 1: Study Consent Form

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Study Consent Form

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
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Telephone 0772-963074

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1

INFORMED CONSENT NARRATIVE

Good morning / afternoon. My name is _____, and I am working on behalf of Makerere University School of Public Health. We are conducting a survey on **Drinking Water Supply, Sanitation, and Hygiene Promotion in your area.**

Purpose
This research aims at finding out the water supply, sanitation and hygiene status in your area, so as to help identify what things can be done to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene. As residents of this area, we therefore kindly request you to participate in the research and also allow your children to participate in the research.

Duration of the study
The research will last approximately three years.

Procedures
During the research, you will be asked some questions as household head. Stool samples may be taken from members in your household if they have diarrheal diseases. These samples will be tested to find out what has caused the diarrhea, and the results will be explained to you by the staff project team. We request that you continue furnishing us with the progress of the household members in regards to their illnesses, especially diarrhea. To collect this information, you will be visited at the household on a regular basis at 3 to 6 months intervals. This is to help us identify the causes of these diarrheal diseases and therefore be able to take appropriate action.

Household inspection will be done to find out any environmental factors that may increase diarrheal diseases. The sources of the water used in your home will be inspected and where possible water samples taken for microbiological analysis to help establish if your water sources are safe. If they are not safe, the responsible authorities will be informed to take action to make the water source safe for use. Your sanitation status will be assessed, and the present practices will be encouraged or modifications recommended for sustainable hygiene promotion in the community.

The expected duration of the exercise will be approximately 1hr 30min.

Costs/Compensation
All research related procedures and visits will be provided to you at no cost. You will therefore have no added costs from being in this study. There will be no cash incentive from participating in the study.

Benefits
Treatment will be provided for household members found to have diarrhea using the Essential Drug list of the Ministry of Health. Where more costly drugs are needed appropriate referral to health facilities will be done. Where water is found to be unsafe for use, responsible authorities will be informed to take action to make the water source safe for use and appropriate health/hygiene education will be provided. Knowledge will be gained on how to improve the health and living conditions in your area.

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Risks
There will be no risk to you and other household members other than the inconvenience of their providing stool samples if they have diarrhea.

Right to refuse or withdraw
Your participation in this study is entirely voluntary. You may choose not to participate in the study. If you choose to join the study, you are also free to withdraw from the study at anytime should you wish not to continue.

Confidentiality
Details of the household heads and children will be recorded but these will be safely kept and will not be revealed in the report or publication of results of this study. Details are necessary to help the team trace your households and the children in the study for follow up during the three years of the study.
The data collected and the consent form will be securely stored under lock and key with the Principal Investigator.

Questions
In case you have any further questions concerning the research you can contact the project investigators on the project listed on page 1. A signed copy of this form will be provided to you.

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HOUSEHOLD CONSENT

I have been approached to participate in a study to assess the drinking water supply, sanitation, and hygiene promotion. The purpose, procedures, benefits and risks of participating in this study have been explained to me. I understand that during the study the fieldworkers / health workers will:

1. Ask me questions about my household members and the general environmental hygiene.
2. Take stool samples from household member(s) if they have diarrhea. These will be used to test for microorganisms that cause diarrhea and also determine the best drugs to treat these microorganisms. Results of samples collected from my household will be brought to me and explained to me by the staff project team.
3. Visit the household on a regular basis from 3 to 6 months intervals to conduct an environmental and health inspection.
4. Treat household members found to have diarrhea using the Essential Drug list of the Ministry of Health. Where more costly drugs are needed appropriate referral to health facilities will be done.

I also understand that:

1. My household member(s) will not be exposed to any other than the inconvenience of providing stool if they have diarrhea.
2. My participation in the study is voluntary. If I do not participate, I will not be affected in any way and that I can also withdraw from the study at any point during the follow up for the project duration.
3. Information collected during the study will be confidential.
4. There will be no costs related to the study procedures and no cash incentives will be given.
5. The study will last approximately three years.
6. If I have any questions related to the study, I may contact the researchers at anytime.
7. I will be given a copy of this form and that a copy of this form will be kept in the study file.
8. By signing below I agree to participate in this study.

I freely agree to participate in this research and allow my household to join the study.

Name of Interviewee/Guardian.....

Signature.....

Date.....

Name of Interviewer / Health worker.....

Signature.....

Date.....

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If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about

the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

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Appendix 2: Household questionnaire

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Informed Consent: Go through informed consent as indicated

IF RESPONDENT AGREES TO BE INTERVIEWED 1
Thank her / him for accepting to participate.
CONTINUE ↓

IF RESPONDENT DOES NOT AGREE TO BE INTERVIEWED 2
Thank her / him & go to the next household (i.e. household of the next sampling interval) →**END**

Questionnaire No.
GPS READING: _____ **HOUSE HOLD ID NUMBER**_____

DIVISION:
SUB COUNTY (LCIII):
PARISH:
VILLAGE/ZONE (LC1):
TEAM NO:
INTERVIEWER'S NAME: **SIGNATURE & DATE** _____

DATE OF INTERVIEW ……/……../2010
TIME OF INTERVIEW: START _____ **END** _____
SUPERVISOR'S NAME:

ARE ALL QUESTIONS COMPLETED? NO ..... 1 YES 2

IF NOT WHY REFUSED..... 1 OTHER (SPECIFY)……. 2

SUPERVISORS NAME _____ **SIGNATURE & DATE** _____

DATA ENTRANT'S NAME _____ **SIGNATURE & DATE** _____

1.0 HOUSEHOLD DATA COLLECTION FORM ☐

1.1 Respondent particulars

Name of respondent: _____

Sex of respondent	Marital status of Head of HH	Age of respondent (years)	Religion of respondent	Education level of respondent	Region (District) of origin/birth of respondent	Period respondent has been living in area (years)	Is respondent the household head?	If respondent is not household the household head, what is the relationship of the respondent to the household head?
1=Male 2=Female	1=Never married 2=Married/cohabiting (monogamy) 3=Married/ cohabiting (polygamy) 4=Widowed 5=Divorced 6=Separated	1=19-24 2=25-34 3=35-44 4=45-54 5=55-64 6=65+ 99=Don't know	1=Catholic 2=Protestant 3=Pentecostal 4=Muslim 5=Other (specify)	1=None 2=P1-P7 3=S1-S4 4=S5-S6 5=College (post S4) 6=College (post S6) 7=University (post S6)	1=Kampala 2=Central 3=Eastern 4=Northern 5=West Nile 6=West 7=Out of Uganda	1=< 1 2= 1 –3 3= 3-5 4=>5 99= Don't know	1=Yes 2=No	1=Spouse; 2=Son/daughter; 3=Step child; 4=Grand child; 5=Sister/brother; 6=Niece/nephew; 7=Other relative; 8=other (specify)

1.2 Household head particulars

☐

1.2.1 Socio-demographic characteristics of household head

Who is head of HH?	**Sex of Head of HH**	**Marital status of Head of HH**	**Age of Head of HH**	**Religion of Head of HH**	**Education level of head of HH**	**Region (District) of origin/birth of head of HH**	**Period HH head has been living in Banda (years)**
1=Male adult 2=Female adult 3= Male child 4=Female child 5= Other (specify)	1=Male 2=Female	1=Never married 2=Married/cohabiting (monogamy) 3=Married/ cohabiting (polygamy) 4=Widowed 5=Divorced 6=Separated	1=19-24 2=25-34 3=35-44 4=45-54 5=55-64 6=65+ 99=Don't know	1=Catholic 2=Protestant 3=Pentecostal 4=Muslim 5=Other (specify)	1=None 2=P1-P7 3=S1-S4 4=S5-S6 5=College (post S4) 6=College (post S6) 7=University (post S6)	1=Kampala 2=Central 3=Eastern 4=Northern 5=West Nile 6=West 7=Out of Uganda	1=< 1 2= 1 –3 3= 3-5 4=>5 99= Don't know

1.3 Household water/sanitation

1.3.1 Household main water source, cost and usage

What is main source of water for the household? (Give only one)	How far is the main source of water from the HH?	Amount of water used in household per day (Indicate estimated number of 20litre Jerrycans)	Do you pay for this water?	If water is paid for, how much does it cost per jerrycan? (Indicate cost in Ugshs)	Who uses more water in the household?	Who is responsible for collection/fetching water for domestic use?
1=Borehole 2=Protected spring 3=Unprotected pond (river/stream/well) 4=Rain water harvesting 5=Piped water 6=Other (*Specify*)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km	1= 1 2= 2-3 3= 4-5 4= >5	1=No 2=Yes	1=<50 2=50/= 3=75/= 4=100/= 5=150/= 6=200/= 7=>200/=	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)

1.3.2 Household drinking water source, treatment and storage

What is main source of water for drinking? (Give only one)	Do you do anything to your water before drinking?	Where do you store your drinking water?	How often is the container for drinking water cleaned?	How is the container for drinking water cleaned?
1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Boiling 2=Use traditional herbs 3=Use chemicals (water guard tablet/liquid) 4=Filter/Sieve 5=Decant 6=Nothing	1=Traditional pot with cover 2=Traditional pot without cover 3=Plastic jerrycan with cover 4=Plastic jerrycan without cover 5=Other (specify)	1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5=Every month 6=Rarely 7=Other (specify)	1= Rinsed with plain water 2=Rinsed with soapy water 3=Scrubbed and rinsed with plain water 4=Scrubbed and rinsed with soapy water 5=Other (specify)

1.3.3 Household general domestic water source and disposal

What is main source of water for cooking? (Give only one)	What is main source of water for bathing? (Give only one)	What is main source of water for laundry? (Give only one)	What is main source of water for dishwashing? (Give only one)	How do you dispose of waste water from your house?
1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=In soak pit 2=On the road 3=In the backyard 4=In the drainage 5=Other (specify)

1.3.4 Household bathroom and latrine

What type of bathroom does this household use?	If the household bathroom is outside, how many households use the bathroom?	Has your household got a latrine?	If you do not have a latrine, where does the household dispose off their feces?	If community latrine is used, how many households use the latrine?
1=Inside the house 2=Outside (built with blocks) 3=Outside makeshift 4=None	1=1-5 2=6-10 3=11-20 4=21=30 5=>30	1=No 2=Yes	1=Community latrine 2=Neighbor's latrine 3=Bush 4=Bury in the yard 5=Throw outside yard/dwelling 6=Not disposed off 7=Other (specify)	1=1-5 2=6-10 3=11-20 4=21=30 5=>30

1.3.5 Household rubbish disposal

Where do you dispose of your rubbish? (List all)	At household level, who is responsible for disposing off the rubbish?	If rubbish collection is paid for, how much does it cost per week? (Indicate cost in Ug.Shs)	Which company/Whom do you pay to collect your rubbish?(specify)	How often is the rubbish collected?	Are you satisfied with the rubbish collection services in the area?	If no, why are you not satisfied with the rubbish collection services in the area?
1=In KCC skip 2= Open pit (Communal/personal) and buried 3=Open pit and burnt 4=Open pit/trench 5=Any where around the house 6= Bush 7=Pay for rubbish collection 7=Other (Specify)	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)	1=<500 2=500-1,000 3=1,000-2,000 4=2,000-3,000 5=3,000-4,000 6=4,000-5,000 7=>5,000		1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5=Every month 6=Rarely 7=Other (specify)	1=No 2=Yes	

1.4 Household health seeking behavior

Health care services: Generally, if household members are sick, where is treatment sought first?	If first source of treatment is health facility (1-3), how far is this health facility from your household	Are you satisfied with the services at the health facility?	If no, why are you not satisfied with the services at the health facility?	If first source of treatment is other health care service (4-5), how far is this service from your household?
1. Hospital 2. Health center 3. Private Clinic 4. Traditional healer/herbalist 5. Others (indicate)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km	1=No 2=Yes	1=Inadequate medicines 2=Staff unavailable 3=Wait long in lines 4=Others (specify)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km

1.5 Household food sources and storage

Household food sources	Household food storage	Child food storage

Where do you normally get the household vegetables and fruits?	Where do you normally get the household meat/fish?	Where do you normally get the household milk products?	Where are the household vegetables and fruits stored?	How is the household meat stored?	How are the household milk products stored?	How is the food for the child less than five years stored?
1= Vendors at main market in area 2=Kikulu road side vendors 3= Other (specify)	1= Vendors at main market in area 2=Area road side vendors 3= Other (specify)	1= Grocery shops in area 2=Area road side vendors 3= Other (specify)				

1.6 Information accessibility

Do you have any access health, hygiene and sanitation information?	If yes, what is your major source of health, hygiene and sanitation information?	How often do you access health, hygiene and sanitation information?	What language do you prefer access health, hygiene and sanitation information?
1=No 2=Yes	1=Radio 2=Newspaper 3=TV 4=Health worker 5=Seminars/meetings 6=Other	1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5= Monthly 6=Rarely 7=Other (specify)	

1.7 Mortality information

In the past three months, have you lost any child aged less than 5 years? 1=No 2=Yes	If yes, how many children aged less than five have you lost?		Cause* of death for children aged less than 5 years (0-59 months)(Verbal autopsy)
	Number female	Number male	
			Child 1-
			Child 2-
			Child 3-
			Child 4-
			Child 5-

*1=Watery diarrhea; 2= Bloody diarrhea; 3= Measles; 4= Malaria/fever; 5= Cough/ARI; 6=Malnutrition; 7= Accident ; 8= Delivery complications; 9= Others (specify); 10= Unknown

2.0 INDIVIDUAL QUESTIONNAIRE

2.1 Child Immunization , supplementation and de-worming information (Children 6-59 months)

HH No.	**Child No.**	**Child Sex**	***Ask for Child's Health Card*** **Is child health card present?**	**Has the child received any of the following:**(Check child health card)			
				Measles immunisation (Left hand side)	**De-worming**	**Vitamin A Supplementation**	**BCG/Scar** (Right hand)
				1=Yes with card 2=Yes without card 3=No with card 4=No without card 5=Not applicable			
		1=Male 2=Female	1=No 2=Yes	Child>=9 months only	Within past 3 months	Within last 6 months	At birth

2.2 Child morbidity information

2.2.1 Morbidity in past 2 weeks

HH No.	**Child No.**	**Child Sex**	**Does the household have a mosquito net (s)?**	**Did the child sleep under a mosquito net last night?**	**Recent illness (last 2 weeks)**

		1=Male 2=Female	1=No 2=Yes	1=No 2=Yes	**Has child suffered fever in past two weeks?** 1=No 2=Yes	**If child has suffered from fever, what treatment was given?** 1= Chloroquine, Quinine, Coartem (Malaria treatment) 2=Other treatment (not malaria) 3=No treatment	**Has child suffered diarrhea in past two weeks?** 1=No 2=Yes	**If child suffered diarrhea in past two weeks, what was the nature of diarrhea?** 1=Watery diarrhea 2=Bloody diarrhea 3=other (specify)	**Other illness experienced in past two weeks** 1=measles 2=Malnutrition 3=Cough/RTI/Difficulty in breathing 4=Skin diseases 5=Vomiting 6=Eye infection 7=Intestinal parasites 8=Other (specify) 9=No illness

Diarrhea= any episode of more than three stools per day; **Bloody diarrhea =** any episode of more than three stools per day in which there is presence of blood in stool; **Measles =** Any episode of fever accompanied by cutaneous eruption, rhino-pharyngitis or conjuntivitis;

Fever= Elevated body temperature; **Respiratory Tract infection =** any episode with associated fever & cough with signs of; sputum, thoracicpain, dyspnoea , or wheezing

2.2.2 Health seeking behavior for diarrhea

HH. No	Child No.	If child had diarrhea in past two weeks, how long did the diarrhea last?	Was the diarrhea treated?	If diarrhea was treated, where was treatment sought?	If treatment was sought at a health facility (1-3), what type of treatment was given for the diarrhea?	If diarrhea was managed at home, (4), what type of treatment was given for the diarrhea?
		1=1-3 days 2=4-7 days 3=8-14 days 4=> 14 days 5= don't know	1=No 2=Yes	1= Hospital 2= Health center 3= Private Clinic 4= Managed at home 5= Traditional healer/herbalist 6= Others (specify)	1= Oral rehydration fluids 2= Antibiotics (specify) 3=Intravenous fluids (specify) 4=Other (specify) 99= Don't know treatment given	1= Oral rehydration fluids 2 = Home based fluids (specify) 3=Other (specify)

2.2.3 Malnutrition diagnosis and health seeking behavior

HH. No	Child No.	Has the child ever been diagnosed to be malnourished or have illnesses related to malnutrition?	If child has ever been diagnosed to have malnutrition, was the malnutrition treated?	If malnutrition was treated, where was treatment sought?	What type of treatment was given for the malnutrition?
		1=No 2=Yes	1=No 2=Yes	1= Hospital 2= Health center 3= Private Clinic 4= Managed at home 5= Traditional healer/herbalist 6= Others (specify)	1= Medication 2= Dietary advise 3=Other (specify) 99= Don't know treatment given

STOOL EXAMINATION TABLE

HH No.	**Child No.**	**Birth Date** (Day/Month/Year)	**Age** (Months)	**Sex** 1= M 2= F	**Stool analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

SOIL ANALYSIS TABLE

VILLAGE/ZONE (LC1):	**SOIL SAMPLE SOURCE:**	**Soil analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

WATER ANALYSIS FORM

VILLAGE/ZONE (LC1):	**WATER SAMPLE SOURCE:**	**Water analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

Appendix 3: Consent form for Key Informants

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MAKERERE UNIVERSITY
P.O. Box 7072 Kampala Uganda
Website: http://www.musph.ac.ug
Tel: 256-41-532207/543872/541437
Fax: 256-41-531807

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF DISEASE CONTROL AND ENVIRONMENTAL HEALTH

CONSENT FORM FOR KEY INFORMANTS

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074.

INTRODUCTION AND WHAT WE ARE DOING

I am _____, and I work at Makerere University School of Public Health. We are conducting a research on Drinking Water Supply, Sanitation, and Hygiene Promotion in your area. This survey is being conducted in two urban communities of Kampala and Mukono districts.
Your contribution during our discussion will be appreciated and helpful in highlighting issues that only a person of your experience can bring forth.

PURPOSE
This research aims at finding out the water supply, sanitation and hygiene status in urban communities, so as to help identify what approaches could be instituted to reduce the incidence of specific illnesses among such communities that are associated with water, sanitation and hygiene. As a person who is engaged in the water/sanitation/hygiene promotion/health and with good working knowledge, we therefore kindly request you to participate as a Key informant.

PROCEDURES
During the interview, you will be asked questions and have an opportunity to share your opinions on issues of socio economic, water, sanitation and hygiene promotion, environmental and health issues in relation to your work and the study area.

The expected duration of the interview will be 1hour. The answers and opinions from the interview will be kept confidential.

RISKS, STRESS, OR DISCOMFORT
We do not anticipate any risk in your participation in the interview.

BENEFITS

There may not be direct benefit to you, but your participation is likely to help us understand the water and sanitation status in these communities, and consequently enable us contribute to the improvement of the community members health and well being.

CONFIDENTIALITY

The information that we collect from this interview will be kept confidential. Information from the interview will be stored in a file that will not have your name on it, but numbers assigned to it instead. No names will be collected from you during this interview.
The information collected will only be used for research purposes.

CONTACT INFORMATION

_____ (Research Assistant) has described to you what is going to be done, and can be contacted at telephone number _____. If you have any other questions or concerns about this study, you may contact the Principal Investigator Dr. John C. Ssempebwa at telephone 0772-963074.

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

VOLUNTARY PARTICIPATION

You do not have to take part in this interview if you do not wish to do so, and refusing to participate will not affect you in any way.
Your participation in this survey is voluntary. Even after you agree to participate, or sign the consent document, you may decide to stop the interview at any time.

SIGNATURES

I have read, or been informed of the information about this research. I have had the opportunity to ask questions about it and any questions I had have been answered to my satisfaction. I hereby consent voluntarily to participate in the interview and understand that I have the right to withdraw at any time without any consequences.

_____ Date _____ _____
Participants signature Participants Code

_____ Date _____ _____
Signature of Research Ass. Name of Research Ass.

_____ Date _____ _____
Signature of Principal Investigator Name of Principal Investigator

Appendix 4: Key Informant Interview guide

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

KEY INFORMANTS INTERVIEW GUIDES

Sub-county…… Parish…….. Zone ……

Title of Respondent …….

Name of interviewer…… Date of the interview……

1. What water sources are available in your community?
……
……
……
……
……..…
2. Is the community able to tell whether water is safe / unsafe for drinking or home use?
Explain……
……
……
……..……
3. Mention any common dangers associated with consumption of unclean water in the community.
……..……
……
……
4. What sanitation facilities are available in your community? (shared/ unshared)
……
……
……
……
……..…

5. Is the community able to tell whether a sanitary facility is hygienic or not?
Explain……
……
……
6. Mention any common dangers associated with use of unsanitary facilities in the community.
……
……
……

7. What is involved in water quality surveillance?
……
……
……
8. Do you think community involvement in Water Quality surveillance and sanitary inspections of excreta facilities is necessary? Explain.
……
……
……
……
9. Do you think the present water quality surveillance system is adequate? Why?
……
……
……
10. Do you think the current hygiene inspections on excreta facility inspection are adequate? Why?
……
……
……
11. How do you rate the involvement of the District leaders, NGOs/CBOs, Communities and Women in the safe water provision, sanitation and hygiene promotion in your area?
……
……
……
……
……

12. Do you have water user committees in your area? What is the composition of these committees? How long ago in months was this committee created? Are you a member of the water use committee?

……
……
……

13. Has the community had any health talks/workshops/seminars on water, sanitation and hygiene promotion?

……
……
……

14a. What factors might influence the community participation in safe water, sanitation and hygiene promotion activities in your area?

……
……
……

14b. How can these challenges be overcome?

……
……
……
……

Thank you!

Appendix 5: Consent form for Focus Group Discussions

MAKERERE UNIVERSITY
P.O. Box 7072 Kampala Uganda
Website: http://www.musph.ac.ug
Tel: 256-41-532207/543872/543437
Fax: 256-41-531807

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF DISEASE CONTROL AND ENVIRONMENTAL HEALTH

CONSENT FORM FOR FOCUS GROUP

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074

INTRODUCTION AND WHAT WE ARE DOING

I am _____, and I work at Makerere University School of Public Health. We are conducting a research on Drinking Water Supply, Sanitation, and Hygiene Promotion in your area. This survey is being conducted in two urban communities of Kampala and Mukono districts.

PURPOSE
This research aims at finding out the water supply, sanitation and hygiene status in your area, so as to help identify what things can be done to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene. As residents of this area, we therefore kindly request you to participate in the focused discussion.

PROCEDURES
During the discussion, you will be asked questions and have an opportunity to share your opinions on issues of socio economic, water and sanitation, environmental and health issues in relation to your area with other members in your area. The discussion will be audio and video recorded. If you so wish not to have any part of the video or audio recording be done, you can ask for that part to be erased.

The expected duration of the discussion will be 1hr 30min. There will be two sessions of such discussions, one at the beginning of the study, and the second during the third (last) year of the study. The answers and opinions from the focus discussions will be kept confidential.

RISKS, STRESS, OR DISCOMFORT
We do not anticipate any risk in your participation in the discussions.

BENEFITS
There may not be direct benefit to you, but your participation is likely to help us understand the water and sanitation state in your community, and consequently enable us improve health in your community.

CONFIDENTIALITY
The information that we collect from this discussion will be kept confidential. Information from the discussion will be stored in a file that will not have your name on it, but numbers assigned to it instead. No names will be collected from you during this interview,and you should not mention any ones names or identifying information about another individual.
The information collected will only be used for research purposes.

CONTACT INFORMATION

_____ (Research Assistant) has described to you what is going to be done, and can be contacted at telephone number _____. If you have any other questions or concerns about this study, you may contact the Principal Investigator Dr. John C. Ssempebwa at telephone 0772-963074.

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

VOLUNTARY PARTICIPATION
You do not have to take part in this discussion if you do not wish to do so, and refusing to participate will not affect you in any way.
Your participation in this survey is voluntary. Even after you agree to participate in the discussion or sign the informed consent document, you may decide to leave the discussion at any time without penalty or loss of benefits to which you may otherwise have been entitled.

SIGNATURES
I have read, or been informed of the information about this research. I have had the opportunity to ask questions about it and any questions I had have been answered to my satisfaction. I hereby consent voluntarily to participate in the discussion and understand that I have the right to withdraw at any time without any consequences.

_____ Date _____ _____
Participants signature Participants Code
_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

Signature of Research Ass. Name of Research Ass.

_____ Date _____ _____

Signature of P.I Name of P.I.

10-138

Approved by IRB
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JUL 20 2011

The University at Albany

Appendix 6: Focus Group Discussion guide

Drinking Water Supply, Sanitation, and Hygiene Promotion: Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

FOCUS GROUP DISCUSSION GUIDE

Group Composition……....

Facilitator……..

Date of Discussion…….. Venue of Discussion……..

INTRODUCTION:

Good morning/afternoon/evening Sir/Madam. Our names are ……..(mention your names). We are a team from Makerere University School of Public Health and would like to discuss with you about Water, Sanitation and Hygiene promotion in yout area. The purpose of our discussion is to help identify what interventions can be put in place to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene promotion status in your area.

Please feel free to ask for clarifications where needed. You do not have to reveal any personal information if you do not want to. All information given will be used develop community interventions only. Your name will be strictly confidential and will not be directly quoted in the report.

Before we begin I ask that we all introduce ourselves. I request that you speak one at a time as well as loudly and clearly when answering a question so that all your views are understood and written down. When making a point during the discussion, you may choose either to use your name or not. To help us capture the whole discussion and ensure that we do not miss anything that you say, I kindly request that we use this tape recorder here. May I use the tape recorder? May I continue with the interview? Thank-you

Moderator requests all participants to introduce themselves

GUIDE QUESTIONS:

A. Overview (Socio economic, environmental and health issues in area)

A1. Socio-economic issues

A1.1 What are the main socio-economic problems faced by people in this area?

A1.2. What categories of people in the community are affected most by these socio-economic problems? (Probe children, adults, boys, girls, males, females)

A1.3. What do you think are the causes of these socio-economic problems?

A1.4. In your opinion what are the main signs/manifestations of socio-economic problems in the area?

A1.5. In your opinion, during the last five years, do you think socio-economic problems in this area have decreased, remained stable of worsened?

- Give reasons why you think socio-economic problems have decreased, remained stable of worsened?

A1.6. What do you think should be done to improve the socio-economic situation of the affected people in this area. (Probe for best means for alleviating proverty)

A2. Environmental issues

A2.1 What are the main environmental problems faced by people in this area?

A2.2. What categories of people in the community are affected most by these environmental problems? (Probe children, adults, boys, girls, males, females)

A2.3. What do you think are the causes of these environmental problems?

A2.4. In your opinion what are the main signs/manifestations of these environmental problems in the area?

A2.5. In your opinion, during the last five years, do you think these environmental problems have decreased, remained stable of worsened?

- Give reasons why you think socio-economic problems have decreased, remained stable of worsened?

A2.6. What do you think should be done to alleviate the environmental problems of the affected people in this area.

A3. Health issues

A3.1 What are the main health issues/diseases faced by people in this area?

A3.2. What categories of people in the community are affected most by these health issues/diseases? (Probe children, adults, boys, girls, males, females)

A3.3. What do you think are the causes of these health issues?

A3.4. In your opinion what are the main signs/manifestations of health problems in the area?

A3.5. In your opinion, during the last five years, do you think these health problems in the area have decreased, remained stable of worsened?

- Give reasons why you think these health problems have decreased, remained stable of worsened?

A3.6. What do you think should be done to improve the health status of the affected people in this area?

B. Diarrhoea

B1. Would you say diarrhoea is a big problem in this area? Yes/No

- If yes, why?
- If no, why do you say diarrhea is not a big problem in this area?

B2. What are the common types of diarrhea you have seen in this area? (Probe watery/bloody diarrhea)

B3. Do the residents normally seek treatment for diarrhea? Yes/No

- If yes, where do community members normally seek treatment for diarrhea?
  - In your opinion, why do you think they seek treatment in this place?
  - What is the common type of treatment given for diarrhea?
- If no, why do you think they do not seek treatment for diarrhea?

B4. In your opinion, what do you think is the cause of diarrhea in this area? (Probe for water, sanitation, and hygiene conditions)

B5. What are some of the factors influencing community members to adopt good water, sanitation and environmental hygiene practices?

B6. What are some of the barriers hindering community members from adopting good water, sanitation and environmental hygiene practices?

B7. Are you aware of any organisations who have been working in this area to address the issue of diarrhea? Yes/No

- If yes which are these Organisations?
- What were these Organisations doing?

B8. Are you aware of any community efforts in the area to address the issue of diarrhea? Yes/No

- If yes, what are the community efforts in place?
- If no, what community efforts do you think should be done to reduce the incidences of diarrhea in this area?

B9. Who do you think should put into place these interventions to reduce diarrhea and why?

C. Water

C1. What water sources are available in your community?

a) Are all of them functioning? If no why?
b) Which ones are used most by the community? Why?

C2. What is involved in water quality surveillance?

a) Do you think community involvement in Water Quality surveillance is necessary? Explain.
b) Do you think the present water quality surveillance system is adequate? Why?

c) How do you rate the involvement of the District leaders, NGOs/CBOs, Communities and Women in the safe water provision and water quality surveillance processes in your area?
d) Have you had any sensitization workshop/seminar on water quality surveillance?
e) How do you tell that water is not safe for drinking or home use?
f) Discuss any dangers associated with consumption unclean water.
g) How do you think the community and women can be involved in water quality surveillance?

C3. Do you have Water User Committees in your area?

a) What is the composition of these committees?
b) How long ago in months was this committee created?
c) How often do committee members meet?
d) How often do the committees change leadership?
e) Have the committees got any training in Operation & Maintenance of water facilities ?
f) What are the roles and responsibilities of the committees?
g) How do the committees raise funds for running their activities?

D. Do you have any questions or comments regarding our topic of discussion?

THANK YOU FOR YOUR TIME AND COOPERATION

END

Appendix 7: Assent form

Drinking Water Supply, Sanitation, and Hygiene Promotion: Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Assent Form

10-138
Approved by IRB
Valid Thru:
JUL 20 2011
The University at Albany

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074

My name is ..... I am trying to learn about Drinking Water, Sanitation, and cleanliness in your area because. This exercise wants to find out the safety of the water consumed in your area, and the cleanliness of the surroundings, so as to help identify what things can be done to reduce the incidence of specific diseases, particularly diarrhea.

If you decide you want to be in my research, I will collect a small amount of your feces when you go for a long call. You will defecate in a potty, from which I will remove a small amount of the feces to take back with me to the laboratory. In the laboratory, we shall look for small organisms that are contained in the feces to find out whether they are the ones causing you to have diarrhea. I might come back after 3 or 6 months to collect another feces sample if you will still be having diarrhea.

If you are found to have organisms that that cause diarrhea, you will be given medicine to make you feel better, so that you can once again play with your friends. Where water is found to be unsafe for use, I will advise your parents on how best to treat the water so that you don't get diarrhea and to also clean around your home. You will experience no pain from this study.

Other people will not know if you are in my research. I will put things I learn about you together with things I learn about other children in your area, so no one can tell what things came from you. When I tell other people about my research, I will not use your name, so no one can tell who I am talking about.

Your parents or guardian have to say it's OK for you to be in the research. After they decide, you get to choose if you want to do it too. If you want to be in the research now and change your mind later, that's OK. Iit's okay to stop at any time and no one will punish you.

My telephone number is 0772-963074. You can call me if you have questions about the research or if you decide you don't want to be in the research any more.

I will give you a copy of this form in case you want to ask questions later.

Agreement

I have decided to be in the research even though I know that I don't have to do it.

.....(Name of Research Assistant) has answered all my questions.

Code of Study Participant Date

Signature of Research Assistant Date

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

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Appendix 8: Communal / household latrine observation checklist

Drinking Water Supply, Sanitation, and Hygiene Promotion:

Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

COMMUNAL/HOUSEHOLD LATRINE OBSERVATION CHECKLIST

1. Zone (LC 1):…… 2. Code Number ……

3. Date of Visit ……

1.	Does the household have no latrine?	Y/N
2.	Is the latrine > 5 meters from the house?	Y/N
3.	Has the latrine got no proper access leading to it ?	Y/N
4.	Has the latrine lack a door?	Y/N
5.	Does the latrine lack a roof?	Y/N
6.	Does the latrine lack a hole cover	Y/N
7.	Does the latrine lack a ventilation pipe?	Y/N
8.	Is the bottom of the latrine seen?	Y/N
9.	Is there presence of fecal matter/urine on the slab?	Y/N
10.	Is the latrine smelly?	Y/N
11.	Is the latrine infested with flies?	Y/N
12.	Are the latrine walls smeared with fecal matter?	Y/N
13.	Is there no hand washing facility near the latrine?	Y/N
14.	Is there no soap near latrine hand washing facility?	Y/N

Total Score of Contamination Risks ……../14

Contamination Risk Score: 10-14 = Very high; 7-9 = High; 4-6 = Medium; 1-3 = Low 0 = None

Results and Recommendations:

The following important points of risk were noted:

Name and signature of Research Assistant: ……..…

COMMUNAL / HOUSEHOLD ENVIRONMENTAL HYGIENE

OBSERVATION CHECKLIST

1. Zone (LC 1):…… 2. Code Number ……

3. Date of Visit ……

Environmental hygiene

1. Is the household environment dirty? (litter around the house) Y/N
2. Is there no dustbin for household rubbish? Y/N
3. Is the dustbin dirty and overflowing? Y/N
4. Is there fecal matter around the household? Y/N

Drainage

5. Is there no drainage around the house? Y/N
6. Is the drainage around the house clogged? Y/N

Utensils

7. Is there no utensil drying rack present? Y/N
8. Are the household utensils dirty and left unclean in the open? Y/N

Water container

9. Does the drinking water container have a wide mouth/opening? Y/N
10. Has the drinking water container got no lid/cover? Y/N
11. Is the drinking water container kept on the floor level? Y/N
12. Is the inside of the container dirty? Y/N
13. Is the outside of the container dirty? Y/N

Total Score of Contamination Risks …….../12

Contamination Risk Score: 10-12 = Very high; 7-9 = High; 4-6 = Medium; 1-3 = Low 0 = None

Results and Recommendations:

The following important points of risk were noted:

Name and signature of Research Assistant: ……..……

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

Baseline Survey Report

Kikulu Zone, Kawempe Division, Kampala City

Prepared by:

Department of Disease Control and Environmental Health
Makerere University College of Health Sciences
School of Public Health

June, 2011

ACKNOWLEDGMENTS

Makerere University School of Public Health would like to extend its gratitude to the Higher Education for Development (HED) for the commitment and financial support towards this project.

We would also like to acknowledge our partners in implementing this project from University at Albany, State University of New York and Tuskegee University, Alabama, US.

Special thanks go to Kawempe Division authorities as well as the local community in in the area who gave valuable information that was used in the compilation of this report. We also extend our gratitude to the local council leaders and all the members of local organizations that were consulted during this study.

All the other stakeholders including NGOs, government institutions, schools and health facilities that contributed and participated in this study are also greatly appreciated for their support, cooperation and guidance in the entire process.

We are grateful to the entire research team that worked during the process of the study including data collection, entry, analysis and report writing. We also greatly appreciate the support of all members who contributed to this survey directly or indirectly.

ABBREVIATIONS

FGD	Focus Group Discussion
HED	Higher Education for Development
HH	Household
HHH	Household Head
KCC	Kampala City Council
KIs	Key Informants
MakSPH	Makerere University School of Public Health
MOH	Ministry of Health
MWLE	Ministry of Water, Lands and Environment
SPSS	Statistical Package for Social Scientists
UNDP	United Nations Development Program

KEY CONCEPTS

Access to safe water: the number of people who have a reasonable means of getting an adequate amount of water that is safe for drinking, washing, and essential household activities, expressed as a percentage of the total population.

Morbidity rates: the proportion of patients with a particular disease during a given year per given unit of population.

Mortality rates: number of deaths (in general, or due to a specific cause) in some population, scaled to the size of that population, per unit time. Mortality rate is typically expressed in units of deaths per 1000 individuals per year.

EXECUTIVE SUMMARY

Introduction and background

In slum settlements of Kampala and Mukono, the major risk factor for diarrheal diseases is contaminated drinking water due to poor latrine status, low safe water coverage, and poor domestic and personal hygiene practices. The majority of community members have insufficient knowledge on the link between water, sanitation, hygiene and health evidenced by the frequent epidemics of cholera and a high incidence of diarrheal diseases particularly in children under 5 years. To address these challenges, Makerere University School of Public Health in partnership with University at Albany, State University of New York, USA and Tuskegee University, Alabama, USA are implementing this project to promote safe drinking water supply, sanitation and hygiene among two urban slum areas in Kampala district and Mukono municipality.

Objectives

The general objective of the project is to improve the health status of the inhabitants of the two communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities through community pro-active and sustainable interventions.

This baseline survey aimed at examining the socio-economic and cultural factors and practices that result into the current environment and community health status; analyzing the linkages between the bio-physical factors and health status.

Survey methods

The survey was cross-sectional in nature involving both qualitative and quantitative data collection methods. It was conducted in Kikulu Zone, Kawempe Division, Kampala City. A total of 102 households were involved in the survey. 12 key informant interviews and 4 FDGs were also held. Drinking water, soil and stool samples from children with diarrhea were collected from the households and analysed.

Summary of findings

- Public taps were the most used water sources among the households (67.6%). Over three quarters of the respondents paid 100 or 150 Uganda shillings per 20 liter jerrycan of piped water.
- Almost all the households (96%) boiled their water in order to render it safe for drinking. The majority of households (69.9%) stored their drinking water in plastic jerrycans with covers. About a quarter of the households (27.5%) had drinking water with no coliforms therefore making it safe for consumption. However, almost a third of the households (39.4%) had drinking water with too numerous to count colony forming units.
- The majority of households (73.5%) owned latrines. Most of the households which did not have latrines used community ones which they shared among 1 – 5 households. Large proportions (82.3% and 85.3%) of the latrines lacked hole covers and vent pipes respectively.
- Over half of the households (58.8% and 53.9%) lacked dustbins and utensil drying racks respectively.
- There was poor solid waste management noted in the area with a significant number of households (47.1%) disposing of refuse in open pits where it eventually got burnt. No skip was available in the community for storage of waste.
- Private clinics were the first choice health facility for households seeking healthcare. The prevalence of diarrheal diseases and fever among children was low. A significant number of children (41.4%) did not have their immunization cards available.
- Mass media (radio and television) were the primary source of health, hygiene and sanitation information. The most preferred language by the respondents for health education was *Luganda*.

Conclusions

- Public taps were the commonest source of water.
- Boiling water was the commonest practice by households to render it safe for drinking.

- From bacteriological analysis, most of the drinking water of the households was contaminated with fecal coliforms therefore unsafe for human consumption.
- Households in the area mostly use shared latrines. Majority of the latrines lacked hole covers, ventilation pipes, handwashing facilities and soap for washing hands.
- There was poor solid waste management with majority of households disposing of refuse in open pits.
- Private clinics were the first choice health facility for the households seeking healthcare.
- Mass media was the primary source of health, hygiene and sanitation information.
- The most preferred language for health education was *Luganda*.

Recommendations

1. The project should health educate the community on the best practices in safe water, sanitation and hygiene at household levels.
2. *Luganda* should predominantly be used while carrying out health education among the community.
3. The project can explore the use of mass media particularly radio to pass on health information to the community.
4. The project should sensitize parents to always keep the immunisation cards of their children.
5. Kampala City Council should endeavour to provide a skip in the community to improve refuse management in the area.

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CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1. Introduction

Between 1900 and 1930 total mortality in the US fell from 17.5 to 8 deaths per 1,000 population (McKinlay and McKinlay, 1977). This was a period prior to there being any effective antibiotics, prior to most immunizations and certainly prior to the current excellent but expensive modern medicine. The reason is almost entirely the provision of clean drinking water and improved general sanitation. The decline in total mortality in the US in this 30 year period is greater than any proportional improvement at any time since, even with the development of high-tech medicine. Thus access to clean drinking water is one of the most important factors in determining the health of a population.

Drinking water can come from only two natural sources: ground water and surface water. Whereas ground water is usually less contaminated than surface water, primarily because of the natural filtration through soil, both are vulnerable to contamination with infectious organisms as well as chemical contaminants. Therefore, one cannot discuss safe drinking water without considering the sources of contamination.

Although internationally recognized, the term “sanitation” is usually used in the narrow sense of excreta disposal, excluding other environmental health interventions such as solid waste management and surface water drainage. In this study, solid waste management and surface water drainage are considered as components of sanitation and as being relevant in the efforts to deliver clean drinking water.

Worldwide, low-income populations inhabit the fringes of cities and often these settlements transform into slum settings. Rapid growth of slums has become a global concern (UN-HABITAT, 2003; UNDP, 2003). In particular goal 7, target 11 of the millennium development goals, aims at significantly improving the lives of at least 100

million slum dwellers by the year 2020 (UNDP, 2003). The majority of this population resides in low income countries, accounting for 43% of the urban population, in contrast to 6% in high income countries. Sub-Saharan Africa had the largest proportion of the urban population resident in slums, which reached 71.9% in 2001 (UN-HABITAT, 2003). The worldwide number of slum dwellers increased by 36% in the 1990s to 923 million people. At its current pace, the number could double to 2 billion by 2030 (Beth, 2009).

As cities continue to expand and the economic situation deteriorates, the poor are pushed to the outskirts which are congested, unplanned and inadequately provide infrastructure and services. This is particularly true of Sub-Saharan Africa cities. Furthermore, the continued rural-to-urban migration of a predominantly poor population, the bulk of who are engaged in informal economic activities, has accelerated the growth of slums. The government of Uganda has launched a national Urban Campaign with a pledge to promote policies that would provide more access to housing and services for the urban poor.

Slums are characterized by problems that only vary in magnitude from one place to another. Slums are conspicuous for environmental decay, giving rise to unprecedented health risks to communities. Clear manifestations of the fast declining health status triggered by the degradation in the ecosystem in slums in Uganda, and especially in Kampala, are evidenced by the epidemics of cholera and typhoid, and a high incidence of diarrheal diseases with a case fatality rate of 2.5% and causing 19% of infant deaths (Alajo et al., 2006). Other ill health conditions common in slums which affect mostly children under 5 years include malnutrition, malaria and pneumonia.

Slum dwellings are characterized by the following problems: poor solid waste management, inadequate excreta management, insufficient drinking water management, unsatisfactory wastewater management, unequipped drainage especially of stormwater, poor housing conditions, unsafe food safety and nutrition, undesirable vector and vermin control, and unhealthy personal and general hygiene.

According to the Uganda Demographic and Health Survey (2006), only 15% of the households in urban areas have improved and non-shared toilet facilities. This leaves most of the households in urban areas using non-improved facilities such as pit latrines without slabs and are shared facilities with other households that very often are unhygienic and foul smelling. According to the Sanitation Strategy and Master Plan for Kampala City (2004), between 3 to 7 households in Kampala use shared toilets because of large number of people living in these areas.

Water is an important component of sanitation and it impacts the health status of the population. Unsafe drinking water causes diseases which can be classified as water or excreta related. Many are both. Diseases such as cholera, typhoid, dysentery, diarrhea, guinea worm and hookworm infestations commonly occur in Kampala. In the past decade, cholera epidemics have been experienced almost every year. In 2008, there were 101 reported cholera cases and 8 deaths in Kampala. Cholera is almost always caused by consumption of contaminated drinking water. The major factors leading to contamination of the drinking water are low latrine coverage, low safe water coverage and poor domestic and personal hygiene practices (MoH, 2004/05).

1.2 Background

While there has been rapid growth of a poor population in the slums in Africa, and in Uganda in particular, slums lack adequate safe drinking water and sanitation services, leading to poor personal and general hygiene. The situation is aggravated by the fact that urban authorities lack the resources to satisfactorily provide the required services and infrastructure. As a result slums have become breeding grounds for disease, making the search for solutions to improve health in slums an utmost urgency. In addition to poor environmental health in Ugandan slums, worsening poverty has led to poor nutrition which particularly affects children, making the control of diseases related to poor nutrition difficult. In response to this, temporary clinics are often established to handle immediate cases. These clinics, however, are far from satisfactory in terms of resources, facilities, and health personnel and cannot be sustained for a reasonable

period of time. This further worsens the condition as these illnesses are poorly managed, contributing to the high infant mortality rate. The envisaged plausible solution to which this project is targeted is to seek solutions within the affected communities in order to improve the prevailing poor environment in slums as a deliberate effort to improve community health.

This project is targeting Kikulu zone, Kawempe division, Kampala city; and Basiima Kikooza, Kitega, Lweza and Ngandu wards in Mukono municipality. The goal of the project is to improve the health status of the inhabitants of these communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities.

Both study areas in Kampala and Mukono (more so Kampala) are characterized by floods after every heavy rain downpour. The inadequacy of drainage channels coupled with blockage of those in existence creates ideal conditions for flooding. Flood waters in Kikulu zone have been reported to wash excreta material into water and food intended for human consumption. Disease outbreaks have been reported in both areas. Kalerwe, which is a nearby community to the Kampala study area, has registered cases every rainy season when cholera epidemics are reported in Uganda. These include: 1978, 1982, 1991, 1992, 1997, 1998 and 2002 (Wandiga, 2006). Globally the most severe cholera outbreak was reported in 1998, with 72% of the cases in Africa, and with Uganda being among the most affected countries (Alajo et al., 2006; EPI/IDS, 2000). The major health risk factors among the project communities in Kampala and Mukono are low latrine coverage, low safe drinking water coverage, and poor domestic and personal hygiene practices. The situation is life threatening to the extent that the word cholera or typhoid in Kampala district is synonymous with some areas such as Kalerwe.

1.2.1 The Water Situation at Present

The communities of Kikulu zone, and those in Mukono municipality rely on piped and/or non-piped drinking water sources. The water sources include springs, some of which are unprotected, boreholes, wells and streams. Some of these are liable to flooding during rains. In addition, access to water at some points is limited because there are user fees associated with drawing water, and many poor people cannot afford to pay these fees. This forces some people, especially the very poor, to continue to use alternative traditional sources which are of poor quality. Some people are not within easy distance to the water sources, often being beyond 1.5 kilometers, the maximum distance set in the National Water Policy. Studies have shown that the distance to the source is a major factor determining the quantity of water used in a household (MWLE, 2003).

At some water points, physical access is also a problem both at the exact points and/or the foot paths leading to the point. Community members with physical disabilities as well as children are most likely given the role of fetching water and may not be able to collect water without assistance. Women and children may feel insecure when traveling to isolated locations which limit them from gaining access as much as they would like, and consequently reducing the amount of water used or being driven to alternative unsafe water sources.

Some of the water points, particularly the piped water supply, have an irregular supply, sometimes for a limited number of hours in a day. There is also the problem of crowding at water points, which leads to extended collection times that reduces time for tending to other tasks. Both of these circumstances affect the quantity of water used for domestic purpose. The construction of some water points is substandard, and the poor hygienic conditions in surrounding areas can easily cause contamination of water sources.

In these settlements where piped water is available, it is not regularly or properly tested. This situation could be improved if more hard data were available on the quality of drinking water sources. However, the cost and technical complexity of water testing and treatment has presented real barriers to the wider and more systematic use of these tools in the detection and prevention of water-borne bacteriological health risks.

1.2.2 Sanitation in Kampala and Mukono

In both slum settlements of the study areas in Kampala and Mukono in Uganda, the major risk factor for diarrheal diseases is contaminated drinking water due to low latrine coverage, low safe water coverage, and poor domestic and personal hygiene practices. As a result of poor planning, often the location of pit latrines and other sanitary facilities is such that they end up contaminating the drinking water sources. The majority of pit latrine facility users have insufficient knowledge of the link between fecal matter and health, making the utilization and maintenance of such facilities poor.

There are very few latrines, with many being shared between families in tenements. Many pit latrines are not constructed to recommended standards and this predisposes them to collapse and / or quick filling and infestation with flies, cockroaches and mosquitoes. In some areas of these slum settlements, “flying toilets “are used. Flying toilet is a practice that involves defecation in a plastic bag, which then gets thrown away indiscriminately at night.

While the linkage between water quality and disease is not well appreciated at the community and household levels, waterborne diseases constitute a major public health burden for communities in Uganda, often leading to serious epidemics of diarrhea, typhoid and cholera. Inadequate training, lack of appropriate equipment and facilities for water quality testing and treatment at the source and at household levels, inadequate budget allocations for water quality testing and management, low levels of public awareness and poor enforcement of legislation regarding safeguarding water

quality and source protection all contribute to the poor state of water quality management.

Poor infrastructure and poor urban services in urban settlements often result in a poor environment and poor community health. Diarrheal diseases, especially among children below 5 years, are among the major diseases identified.

These factors direct the project and are the focus of the environment and health improvement interventions at the study sites. By enabling these communities to achieve safer drinking water and sanitation, this project will contribute to a more equitable and sustainable development – economic, social and environmental.

1.3 Statement of the problem and justification

In both slum settlements of Kampala and Mukono, the major risk factor for diarrheal diseases is contaminated drinking water and food due to low latrine coverage, low safe water coverage, and poor domestic and personal hygiene practices. The majority of the community members have insufficient knowledge of the link between water, sanitation, hygiene and health, evidenced by the epidemics of cholera and typhoid, and a high incidence of diarrheal diseases particularly in children under 5 years.

The project is enhancing the human and institutional capacity building at Makerere University while targeting improvements in both the environment and the health of the selected communities.

The project is focused on providing education and local empowerment in these communities by helping residents understand the causes of disease.

By enabling these communities to achieve safer drinking water and sanitation, the project is contributing to a more equitable and sustainable development – economic, social and environmental.

1.4 General Objective

To improve the health status of the inhabitants of the two communities through implementation of strategies targeting two priority problem areas: access to safe drinking water and improved sanitation facilities through community pro-active and sustainable interventions.

1.5 Specific objectives

Baseline phase

- Examine the socio-economic and cultural factors and practices that result into the current environment and community health status in the two study sites.
- Analyze the linkages between the bio-physical factors and health status in the two study sites with a focus on diarrheal diseases.

Intervention phase

- Initiate and pilot community based health interventions for reducing morbidity due to ill health with specific emphasis on diarrheal diseases.

1.6 Performance Objectives

1. To survey the water sources and sanitation facilities available in the study areas.
2. To estimate the current incidence of selected water-borne and excreta diseases in the population with an emphasis on children.
3. To identify risk factors associated with identified water and excreta related diseases in these specific communities.
4. To determine constraints limiting access and proper utilization of water and sanitation facilities which impede hygiene conditions in the study areas.
5. To use the information obtained to promote policies that will address the infrastructural and educational issues within the governments of Uganda and other nations.

CHAPTER TWO

BASELINE SURVEY METHODS

2.1. Survey area

The survey was conducted in Kikulu zone which is located in Kisaasi parish, Kawempe Division, Kampala city. It has an estimated area of 6 square kilometres with a population of 6,576 people (Kawempe Division, 2008). There are three (3) primary schools and one (1) secondary school in this zone. There are no government health units in the area with the nearest health unit located 1 ½ Kms from the zone. The area is predominantly residential with several small businesses managed by residents.

2.2. Survey design

It was cross-sectional in nature involving both qualitative and quantitative data collection methods.

2.3. Survey population

The Kikulu zone population was the survey population.

2.4. Survey units

The survey units were the households in Kikulu zone.

2.5. Sample size

2.5.1. Household sample size

The sample size of households that were involved in the survey was calculated using the formula of cross–sectional studies. The formula was derived by Kish Leslie (1965); however it was modified to incorporate a power calculation. The formula is as follows.

$$n = \frac{z^2 pq}{d^2} = \frac{z^2 p(1 - p)}{d^2}$$

Where;

$q = 1 - p$

Z^2 = standard critical value at 95% confidence (1.96)

n = sample size

p = since there was no accurate data on sanitary facility coverage specific to Kawempe division, a prevalence of 50% was assumed

d = level of precision; for the study we selected a precision of 10%.

$$\frac{(1.96^2 \times 0.5 \times 0.5)}{0.1^2}$$

= 96 households

A total of 102 households were considered for the survey.

2.5.2. Key informants' sample size

A total of 12 key informants were considered for the baseline survey.

2.5.3. Focus group discussion sample size

A total of four (4) FGDs were conducted for different categories of populations in the community. The categories were male adult, female adult, male youth and female youth. Each FGD had between 7 – 9 participants.

2.6. Sampling procedure

2.6.1. Household interviews

Kikulu zone was divided into five (5) geographical clusters since there were five pairs of data collectors. In each of the clusters, an average of 20 households was sampled. In each cluster, the relative central point was the starting point and moved spirally outwards skipping one household. Only households with children below five years were eligible to participate in the survey. In the event that a household did not have a child under five years, the next household which met that criterion was selected.

2.6.2. Key informants

These were chosen from a cross section of persons who were well informed about the different aspects that the survey looked at. The categories among which these key informants were selected included local leaders, religious leaders, teachers and health workers.

2.6.3. Focus group discussion participants

The different FGDs for adult men, adult female and youths had various participants who were chosen with regards to their geographical location to ensure that the entire zone was well represented in each FGD.

2.7. Data and data collection

2.7.1. Data types

Primary data was collected from the field while secondary data was obtained from review of documents. Primary data was both qualitative and qualitative. Quantitative data was collected from the household questionnaires and observational checklists while qualitative data was got from key informant interviews and focus group discussions.

2.7.2. Data collection tools

Household questionnaires were used to collect data from households. Key informant interview and focus group discussion guides were used to gather information from key informants and FGD participants respectively. Observational checklists for different aspects including environmental sanitation, status of sanitary facilities and cleanliness of water storage facilities were used to make key observations relevant to the study.

2.7.3. Data collection procedure

2.7.3.1. Questionnaire administration

Household questionnaires were administered to household heads or the adult next of kin found at the household at time of data collection. The interviewers asked questions and recorded responses as mentioned by the respondent.

2.7.3.2. Focus group discussions

For the FGDs, there was a Chairperson and two Secretaries. The Chairperson moderated the discussions while the Secretaries took notes which they later compared and merged. The discussions were also tape recorded and later transcribed for inclusion in the report.

2.7.3.3. Observations

The observation checklists used entailed the data collectors making key observations using their senses majorly sight and smell.

2.7.4. Water sample collection

Water samples were collected from all sampled households. Specifically, water samples were obtained from drinking water storage facilities that each household used.

Equipment for water sample collection included:

1. Sterile water sample collection bottles (300 ml)
2. Cooling box for the collected water samples
3. Sample labels

Procedure:

- The sterile sample collection bottles were kept in a cooling box.
- At the point of collection of the water sample, the data collector carefully opened the sterile water sample bottle and collected the sample.
- The sample was coded with a number corresponding with that of the household where it was obtained then placed in the cooling box.
- The source of the water sample (household drinking water storage facility) was then recorded on the household questionnaire.

2.7.5. Stool sample collection

Stool samples were collected from only children under five years who had diarrhea at the time of the survey.

Materials and equipment for stool sample collection included:

1. Stool sample collection bottles (50ml) (with a scooping spoon)
2. Cooling box for the collected stool sample
3. Sample labels
4. Hand gloves
5. Polythene bags

Procedure:

- After establishing that the child had an episode of diarrhea in the past 24 hours, the mother was requested to give the child his or her usual defecation facility (potty, paper or any other material) for the child to defecate while other interviews continued.
- After the child had defecated, the data collector then put on gloves, opened the stool sample bottle and scooped at least ten (10) spoonfuls of the stool. The data collector then closed the stool sample bottle tightly, sealed it in transparent polythene then put the sample in the cooling box.
- The gloves were then removed carefully and place in a black polythene. The data collector then washed hands thoroughly with soap before proceeding with any other activity.

2.7.6. Soil sample collection procedure

Soil samples were got from all households that were sampled. The choice of the specific location where the soil samples were obtained was on the basis of the information about the place where children mostly played from within the compound. This information was got from the respondent.

Materials and equipment for soil sample collection were:

1. Meter rule
2. Trowel
3. Polythene bags for sample collection
4. Sample labels
5. Gloves

Procedure:

- At the identified location within the household compound where children play from, the data collector measured a 60 cm sq. on the ground using the meter rule with gloves on.
- The data collector then clearly demarcated the square using the trowel and removed any big materials of more than 5 cm^3.
- Using the trowel, the top soil was scraped from all the corners of the demarcated square towards its center.
- The collected soil was then placed in the small polythene bag and labeled.
- The soil samples were put in a lager polythene bag for transportation to the laboratory for analysis.
- The data collectors then removed the gloves and washed their hands with soap before proceeding with any other activity.

2.8. Data analysis

2.8.1. Household questionnaires

Data from questionnaires was cleaned and entered in Epidata software. The entered data was cleaned and transferred to SPSS for Windows version 17.0 for analysis using stata transfer version 10.

2.8.2. Water sample analysis

Standard bacteriological procedures for water quality testing were adopted. The parameters that were examined for were colony forming units (CFU/50ml).

2.8.3. Stool sample analysis

Standard procedures for stool sample analysis were adopted. The analysis techniques of the stool samples included macroscopy, microscopy, modified ZN stains and culture and antibiotics sensitivity testing. The organisms investigated for in the stool sample analysis included ova, cysts, yeast cells and oocysts.

2.8.4. Soil sample analysis

Standard procedures for soil sample analysis were adopted. The organisms investigated for in the soil sample analysis included ova, cyst or larvae of any pathogenic organism.

2.9. Quality control and assurance

A team of ten (10) competent and experienced data collectors was used in this survey. These were trained for four days to ensure that they were well versed with the data collection process. Experienced trainers from MakSPH for the different data collection aspects including stool, water and soil sample collection were used to train the data collectors.

During data collection, the data collectors were paired to increase efficiency in the data collection process.

The survey supervisors closely followed the work of the data collectors throughout the entire process and at the end of each day, held debriefing meetings to share experiences to improve on the process whenever there was need.

2.10. Ethical considerations

The project got approval from University at Albany, State University of New York Institutional Review Board (IRB Protocol Number: 10-138).

Ethical approval was also obtained from Makerere University School of Public Health Higher Degrees, Research and Ethics Committee. Research clearance was also obtained from Uganda National Council for Science and Technology.

Several meetings were held with community local leaders informing them about the project and the baseline survey activities.

All the respondents only participated in the survey after understanding the purpose of the survey and giving a written consent. For the children who were involved in the survey especially those who gave the stool samples, an assent form was signed by the parents before the providing the sample.

CHAPTER THREE

RESULTS AND DISCUSSION

3.1. Socio demographic characteristics

3.1.1. Socio demographic characteristics of respondents

The socio-demographic characteristics of respondents are shown in Table 3.1.

Table 3.1: Socio demographic characteristics of the respondents

Variable	Particulars	Frequency (N = 102)	Percentage (%)
Sex	Male	10	9.8
	Female	92	90.2
Marital status	Singe (never married)	7	6.9
	Married / cohabiting	89	87.3
	Divorced / separated	6	5.8
Age group (years)	19 - 24	25	24.5
	25 - 34	55	53.9
	35 - 44	19	18.6
	45 - 54	1	1.0
	55 and above	2	2.0
Religion	Catholic	23	22.5
	Anglican	18	17.6
	Pentecostal	17	16.7
	Muslim	43	42.2
	Others	1	1.0
Highest education level attained by respondent	None	5	4.9
	Primary 1 – Primary 7	38	37.3
	Senior 1 – Senior 4	43	42.2
	Senior 5 – Senior 6	4	3.9
	College (post Senior 4)	3	2.9
	College (post Senior 6)	6	5.9
	University	3	2.9
Region of origin	Kampala	7	6.9
	Central	48	47.1
	Eastern	24	23.5
	Northern	3	2.9
	West Nile	2	2.0
	Western	18	17.6
Duration spent in the area	Less than 1 year	11	10.8
	1 – 3 years	30	29.4
	3 – 5 years	21	20.6
	More than 5 years	38	37.3
	Do not remember	2	2.0
Respondent status	Household head	24	23.5
	Not household head	78	76.5
Respondent's Relationship to household head (n = 78)	Spouse	70	89.7
	Son/daughter	5	6.4
	Sister/brother	2	2.9
	Other relative	1	1.3

The majority of respondents (90.2%) were females. A large proportion of the respondents (87.3 %) were married / cohabiting. Over half of the respondents (53.9%) were in the age group of 25 – 34 years of age. Over 40% of the respondents were Muslims. This is higher than national statistics that put the percentage of the Muslim community below 30%. This implies that Islamic values and traditions with regard to hygiene and sanitation will be more dominant in this area as compared to other areas where the percentage of Muslim community is low. Only 4.9% of the respondents had never been to school. However, the majority had dropped out in either primary (37.3%) or lower secondary (42.2%) levels. Nevertheless, this is a relatively high literacy level in the community which can be explored during health promotion. Over half of the respondents originated from the central region including Kampala. However, a certain proportion of respondents (23.5%) migrated from the eastern part of the country. Rural – urban migration is a common phenomenon where people move to urban centres looking for means of earning a living. Indeed, their only starting point is getting shelter in low cost areas where they can afford accommodation among other needs. More than half of the respondents had stayed in the area for at least three years. It is therefore likely that they were familiar with their environment and could provide adequate information about the water, hygiene and sanitation situation in the area.

3.1.2. Socio demographic characteristics of household heads

The socio-demographic characteristics of the household heads who were not respondents in the survey are shown in Table 3.2.

Table 3.2: Socio demographic characteristics of household heads

Variable	Particulars	Frequency (N = 78)	Percentage (%)
Sex	Male	69	88.5
	Female	9	11.5
Marital status	Single (never married)	2	2.6
	Married/cohabiting	71	91.0
	Widowed	2	2.6
	Divorced/separated	3	3.9
Age group (years)	19-24	2	2.6
	25-34	34	43.6
	35-44	28	35.9
	45-54	8	10.1
	55-64	2	2.6
	65 and above	2	2.6
	Don't know	2	2.6
Religion	Catholic	23	29.5
	Protestant	15	19.2
	Pentecostal	7	10.3
	Muslim	32	41.0
Education level	None	5	6.4
	Primary 1-Primary 7	17	21.8
	Senior 1-Senior 4	29	37.2
	Senior 5-Senior 6	12	15.4
	College (post senior 4)	5	6.4
	College (post senior 6)	3	3.8
	University	7	9.0
Region of origin	Kampala	6	7.7
	Central	38	48.7
	Eastern	14	17.9
	Northern	5	6.4
	West Nile	3	3.8
	Western	12	15.4
Duration stayed in the zone (years)	Less 1	6	7.7
	1-3	19	24.4
	3-5	16	20.5
	More than 5	34	43.6
	Don't know	3	3.8

The majority of household heads who were not respondents (89.6%) were males. The majority of household heads were married, from central region, in the age bracket of 25 – 44 years and had a relatively high literacy level. In water, hygiene and sanitation programs, it is important to involve household heads as much as possible since these are the decision makers at family level who also determine household expenditure.

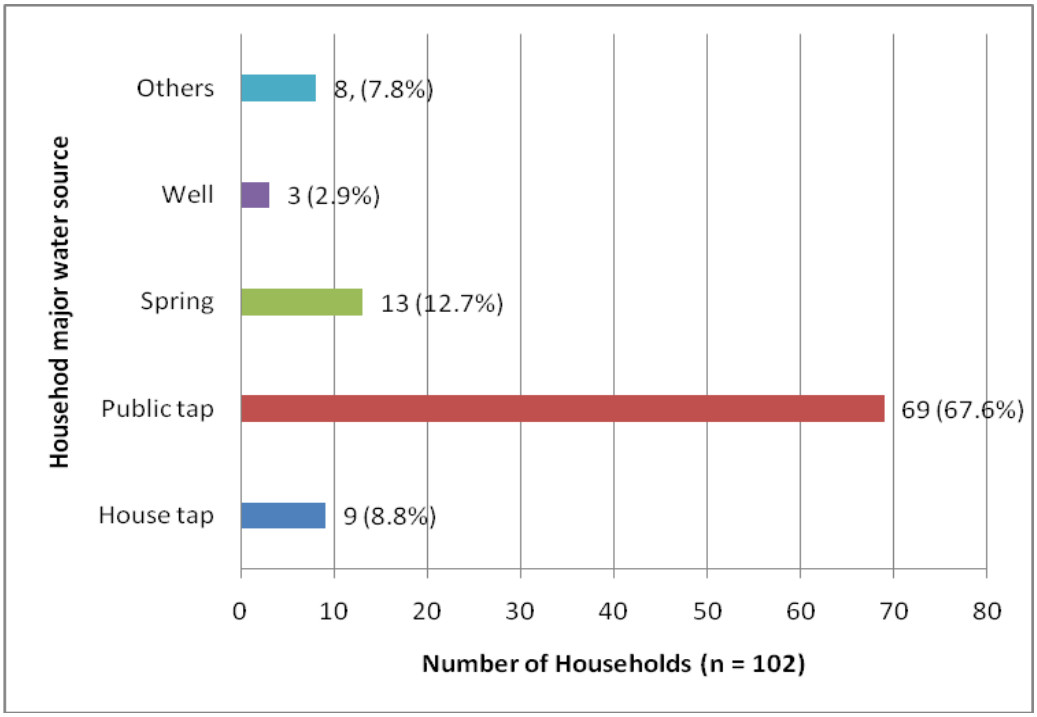
3.2. Water, Hygiene and Sanitation situation

3.2.1. Water

3.2.1.1. Water sources

The main water sources for domestic use in the area are summarized in Figure 1.

Figure 1: Water sources of water for domestic use



Public taps were the commonest water sources used by the community. However, residents had to pay for each jerrycan of water. This was also noted in one FGD that:

> *"……. we have taps, boreholes and a spring that are used by community but access to the spring was cut off by the northern by pass. Not all the water sources are functioning; some broke down and have never been repaired like the borehole. Most people use tap water as they buy it from people who own taps in their households"*. (Adult male FGD)

The sources of water used by the community are important since water sources have different water qualities due to the various risks that they may be exposed to. Generally, water sources like streams are more prone to contamination as opposed to underground water sources like boreholes. Piped water systems are normally of better water quality compared to surface water as long as the entire piped water system is not compromised for example by leakages in the piping system.

Residents collecting water from an unsafe source in Kikulu zone

3.2.1.2. Distance of water sources from households

The distance of different water sources from households is shown in Table 3.3.

Table 3.3: Distance of the main water sources from households

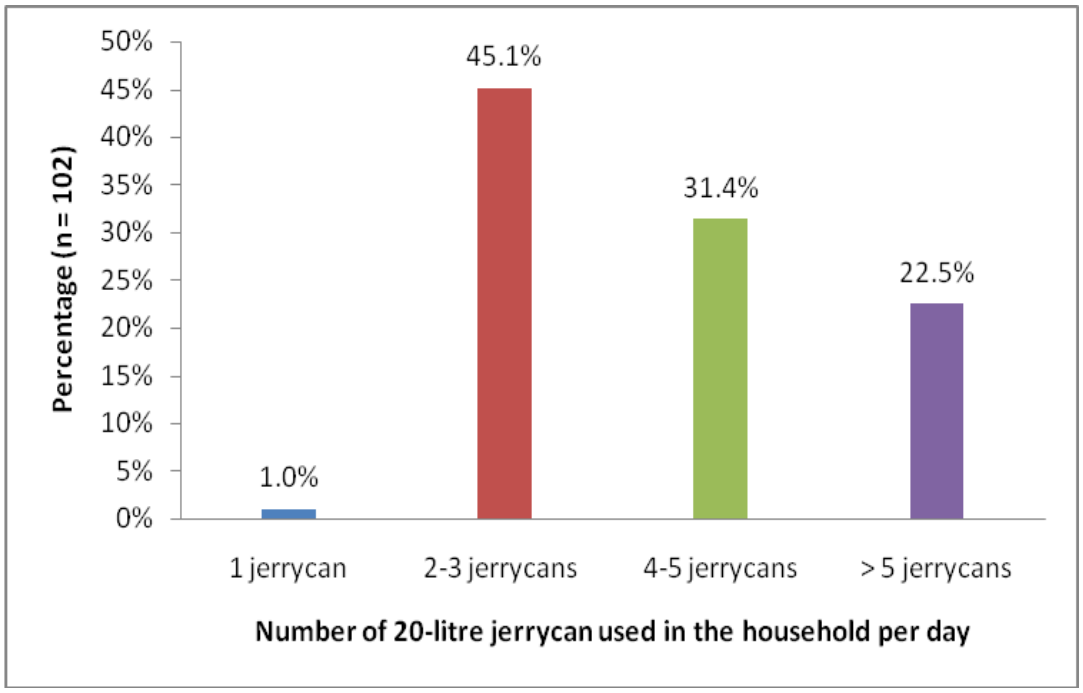
Type of water source	**Distance of water source from household**			**Total**
	Less than 1km	1-3km	More than 3km	
Protected spring	9	1	4	**14**
Public tap	0	2	1	**3**
Un protected Spring	31	1	51	**83**
River/Stream	0	0	2	**2**
Total	**40**	**4**	**58**	**102**

Only 39.2% (40/102) of the households had their water sources with a distance of 1km. This is an indication that water is generally not accessible in the community as according to national guidelines, safe water sources should be within a distance of 200 meters from households (DWD, 2010).

3.2.1.3. Amount of water used per day

It is important for all household members to get adequate water for use every day. The amount of water used per day per household is summarized in Figure 2.

Figure 2: Amount of water used per day in households

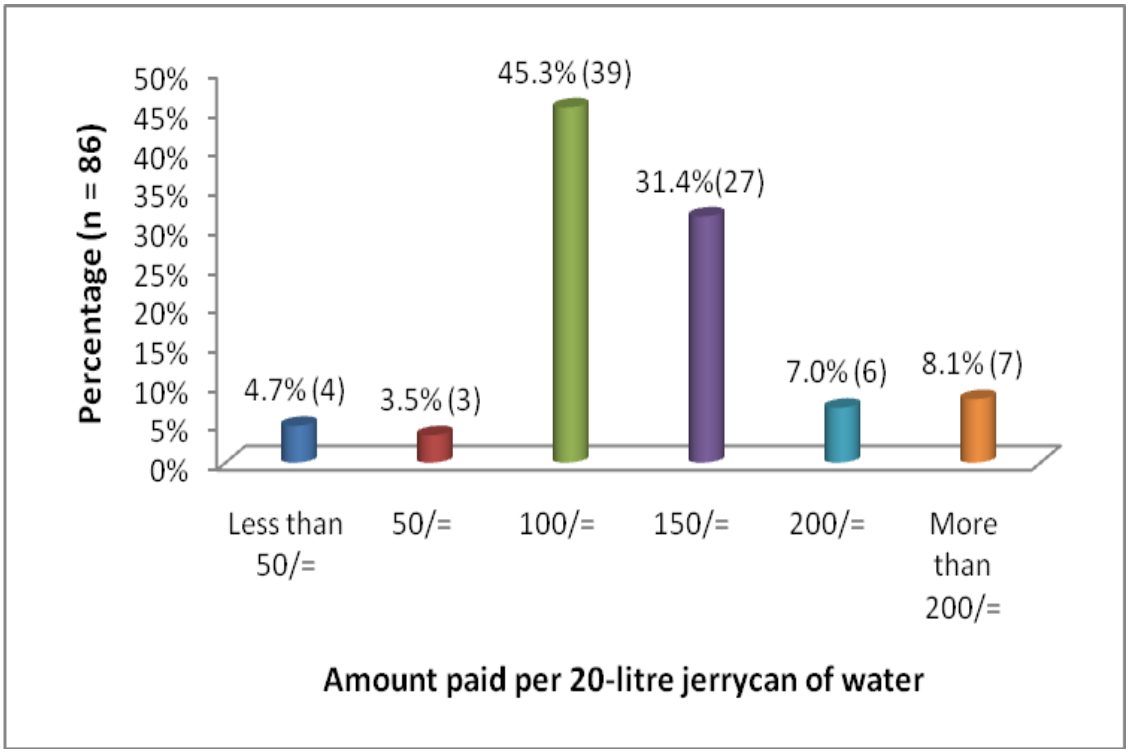


Nearly half of the households (45.1%) used 2 – 3 twenty liter jerrycans (40 – 60 liters) of water per day. The amount of water used in a day per household is normally influenced by household size, age categories of household members and household activities. On average, per capita consumption of water per day per person is at least 15 liters. This therefore implies that 2 – 3 twenty liter jerrycans of water per day can only be sufficient for a household size of 3 - 4 people beyond which it would not be adequate.

3.2.1.4. Payment for water used

The majority of households (84.3%) paid for the water they used. The amount paid per household per twenty liters of water is shown in Figure 3.

Figure 3: Amount paid by households per 20 liters of water



Over three quarters of the respondents paid 100 or 150 shillings (approximately 4 US cents) per twenty liter jerrycan of water. It was also noted that the water prices were not stable and varied from one seller to another and from season to season. However, the higher the cost of water, the less the number of households that may afford to buy the water.

3.2.1.4. Household expenditure on water per day

Household expenditure on water per day is shown in Table 3.4.

Table 3.4: Household expenditure of water per day

Amount paid (UGX)	Amount of water used per day (20 liter jerrycan)				Total
	1	2-3	4-5	More than 5	
Less than 50/=	0	1	0	3	**4**
50/=	0	0	3	0	**3**
100/=	0	**18**	**13**	8	**39**
150/=	0	**14**	**9**	4	**27**
200/=	1	3	2	0	**6**
More than 200/=	0	4	0	3	**7**
Total	**1**	**40**	**27**	**18**	**86**

Most of the households used between 2 and 5 twenty liter jerrycans of water per day each costing 100 or 150 Uganda shillings. Considering the socio-economic status of slum dwellers, this may not be affordable by all households and can lead to the use of inferior water sources such as the stream that existed in the area.

There were several socio-economic challenges that were faced by the residents as stated in the FGDs:

Socio-economic challenges faced by residents:

- *Lack of accommodation leading to over congestion*
- *Poor family planning and budgeting*
- *Poor health*
- *Poor hygiene*
- *Inadequate education, immorality, drug and substance abuse*
- *Unreliable*
- *95% of the youth do not have what to do (unemployment)*
- *Inadequate education facilities in form of schools*
- *Lack of awareness and education about nutrition for children*
- *Mothers lack information about how to properly raise their children.*

(Male, female and youth FGDs)

The causes of these challenges were outlined as follows:

Identified causes of the socio-economic problems included:

- *Poverty*
- *Laziness*
- *Lack of awareness and carelessness*
- *Ignorance*
- *Low level of education*
- *Lack of jobs*
- *High population*
- *Wrangles / conflicts such as religious ones*
- *Selfishness*
- *Discrimination and traditional / cultural beliefs.*

(Male, female and youth FGDs)

3.2.1.4. Person who uses water most in the household

3.2.1.5. Person responsible for collecting water

The person responsible for collecting water for domestic use in households is shown in Table 3.5.

Table 3.5: Person responsible for collecting water for domestic use

Person who fetches water	Frequency (N = 102)	Percentage (%)
Female spouse	78	76.5
Male spouse	3	2.9
Female children	8	7.8
Male children	4	3.9
Female relative	5	4.9
Other	4	3.9

Female spouses (76.5%) were the ones who mostly collected water. While addressing issues relating to the quality and safety of water at household level, females should mainly be targeted because of their increased involvement in water issues.

Female spouses were also noted to use most water at home (75.4%) followed by female children (9.8%). This is probably because females are more involved in household activities including those that involve the use of water. In addition, women are the ones who are mostly responsible for cleanliness of children as well as sanitation in households.

3.2.1.6. Sources of water for different purposes in the household

The sources of water for different uses in the household are shown in Table 3.6.

Table 3.6: Sources of water for different purposes in households

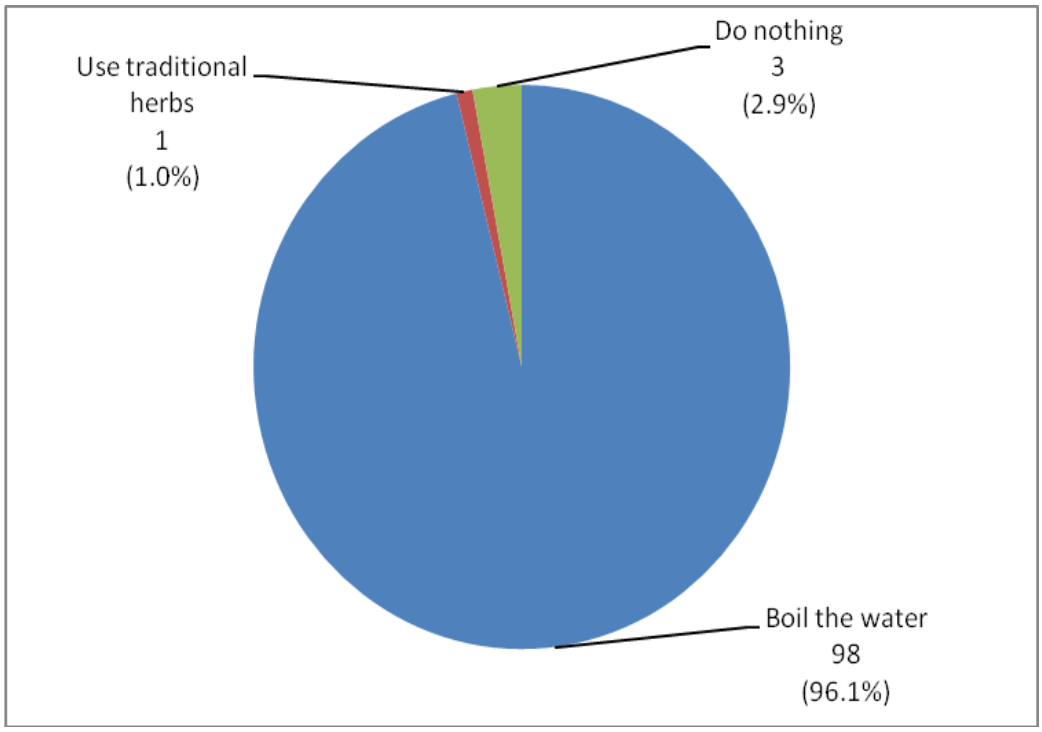
Source of water	Use of water									
	Drinking		Cooking		Bathing		Laundry		Dish washing	
	n=102	%	n=102	%	n=102	%	n=102	%	n=102	%
House tap	9	8.8	9	8.8	9	8.8	8	7.8	9	8.8
Public tap	67	65.7	71	69.6	71	69.6	67	65.7	69	67.6
Spring	14	13.7	11	10.8	11	10.8	15	14.7	13	12.7
Well	3	2.9	3	2.9	3	2.9	1	1.0	3	2.9
Other	9	8.8	8	7.8	8	7.8	11	10.5	8	7.8

Public taps were the commonest source of water for the different uses in households. Generally, there was not much difference in the sources of water for different uses. The community may not perceive the significance of using water from different sources for specific purposes such as tap water for only drinking and cooking.

3.2.1.7. Drinking water chain

The action taken by respondents to render their drinking water safe are shown in Figure 4.

Figure 4: Actions taken by households to render water safe



Almost all the respondents (96%) indicated they boiled their water for drinking. This method of water treatment renders water safe for consumption. Boiling water is an ideal way of treating it due to the fact that most pathogens are killed at high temperatures.

3.2.1.8. Drinking water storage facilities

The drinking water storage facilities used by respondents are shown in Table 3.7.

Table 3.7: Drinking water storage facilities

Storage facility	Frequency (n = 102)	Percentage (%)
Traditional pot with cover	9	8.8
Plastic jerrycan with cover	71	69.6
Plastic jerrycan without cover	17	16.7
Others	5	4.9

The majority of respondents (69.9%) stored drinking water in plastic jerrycans that had covers. These are normally good water storage facilities as long as they are kept clean

at all times and no contamination is allowed to occur. Water storage facilities are one of the major contamination sites therefore they should be taken into consideration while emphasizing safety aspects of the safe water chain. A good water storage facility should always be covered to prevent contamination. Since nearly a quarter of the households used undesirable water storage containers such as jerrycans without covers, the entire community would benefit from sensitization on ideal water storage facilities.

3.2.1.9. Cleaning of drinking water storage containers

The frequency of cleaning drinking water storage containers is shown in Table 3.8.

Table 3.8: Frequency of cleaning drinking water storage containers

Cleaning period	**Drinking water storage containers**				**Total**
	Traditional pot with cover	Plastic jerrycan with cover	Plastic jerrycan without cover	Others	
Every day	0	9	2	3	**14**
Twice a week	4	32	6	0	**42**
Weekly	3	9	4	0	**16**
Every two weeks	0	2	0	0	**2**
Every month	0	0	1	0	**1**
Rarely	0	2	0	1	**3**
Do not know	2	17	4	1	**24**
Total	**9**	**71**	**17**	**5**	**102**

The majority of respondents (57%) washed their water storage containers once or twice a week. Regular cleaning of water storage containers is an important component in the safe water chain. This is because if water is stored in a container for a long time, dirt may accumulate in it which favours the growth of micro organisms. Accumulated dirt may also change the taste, odour and colour of water rendering it unsafe for human consumption. It is therefore important to emphasize that before refilling the water storage containers, they should be washed thoroughly.

3.2.1.10. Methods of cleaning drinking water storage containers

The methods of cleaning drinking water storage facilities are shown in Table 3.9.

Table 3.9: Methods of cleaning the drinking water storage facilities

Cleaning methods	Drinking water storage containers				Total
	Traditional pot with cover	Covered plastic jerrycan	Plastic jerrycan without cover	Others	
Rinsed with water only	2	0	0	0	**2**
Rinsed with soapy water	2	22	2	1	**27**
Scrubbed and rinsed with water only	0	3	2	1	**6**
Scrubbed and rinsed with soap water	2	44	13	2	**61**
Others	3	2	0	1	**6**
Total	**9**	**71**	**17**	**5**	**102**

The majority of respondents (60%) cleaned their drinking water storage containers by scrubbing and rinsing them with soapy water. The use of soap in washing water storage containers should be promoted among the community as it has properties that kill microorganisms.

3.2.1.11. Bacteriological quality of drinking water

The bacteriological quality of the drinking water as sampled from the 102 households is shown in Table 3.10.

Table 3.10: Bacteriological quality of drinking water

CFU*/50ml of water	Frequency (n = 102)	Percentage (%)
0 CFU/50ml**	28	27.5
< 10 CFU/50ml	17	16.7
11 - 50 CFU/50ml	20	19.6
51 - 100 CFU/50ml	5	4.9
101 - 200 CFU/50ml	2	2.0
TNTC***	30	29.4
Total	**102**	**100.0**

* CFU – Colony Forming Unit

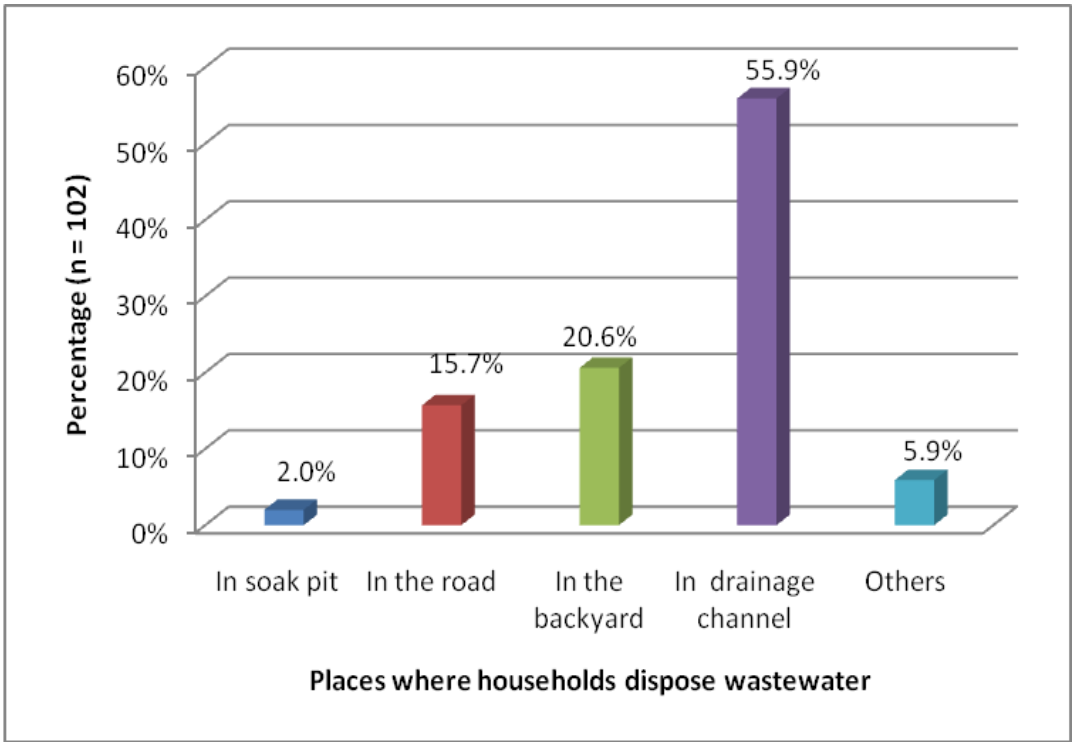
*** TNTC – Too Numerous To Count

Nearly a third of the households (29.4%) had drinking water with too numerous to count levels of contamination. National guidelines state that drinking water should have at most 10 CFU/100ml of water (MWE, 2007) although water with zero (0) CFU is recommended. Only 27.5% of the households had drinking water with no coliforms hence safe for drinking. Whereas the majority of respondents indicated to boil their drinking water, there may have been recontamination due to several factors such as poor storage facilities and unsafe water handling practices. It is therefore important to emphasize to the community all the points in the water chain where contamination can occur such as during storage.

3.2.2. Management of wastewater from households

The methods of disposal of wastewater from households are shown in Figure 5.

Figure 5: Disposal of wastewater from households



More than half of the households (55.9%) disposed their wastewater in drainage channels while only 2% used soak pits. Disposal of wastewater is a very important

aspect of environmental sanitation as poorly drained sites are unsightly and pools of water can be used for mosquito breeding.

A poorly maintained wastewater pit in Kikulu zone

3.2.3. Presence, type, location and use of bathrooms

3.2.3.1. Presence and location of bathrooms

The presence and location of bathrooms in households is shown in Table 3.11.

Table 3.11: Presence and location of bathrooms

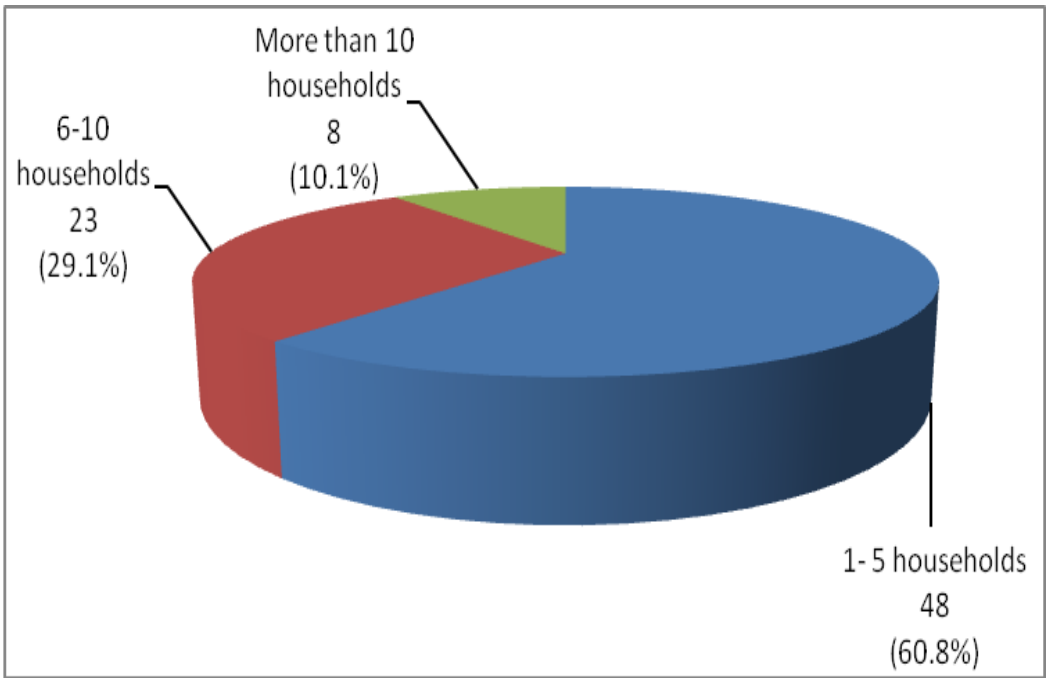
Type of bathroom	Frequency (n = 102)	Percentage (%)
Inside the house	24	23.5
Outside the house and permanent	67	65.7
Outside and makeshift in nature	8	7.8
None	3	2.9
Total	**102**	**100.0**

Nearly two thirds of the households (65.7%) used bathrooms located outside the houses and were permanent structures. Bathrooms are an important sanitation facility that every household should have. Proper management of wastewater from bathrooms should be emphasized to the community including having well maintained soak pits.

3.2.3.1. Number of households using shared bathrooms

The number of households sharing bathrooms that were located outside houses is shown in Figure 6.

Figure 6: Households sharing bathrooms



The majority of households (60.8%) shared their bath shelters among 1 – 5 households. Sharing bathrooms among several households has a challenge of maintaining the cleanliness of the facility as some households may not contribute towards this shared responsibility. It should also be noted that the more the number of households using a bathroom, the more waster water that is likely to be generated. This calls for adequate wastewater management facilities for such bathrooms. However, in terms of raising capital for improvement of the facility, it would be easier to have more households

contribute a small amount as compared to fewer households contributing more to effect similar developments.

3.2.4. Presence, location and use of latrines

3.2.4.1. Presence of latrines

The majority of households (73.5%) owned latrines. For households that did not have their own latrines (26.5%), the type of facility and number of households with which they shared with are shown in Table 3.12.

Table 3.12: Number of households using shared latrines

Type of latrine	Number of households sharing latrines		Total
	1-5	6-10	
Community latrine	24	3	**27**
Neighbor's latrine	1	0	**1**
Dispose excreta indiscriminately	0	1	**1**
Total	**25**	**4**	**29**

Most of the households (86%) which did not have latrines used community latrines which they shared with 1 – 5 households. Households that did to own latrines used those of the community / neighbours as opposed to disposing of their excreta indiscriminately.

3.2.4.2. Sanitary situation of latrines

For all households that were involved in the survey, a sanitary inspection of the latrines was done and the findings are indicated in Table 3.13.

Table 3.13: Sanitary situation of the latrines

No.	Aspect	Frequency (n = 102)	Percentage (%)
1.	Latrine more than 5 metres from the house	45	44.1
2.	Latrine had no proper access leading to it	34	33.3
3.	Latrine lacked a door	17	16.7
4.	Latrine lacked a roof	7	6.9
5.	Latrine lacked a hole cover	84	82.3
6.	Latrine lacked a ventilation pipe	87	85.3
7.	Fecal matter/urine present on the slab	53	52.0
8.	Latrine smelly	73	71.6
9.	Latrine infested with flies	41	40.2
10.	Latrine walls smeared with fecal matter	43	42.2
11.	No handwashing facility at latrine	79	77.5
12.	No soap near latrine handwashing facility	78	76.5

Several unsanitary conditions were found at latrines of the households. These were lack of hole covers (82.3%), lack of ventilation pipes (85.3%), smelly (71.6%), fecal matter / urine on slab (52%), no handwashing facility (77.5%) and no soap for washing hands (76.5%). The community therefore needs sensitization to maintain their latrines in a good state. The number of latrines without handwashing facilities was very high therefore sensitization in this area is needed. The *tippy tap* technology (which uses a small jerrycan and string) for handwashing can be explored by the project so as to improve on handwashing practices in the community.

3.2.4.3. Score of contamination risks

The total score of contamination risks of the different latrines are summarized in Table 3.14.

Table 3.14: Total score of contamination risks

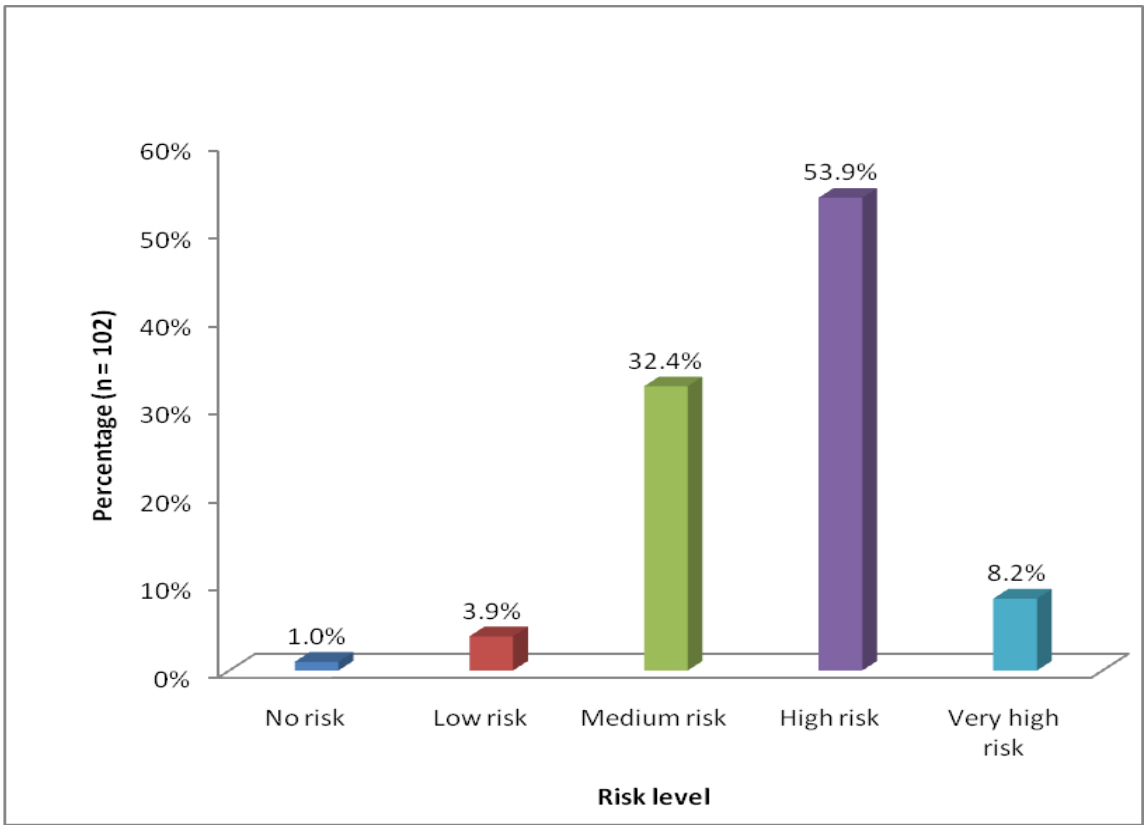
Score	Frequency	Percentage
0	1	1.0
2	3	2.9
4	12	11.8
5	13	11.7
6	11	10.8
7	15	14.7
8	19	18.6
9	21	20.6
10	4	3.9
11	4	3.9
Total	**102**	**100.0**

These contamination risk scores were used to compute the sanitary risk levels shown in section 3.2.4.4.

3.2.4.4. Sanitary risk levels of latrines

The risk levels of the inspected latrines are summarized in Figure 7 below. The sanitary risks scores were categorized as follows: 0 = No risk; 1 - 3 = Low risk; 3 - 5 = Medium risk; 6 - 8 = High risk; 9 - 10 = Very high risk.

Figure 7: Sanitary risk levels of the inspected latrines



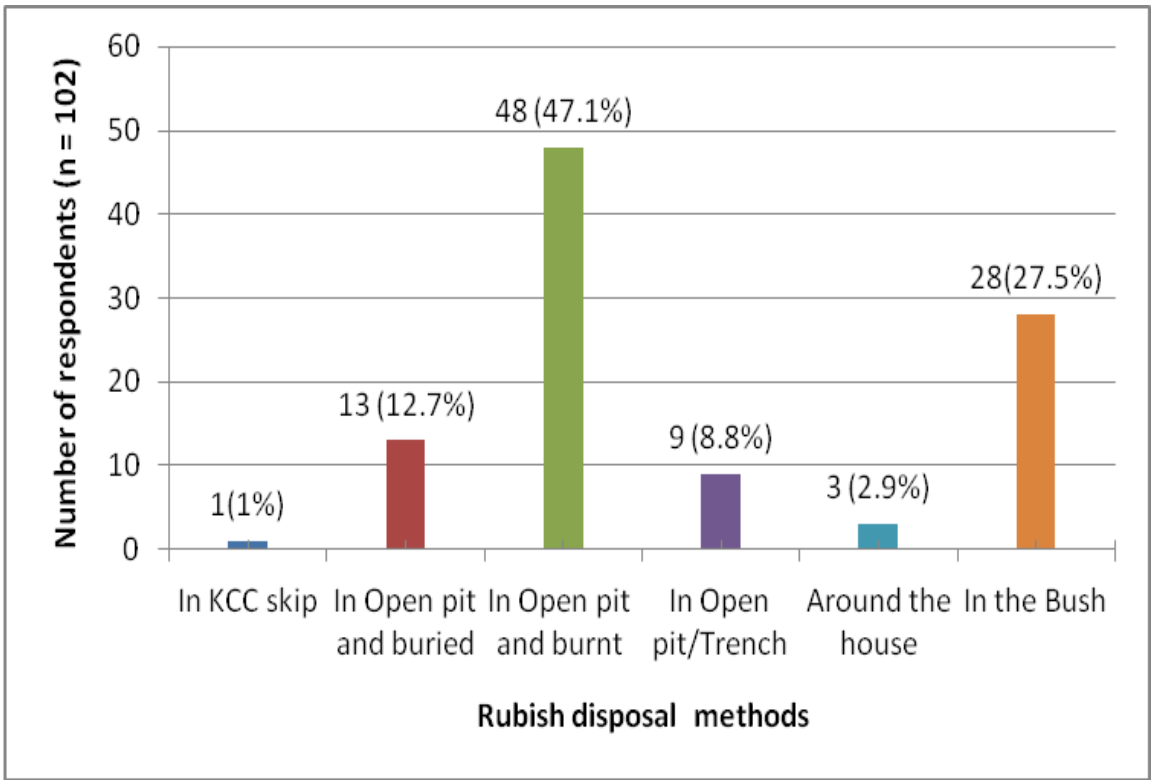
More than half (53.9%) of the sanitary facilities were of high risk. This is a worrying sanitary situation that puts households at risk of diarrheal diseases among others. It is therefore important to promote proper maintenance of latrine facilities among the community. This can mainly be achieved through health education of the population.

3.2.5. Collection and disposal of rubbish

3.2.5.1. Disposal methods

The methods of disposal of rubbish in households are shown in Figure 8.

Figure 8: Household rubbish disposal methods



Nearly half of the respondents (47.1%) disposed of their rubbish in open pits and burnt it. This method of waste disposal is not recommended as burning of waste is likely to lead to air pollution which can affect the health of the community. Although disposal of waste in skips is popular in urban communities, this was not the case in this area as no skip was provided by the local authority. This was confirmed by several key informants including local leaders. Lack of skips may lead to indiscriminate disposal of rubbish by residents.

Indiscriminate disposal of rubbish near a stream in Kikulu zone

3.2.5.2. Person responsible for rubbish collection

The person responsible for collection of rubbish at household level is shown in Table 3.15.

Table 3.15: Person responsible for refuse collection

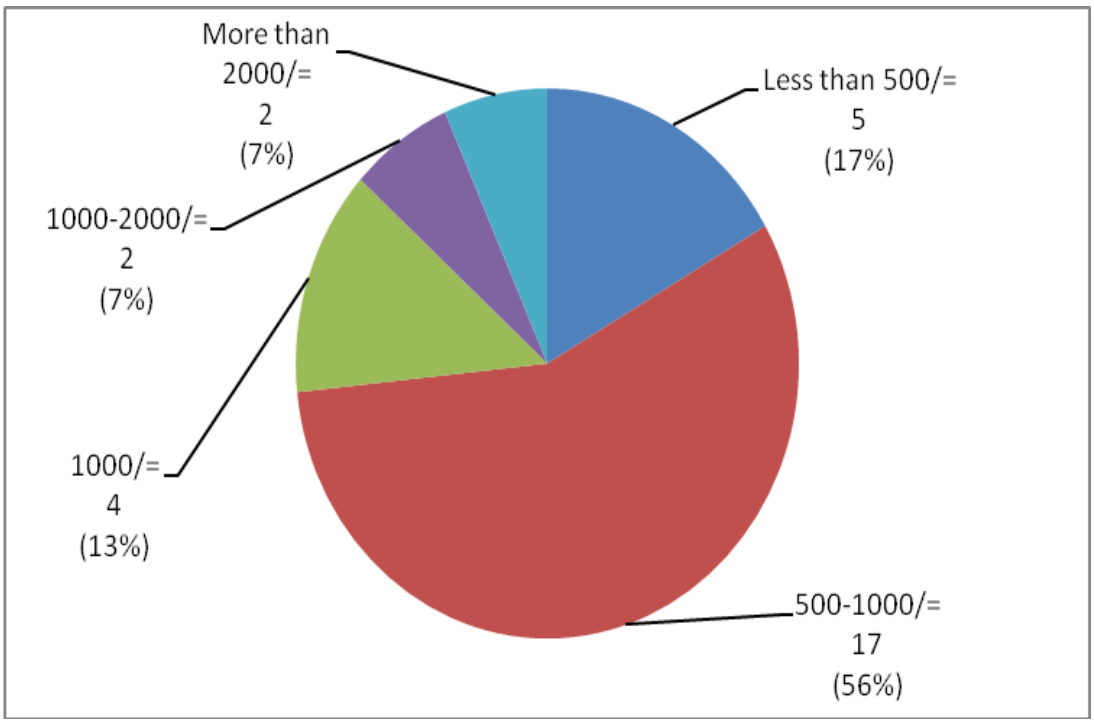
Person responsible	Frequency(n = 102)	Percentage (%)
Female spouse	83	81.4
Male spouse	1	1.0
Female children	8	7.8
Male children	2	2.0
Female relative	5	4.9
Other (specify)	3	3.0
Total	**102**	**100.0**

Female spouses in the majority of households (81.4%) were responsible for rubbish collection. When carrying out programmes to improve household sanitation, special emphasis should therefore be given to women.

3.2.5.3. Payment for rubbish collection

Only 29.4% (30/102) of the households paid for rubbish collection. The amounts paid per week for the households that paid for rubbish collection are shown in Figure 9.

Figure 9: Amount paid for rubbish collection per week



More than half of the households (57%) paid 500 – 1000/= (approximately 20 – 40 US cents) per week for their rubbish collection. This amount may not be easily affordable for many low income families in such urban slums. This may therefore lead to improper disposal of rubbish especially in this community which lacked a skip.

3.2.5.4. Frequency of disposing of rubbish

The frequency of disposing of rubbish by households is shown in Table 3.16.

Table 3.16: Frequency of disposing of rubbish

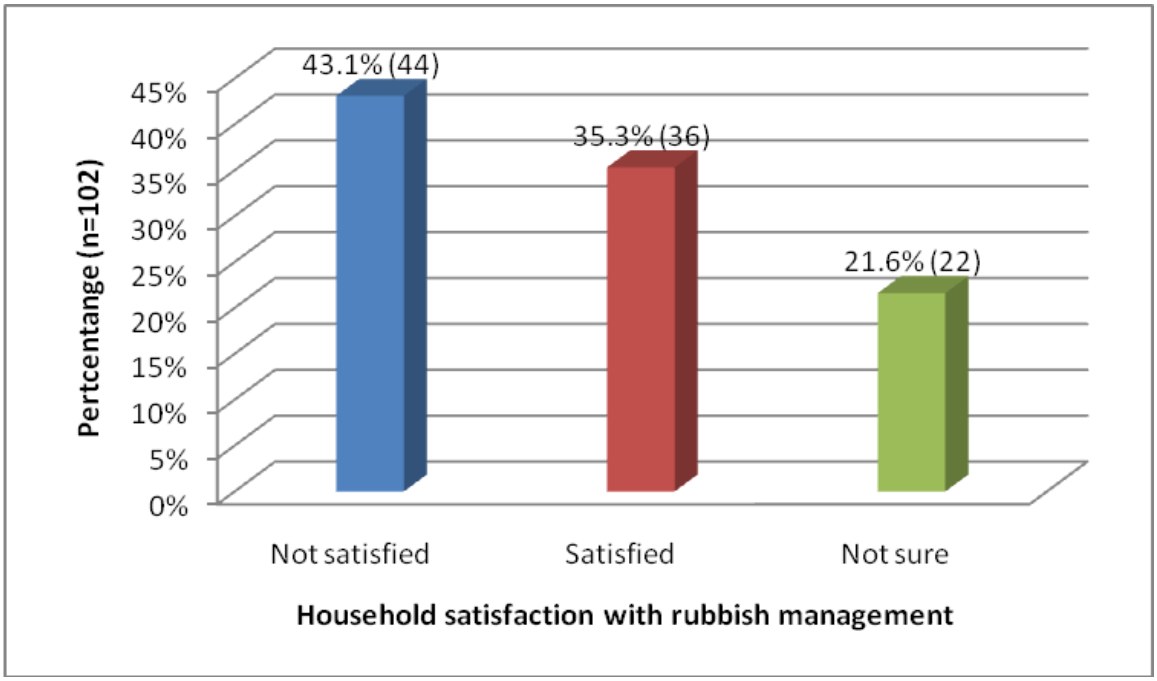
Frequency of disposing of rubbish	Frequency (n = 102)	Percentage (%)
Every day	18	17.6
Twice a week	15	14.7
Weekly	28	27.5
Every two weeks	3	2.9
Every month	2	2.0
Rarely	1	1.0
Others	11	10.8
Irregular	24	23.5
Total	**102**	**100.0**

Over a quarter of the households (27.5%) disposed of their refuse on a weekly basis while 17.6% did so daily. The frequency of disposal of rubbish may depend on the amount generated and the storage facilities used at household level. Households should not leave rubbish to accumulate in their houses which may attract vectors and pests such as flies and rats which can transmit diseases including diarrhea.

3.2.5.5. Household satisfaction with management of solid waste

The level of satisfaction of households regarding refuse management is shown in Figure 10.

Figure 10: Households' satisfaction about refuse management



A high proportion of households (43.1%) were not satisfied with the management of refuse in their area. This shows that solid waste management remains a challenge in this urban slum. Reasons highlighted for the dissatisfaction included:

1. Poor community attitude towards rubbish disposal
2. Lack of proper disposal facilities
3. High costs of refuse collection
4. Lack of specific garbage collection company
5. Lack of skips in the area

Kampala City Council could provide a skip in the area to improve on solid waste collection and disposal from households.

3.2.5.6. Environmental inspection results

In all households sampled, an environmental inspection was conducted and the findings are summarized in Table 3.17.

Table 3.17: Household environmental inspection results

No.	Aspect	Frequency	Percentage
1.	Household environment dirty	48	47.1
2.	No dustbin for household rubbish	60	58.8
3.	Dustbin dirty and overflowing	12	11.8
4.	Fecal matter around the household	16	15.7
5.	Poor drainage around the house	38	37.3
6.	Drainage around the house clogged	36	35.3
7.	No utensil drying rack	55	53.9
8.	Household utensils dirty and left unclean in the open	19	18.6
9.	Drinking water container with wide mouth / opening	8	7.8
10.	Drinking water container with no lid / cover	46	45.1
11.	Drinking water container kept on the floor level	50	49.0
12.	Inside of the container dirty	9	8.8
13.	Outside of the container dirty	21	20.6

Several undesirable conditions were found at the households including lack of dustbins (58.8%), lack of utensil drying racks (53.9%) and keeping drinking water storage containers on floor level (50%). Storing drinking water on the floor makes is prone to contamination from dust and other pollutants. Children may also easily contaminate

drinking water which is in their reach. It is therefore advisable for drinking water to be stored on a raised surface such as in a refrigerator or on a table.

3.2.5.7. Environmental risk scores

The environmental risk scores for the households are shown in Table 3.18.

Table 3.18: Environmental risk scores

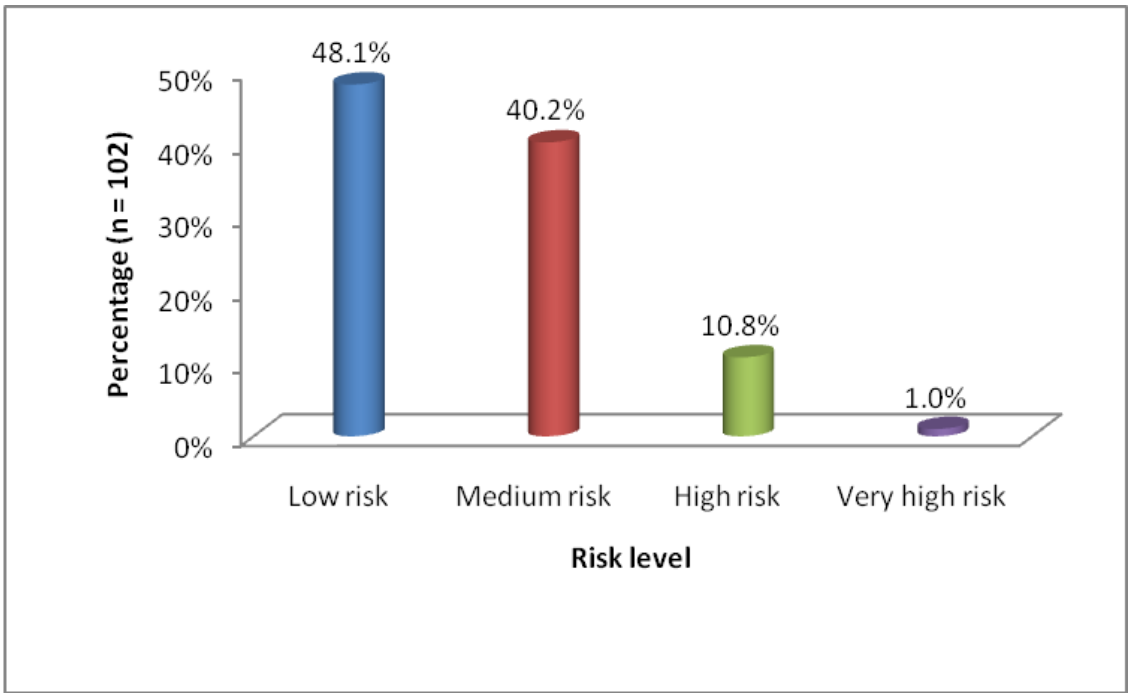
Score (out of 13)	Frequency	Percentage
0	5	4.9
1	3	2.9
2	12	11.8
3	30	29.5
4	18	17.6
5	13	12.7
6	9	8.8
7	7	6.9
8	3	2.9
9	1	1.0
10	1	1.0
Total	**102**	**100.0**

These risk scores were used to compute the household environmental risk levels shown in section 3.2.5.8.

3.2.5.8. Environmental risk levels

The household environmental risk levels are shown in Figure 11 below. These were characterized as follows: 0 = No risk; 1-3 = Low risk; 3-5 = Medium risk; 6-8 = High risk; 9-10 = Very high risk.

Figure 11: Household environmental risk levels



Nearly half of the households (48.1%) were at low risk while 40.2% were at medium risk. Effort is needed to reduce on the specific risks identified so as to maintain proper sanitation and hygiene status within households.

3.2.5.9. Contamination of soils where children play from

The results of soil analysis from samples collected from the places where children played from are shown in Table 3.19.

Table 3.19: Soil sample analysis results

Result	Frequency (n = 102)	Percentage (%)
No ova, cyst or larvae seen	95	93.1
Ascaris ova seen	4	3.9
Hookworm ova seen	3	2.0
Total	**102**	**100.0**

The majority of samples (93.1%) did not have any pathogenic organisms or helminthes. Open defecation especially by children in the communities is likely to be low. Proper

disposal of children's excreta should be encouraged particularly among mothers who are usually responsible for helping their children when they want to excrete.

3.3. Household healthcare seeking behaviour

3.3.1. Place where healthcare is first sought

The place and distance where the households first sought their healthcare is shown in Table 3.20.

Table 3.20: Health facilities where households first sought their healthcare

Distance from household	Health facility			Total
	Hospital	Health centre	Private clinic	
Less than 1km	1	0	53	**54**
1-2km	3	2	17	**22**
2-3km	4	1	9	**14**
3-5km	0	0	3	**3**
More than 5km	3	1	4	**8**
Not sure	0	0	1	**1**
Total	**11**	**4**	**87**	**102**

Private clinics were the most preferred health facility for seeking healthcare (85.3%) majority (60.9%) were within a distance of 1 kilometre of the households. This can be attributed to the many clinics which have been established in urban communities because of public health facilities including hospitals being few in such areas. In addition, these public facilities may be at long distances from many households hence use of clinics becomes the first option for healthcare.

3.3.2. Satisfaction with health care services

Most of the households were satisfied with the healthcare services they received at the different health facilities as shown in Table 3.21.

Table 3.21: Households' satisfaction with healthcare services

Health facility	Healthcare satisfaction		Total
	Satisfied	Not satisfied	
Hospital	7	4	**11**
Health centre	4	0	**4**
Private clinic	81	6	**86**
Total	**92**	**10**	**102**

The majority of respondents (90.2%) were satisfied with the healthcare they received from health facilities. This may be due to the fact that since clinics were mostly used, these normally offer more client friendly services as compared to public facilities. Indeed, several studies have shown dissatisfaction with services offered at government facilities because of the numerous difficulties faced such as regular stock out of drugs, lack of skilled staff, late referral of patients, poor health worker attitudes, and low quality of care (Kiwanuka *et al*, 2008; WHO/AFRO, 2001).

3.4. Household nutrition

3.4.1. Sources of food

The sources of different foods for the households are shown in Table 3.22.

Table 3.22: Household sources of food

Source	Vegetables		Meat / fish		Milk / milk products	
	n = 102	**%**	**n = 102**	**%**	**n = 102**	**%**
Main market / Shop	33	32.4	32	31.4	62	60.8
Kikulu road side vendors	38	37.3	47	46.1	10	9.8
Others	31	30.4	23	22.5	30	29.4

Over a third of the households (37.3% and 46.1%) got their vegetables, meat and fish respectively from the main market in the area while milk and milk products were mainly got from grocery shops (60.8%). This pattern justifies that various foodstuffs have different sources depending on their availability within the community.

3.4.2. Storage of food

3.4.2.1. Food storage practices

The methods of food storage at household level are shown in Table 3.23.

Table 3.23: Households' food storage practices

Store foods	Vegetables		Meat / fish		Milk / milk products		Food for children under 5 years	
	n=102	%	n=102	%	n=102	%	n=102	%
Store	39	38.2	20	19.6	23	22.5	27	26.5
Do not store	63	61.8	82	80.4	79	77.5	75	73.5

The majority of respondents (61.8%, 80.4%, 77.5%, and 73.5%) did not store vegetables, meats / fish, milk products and food for children under 5 years respectively. This is a clear indication that food storage is not a common practice among the community.

3.4.2.2. Food storage facilities

For those who stored their food, the storage facilities are shown in Table 3.24.

Table 3.24: Places / facilities where households store foods

Vegetables	Meat / fish	Milk and milk products	Food for children under 5 years
- Anywhere in the open - In cupboard - In fridge - In pail with water - In saucepan - In basket - On food rack	- In covered container - In covered saucepan - In fridge - In container after smoking	- In saucepan after boiling - In covered bucket - In fridge - In kettle - In bottle - In flask	- In food flask - In fridge - In saucepan - Leave on charcoal stove - In bottle - In covered dish

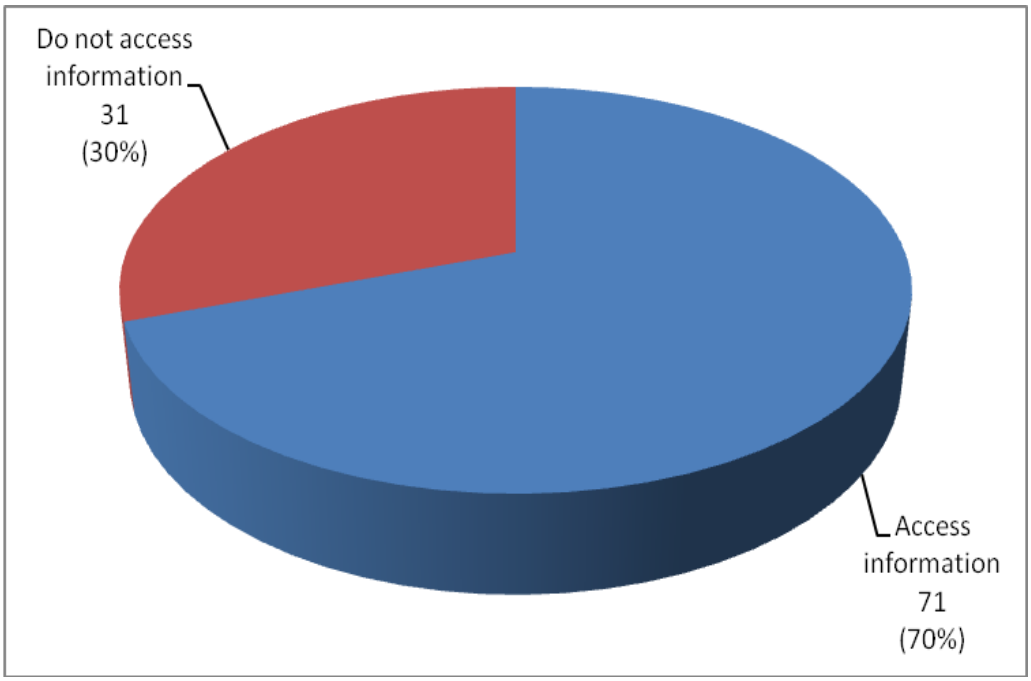
Households that used storage facilities such as sauce pans and buckets endeavoured to cover them. This is a good practice to prevent food contamination and should be encouraged among the community.

3.5. Access to health, hygiene and sanitation information

3.5.1. Access

The respondents who had access to health, hygiene and sanitation information are shown in Figure 12.

Figure 12: Respondents' access to health, hygiene and sanitation information



Although the percentage of those who accessed health information was high (70%), it is important to conduct community sensitization programs. This is necessary to keep the entire community updated with relevant messages in water, sanitation and hygiene.

3.5.2. Information sources and frequency

The source and frequency of accessing the information are shown in Table 3.25.

Table 3.25: Sources and frequency of health, hygiene and sanitation information

Frequency of access	Major source of information					Total
	Radio	TV	Health worker	Seminars	Other	
Every day	19	7	0	0	1	**27**
Twice a week	8	4	0	0	0	**12**
Weekly	8	2	0	0	1	**11**
Twice a month	1	0	1	0	0	**2**
Monthly	2	1	1	0	1	**5**
Rarely	9	1	1	2	0	**13**
Other	1	0	0	0	0	**1**
Total	**48**	**15**	**3**	**2**	**3**	**71**

The majority of respondents that accessed health information (67.6%) mainly got it from radios and at least on a weekly basis. Therefore, the use of radio by the project to sensitize the community may be explored in addition to physical sensitization sessions.

3.5.3. Preferred language for health education

The majority of respondents (79.4%) preferred *Luganda* followed by English (10.7%). Therefore while carrying out sensitization in the community, *Luganda*, which is the most used local language in the central region of the country, should be used.

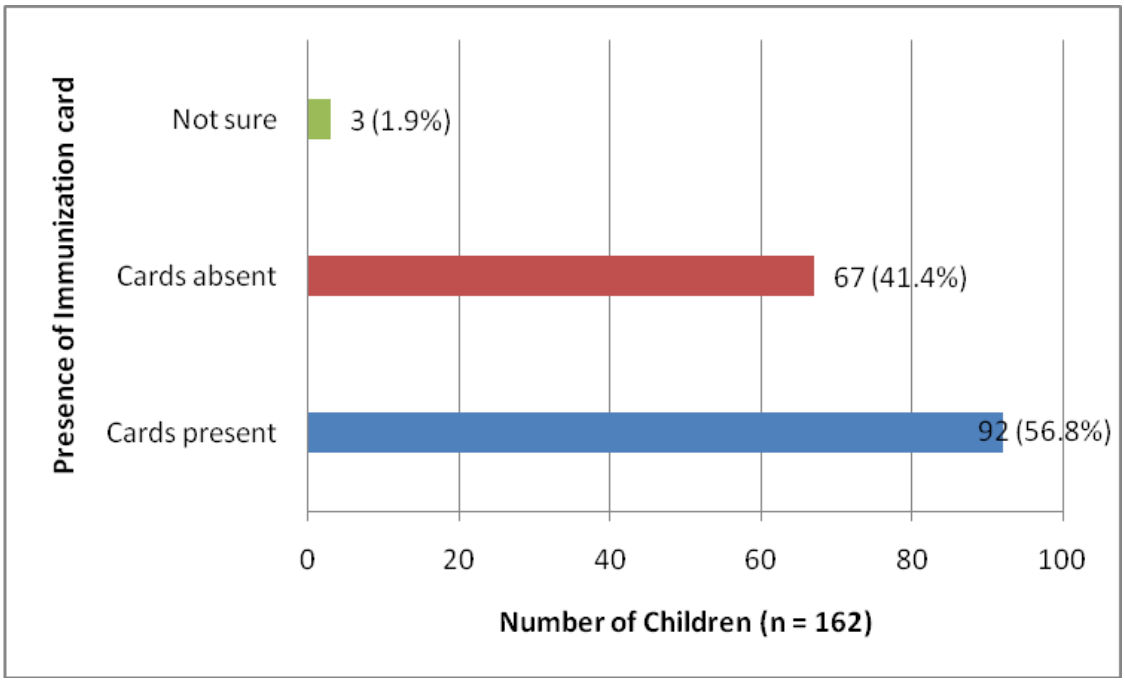
3.6. Child immunization

From the households involved in the baseline survey, a total of 159 children below 5 years of age were involved in the assessment of their immunization status. Among these children, 52.8% were females while 47.2% were males.

3.6.1. Presence of child immunization cards

The presence of child immunization cards among children is shown in Figure 13.

Figure 13: Presence of child immunization cards



The majority of children (56.8%) had their immunization cards. It is easier for parents to follow the immunization schedules of their children when they have these cards as opposed to those without them.

3.6.2. Child immunization status

The child immunization status is shown in Table 3.26.

Table 3.26: Child immunization status

Status	Measles (Left hand side) Child older than 9 months only		De-worming within past 3 months		Vitamin A supplementation within last 6 months		BCG / scar (Right hand) - At birth	
	n = 162	%	n = 162	%	n = 162	%	n = 162	%
Yes with card	66	40.7	37	22.8	39	24.1	81	50.0
Yes without card	53	32.7	46	28.4	30	18.5	64	39.5
No with card	7	4.3	30	18.5	42	25.9	4	2.5
No without card	14	8.6	36	22.2	40	24.7	5	3.1
Not applicable	18	11.1	8	4.9	5	3.1	0	0
No response	4	2.5	5	3.1	6	3.7	8	4.9

Less than half of the children (40.7%) were immunized for measles and had their immunization cards available. However, 32.7% had been immunized for measles but their immunization cards were not available. This finding is similar to BCG immunization status as 50% of the children had been immunized and had their cards present while 39.5% were immunized but had no cards. Parents should be encouraged to keep the immunization cards so as to assist them complete the immunization schedules of their children. Less than a quarter of the children (22.8%) and (24.1%) had received de-worming within the past 3 months and vitamin A supplementation within the last 6 months respectively. This can be addressed by informing parents and the general community the importance of these medications to the health of the children.

3.7. Child morbidity

3.7.1. Presence of mosquito nets

The majority of children (89.3%) were noted to have mosquito nets. Mosquito nets are known to significantly reduce the occurrence of malaria if used effectively. Their use should therefore be promoted.

3.7.2. Children sleeping under mosquito net the previous night

The majority of children (88.1%) were noted to have slept under mosquito nets the night before the baseline survey. Nevertheless, efforts should be strengthened to increase

the use of mosquito nets especially among children under 5 years and pregnant women in the community.

3.7.3. Children suffering from fever

The number of children who had suffered from fever within the past two weeks from the time of data collection is shown in Table 3.27.

Table 3.27: Children suffering from fever in the past two weeks

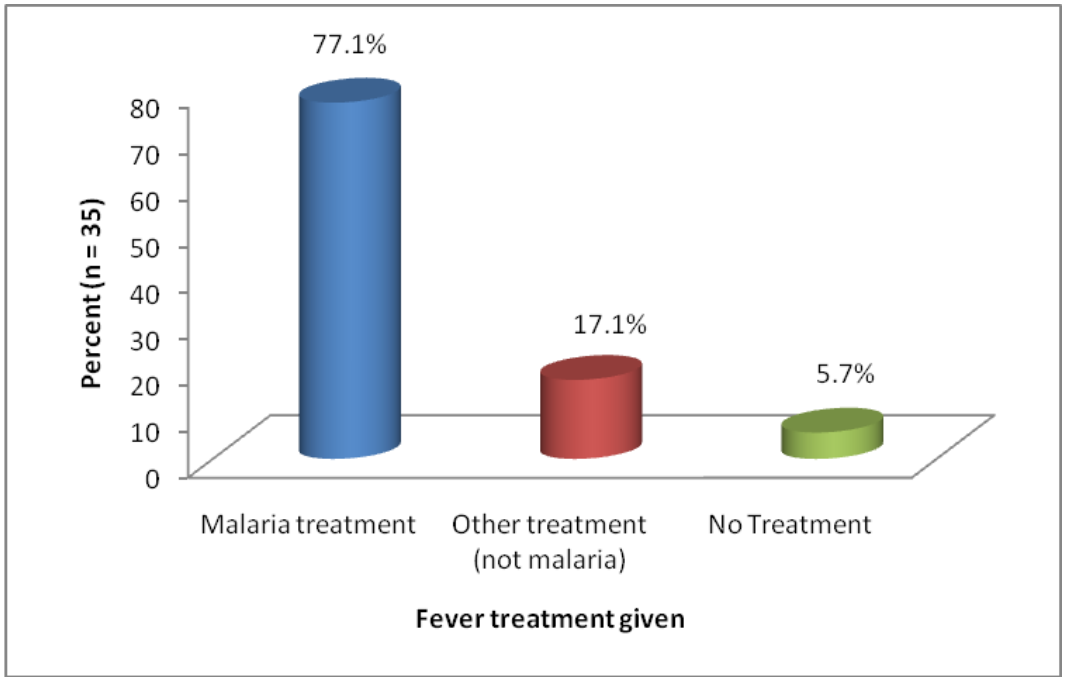
Child suffered fever in past 2 weeks	**Frequency (n = 162)**	**Percentage (%)**
Child suffered	35	21.6
Child did not suffer	122	75.3
No response	5	3.1

Only 21.6% of the children had fever in the past 2 weeks prior to data collection. Fever is normally an indication of malaria therefore the occurrence of malaria during that period could have been low. This may be attributed to the high use of mosquito nets by the children.

3.7.4. Treatment of fever

Among the children who suffered from fever, the treatment they received is shown in Figure 14.

Figure 14: Treatment given to children suffering from fever



The majority of children (77.1%) who suffered from malaria were given malaria treatment. The given malaria treatment includes commonly chloroquine, quinine and coartem which are commonly used anti-malarials in Uganda.

3.7.5. Children suffering from diarrhea

The number of children who had suffered from diarrhea in the past two weeks from the time of data collection is shown in Table 3.28.

Table 3.28: Child suffering from diarrhea in the past two weeks

Child suffering from diarrhea in past two weeks	Frequency (n = 159)	Percentage (%)
Child suffered from diarrhea	37	22.8
Child didn't suffer from diarrhea	117	72.2
No response	8	4.9
Total	162	100.0

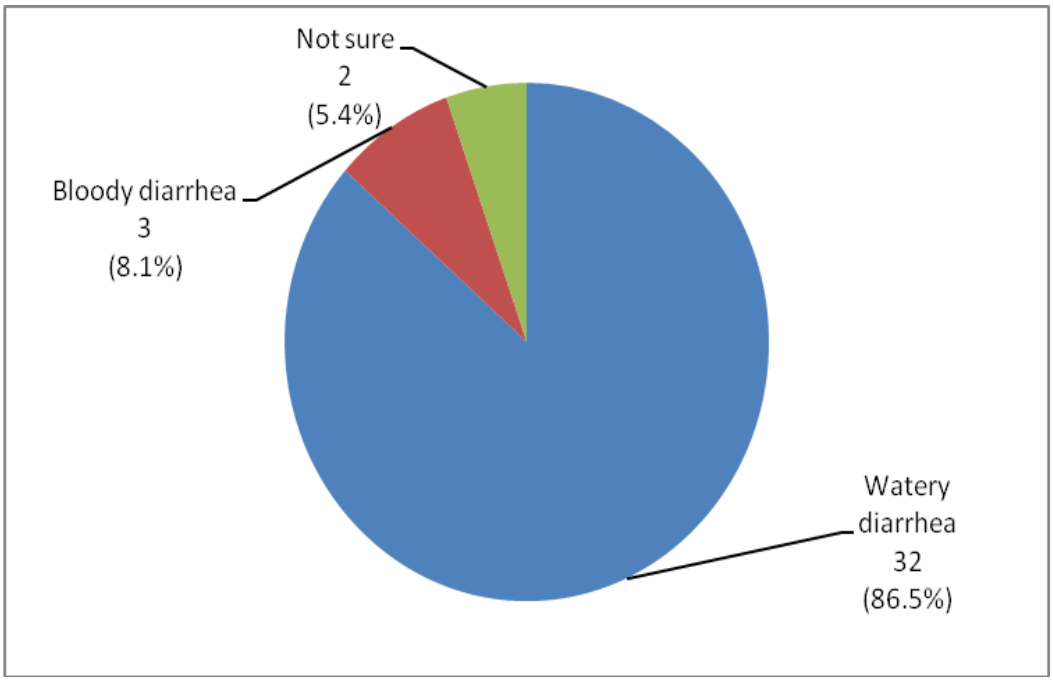
Only 22.8% of the children had suffered from diarrhea in the 2 weeks prior to data collection. It was noted from key informants that during rainy seasons, the occurrence of

diarrheal diseases increases significantly. Therefore, effort to promote safe water, sanitation and hygiene among the community should be strengthened.

3.7.6. Categorization of diarrhea

The categorization of diarrhea that children suffered from is shown in Figure 15.

Figure 15: Categorization of the diarrhea



The majority of diarrhea cases among children (86.5%) were watery as opposed to being bloody (8.1%). Whereas watery diarrhea can be associated to various conditions including many water borne illnesses, the bloody one is normally linked to dysentery which is a bacterial infection.

3.7.7. Stool analysis

For the 4 children who were found with diarrhea at the time of data collection, the results of analysis of their stool samples are shown in Table 3.29.

Table 3.29: Stool analysis results for children with diarrhea

Macroscopy	Microscopy	Modified ZN	Culture
Semi formed	No ova and cysts seen, yeast cells ++	No oocysts seen	*Candida* isolated
Loose stool	No ova and cysts seen	no oocysts seen	*Candida* isolated
Loose stool	No ova and cysts seen, yeast cells +++	No oocysts seen	*Candida* +++ isolated
Semi formed	No ova and cysts seen, yeast cells +	No oocysts seen	*Candida* isolated

Only *Candida* sp. was isolated from culturing while only yeast cells were found from microscopy. Since yeast is a normal inhabitant in intestinal tract of humans, some amount of yeast can almost always be recovered in a stool sample. However, when recovered amounts are abnormally high, then further investigations may be required.

Part of the community appreciated that having a clean environment can prevent the occurrence of diarrheal diseases as highlighted by one key informant that:

> *"…. diarrhea is due to a dirty environment. Children just pick dirty objects and play with them including playing in dirty water which makes them sick. However, such problems could be avoided if the environment is clean." Key Informant, Kikulu zone*

3.7.8. Other illnesses

Illnesses other than diarrhea and fever noted among the children are shown in Table 3.30.

Table 3.30: Other illnesses among children

Illness	Frequency (n = 90)	Percentage (%)
Respiratory Tract Infections	76	84.4
Skin diseases	6	6.8
Measles	4	4.4
Others	4	4.4

Respiratory Tract Infections were noted to be illnesses that children suffered from most. This was confirmed by participants of one FGD:

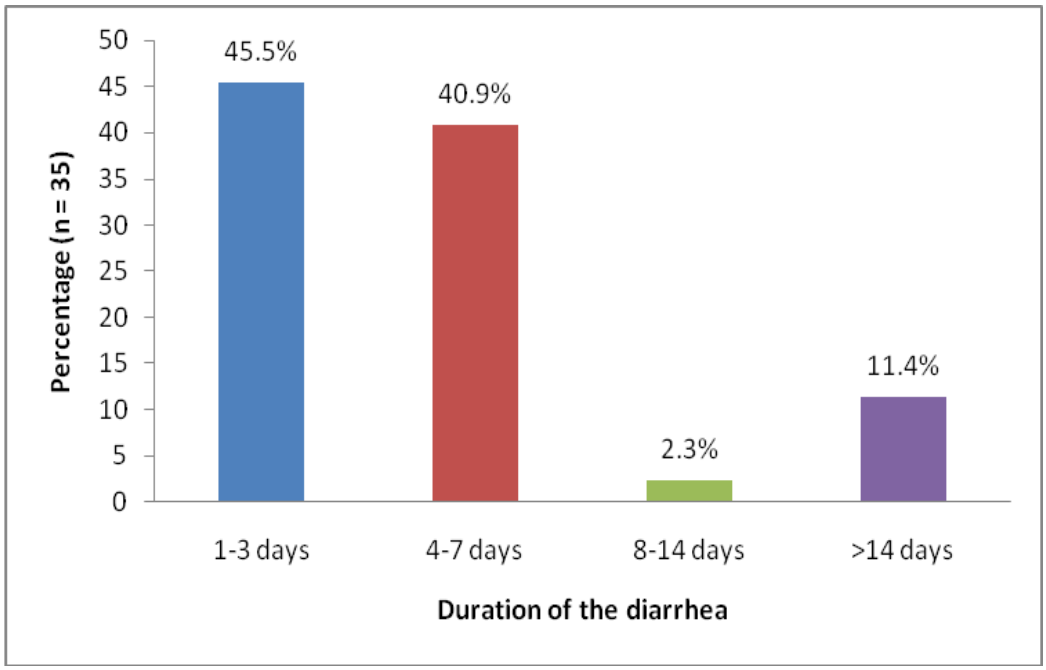
> *"Cough and flu are a very big problem in our area because of the dust. Our roads are not made of tarmac therefore the children are seriously affected by the dust. Even if malaria is a problem here, it has recently reduced as compared to respiratory problems." (Adult male FGD)*

3.8. Management of diarrhea

3.8.1 Duration of the diarrhea

The duration of the diarrhea among children who had suffered it in the 2 weeks prior to data collection is shown in Figure 16.

Figure 16: Duration of diarrhea



Over 80% of the diarrhea cases lasted for at most a week. This may be due to the use of antibiotics from the clinics that the community used frequently when sick. Sometimes, minor diarrhea cases may be self regulating after a few days. However, severe cases may need urgent medical attention.

3.8.2. Treatment of diarrhea

Over three quarters of diarrhea cases (68.6%) were treated. This treatment was probably sought from the clinics within the community. The management of diarrhea at home and health facilities in the community is shown in Table 3.31.

Table 3.31: Management of diarrhea at home and health facility

Treatment	Management in health unit		Management at home	
	n = 25	Percentage (%)	n = 9	Percentage (%)
Oral rehydration fluids	6	24.0	1	11.1
Antibiotics	7	28.0	0	0
Others	6	24.0	7	77.8
Do not know	6	24.0	1	11.1

At the health facility, there was more use of oral rehydration fluids and antibiotics while at home, other treatments such as local herbs were used most. The use of local remedies is very popular among low income earners and for minor conditions which people may think do not need medical attention.

3.9. Child nutritional status

Only 1.3% (2/159) of the children were reported to have been diagnosed with a nutritional problem. Both children were treated for the malnourishment, one in the hospital and another in a private clinic. One of the children was given dietary advice when they sought medical attention.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

Public taps were the commonest source of water for drinking, cooking, bathing, laundry and dish washing among the community. Most households paid for the water they used at a cost ranging between 100 – 150 Uganda shillings per 20 liter jerrycan. However, these prices varied seasonally and between sellers.

Women were the ones who used most water in homes and were also responsible for collecting the water. Women were also responsible for collecting and disposing refuse at households.

Boiling water was the commonest practice by households to render it safe for drinking. However, from bacteriological analysis, most of the drinking water of the households was contaminated with fecal coliforms therefore unsafe for human consumption. Plastic jerrycans were the commonest drinking water storage container.

Most households had latrines that they used for excreta disposal. However, majority of them lacked hole covers, ventilation pipes, handwashing facilities and soap for washing hands. There was indiscriminate disposal of wastewater into drainage channels. There was also poor solid waste management with majority of households disposing of refuse in open pits and burning it. No skip was available in the community for storage of waste.

Private clinics were the first choice health facility for households seeking healthcare. The prevalence of diarrheal diseases and fever among children was low. A significant number of children did not have their immunization cards available.

Mass media (radio and television) were the primary source of health, hygiene and sanitation information. The most preferred language for health education was *Luganda*.

4.2. Recommendations

1. The project should health educate the community on the best practices in safe water, sanitation and hygiene at household levels. Specifically, the following should be considered for health education:
   - safe water chain
   - sanitary condition of latrines
   - handwashing facilities at latrines
   - waste water disposal
   - refuse disposal
   - household environmental conditions

2. The *tippy tap* technology for handwashing can be explored by the project to improve handwashing practices after latrine use among the community.

3. While carrying out health education on sanitation issues among households, the project should give special attention to women who were found to be more involved in water and sanitation activities.

4. *Luganda* should predominantly be used while carrying out health education among the community.

5. The project can explore the use of mass media particularly radio to pass on health information to the community.

6. The project should sensitize parents to always keep the immunization cards of their children.

7. Kampala City Council should endeavour to provide a skip in the community to improve refuse management in the area.

REFERENCES

Alajo et al., (2006): Alajo SO, Nakavuma J, Erume J. Cholera in endemic districts in Uganda during El Nino rains: 2002 - 2003. *Afr Health Sci.* 2006; 6(2): 93 - 97.

Beller Consult and Associates (2004): Sanitation Strategy and Master Plan for Kampala City, Kampala.

Directorate of Water Development (DWD), Ministry of Water and Environment (2010). Water sector guidelines, Final copy, 2010.

Kawempe Division (2008). Kawempe Division 2008/2009 – 2011/2012 Three Year Development Plan.

Kiwanuka S, Ekirapa E, Peterson S, Okui O, Rahman O, Peters D, Pariyo G (2008): Access to and utilization of health services for the poor in Uganda: a systematic review of available evidence. *Trans R Soc Trop Med Hyg.* 2008;102(11): 1067-74.

McKinlay, JB, McKinlay, SM (1977): The Questionable Contribution of Medical Measures t o the Decline of Mortality in the United States in the Twentieth Century. *The Milbank Memorial Fund Quarterly Health and Society, Vol. 55, No. 3 (summer, 1977)*, pp. 405-428.

MWLE (2003): Measuring performance for improved service delivery, Government of Uganda, Ministry of Water, Lands and Environment, September 2003.

UN-HABITAT (2003): The Challenge of Slums Global Report on Human Settlements (2003): United Nations Human Settlements Programme.

UNDP (2003): Slums, Squatter Areas and Informal Settlements – Do They Block or Help Urban Sustainability in Developing Contexts? 9th International conference on Sri Lanka Studies, 28th–30th November 2003, Matara, Sri Lanka

MWE, (2007): Drinking water quality standard.

WHO/AFRO. Uganda. Health Systems. 2001. http://www.afro.who.int/uganda/healthsytems.html [accessed on 15th October 2009].

APPENDICES

Appendix 1: Study Consent Form

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Study Consent Form

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JUL 20 2011
The University at Albany

1

INFORMED CONSENT NARRATIVE

Good morning / afternoon. My name is _____, and I am working on behalf of Makerere University School of Public Health. We are conducting a survey on **Drinking Water Supply, Sanitation, and Hygiene Promotion in your area.**

Purpose
This research aims at finding out the water supply, sanitation and hygiene status in your area, so as to help identify what things can be done to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene. As residents of this area, we therefore kindly request you to participate in the research and also allow your children to participate in the research.

Duration of the study
The research will last approximately three years.

Procedures
During the research, you will be asked some questions as household head. Stool samples may be taken from members in your household if they have diarrheal diseases. These samples will be tested to find out what has caused the diarrhea, and the results will be explained to you by the staff project team. We request that you continue furnishing us with the progress of the household members in regards to their illnesses, especially diarrhea. To collect this information, you will be visited at the household on a regular basis at 3 to 6 months intervals. This is to help us identify the causes of these diarrheal diseases and therefore be able to take appropriate action.

Household inspection will be done to find out any environmental factors that may increase diarrheal diseases. The sources of the water used in your home will be inspected and where possible water samples taken for microbiological analysis to help establish if your water sources are safe. If they are not safe, the responsible authorities will be informed to take action to make the water source safe for use. Your sanitation status will be assessed, and the present practices will be encouraged or modifications recommended for sustainable hygiene promotion in the community.

The expected duration of the exercise will be approximately 1hr 30min.

Costs/Compensation
All research related procedures and visits will be provided to you at no cost. You will therefore have no added costs from being in this study. There will be no cash incentive from participating in the study.

Benefits
Treatment will be provided for household members found to have diarrhea using the Essential Drug list of the Ministry of Health. Where more costly drugs are needed appropriate referral to health facilities will be done. Where water is found to be unsafe for use, responsible authorities will be informed to take action to make the water source safe for use and appropriate health/hygiene education will be provided. Knowledge will be gained on how to improve the health and living conditions in your area.

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Risks
There will be no risk to you and other household members other than the inconvenience of their providing stool samples if they have diarrhea.

Right to refuse or withdraw
Your participation in this study is entirely voluntary. You may choose not to participate in the study. If you choose to join the study, you are also free to withdraw from the study at anytime should you wish not to continue.

Confidentiality
Details of the household heads and children will be recorded but these will be safely kept and will not be revealed in the report or publication of results of this study. Details are necessary to help the team trace your households and the children in the study for follow up during the three years of the study.
The data collected and the consent form will be securely stored under lock and key with the Principal Investigator.

Questions
In case you have any further questions concerning the research you can contact the project investigators on the project listed on page 1. A signed copy of this form will be provided to you.

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HOUSEHOLD CONSENT

I have been approached to participate in a study to assess the drinking water supply, sanitation, and hygiene promotion. The purpose, procedures, benefits and risks of participating in this study have been explained to me. I understand that during the study the fieldworkers / health workers will:

1. Ask me questions about my household members and the general environmental hygiene.
2. Take stool samples from household member(s) if they have diarrhea. These will be used to test for microorganisms that cause diarrhea and also determine the best drugs to treat these microorganisms. Results of samples collected from my household will be brought to me and explained to me by the staff project team.
3. Visit the household on a regular basis from 3 to 6 months intervals to conduct an environmental and health inspection.
4. Treat household members found to have diarrhea using the Essential Drug list of the Ministry of Health. Where more costly drugs are needed appropriate referral to health facilities will be done.

I also understand that:

1. My household member(s) will not be exposed to any other than the inconvenience of providing stool if they have diarrhea.
2. My participation in the study is voluntary. If I do not participate, I will not be affected in any way and that I can also withdraw from the study at any point during the follow up for the project duration.
3. Information collected during the study will be confidential.
4. There will be no costs related to the study procedures and no cash incentives will be given.
5. The study will last approximately three years.
6. If I have any questions related to the study, I may contact the researchers at anytime.
7. I will be given a copy of this form and that a copy of this form will be kept in the study file.
8. By signing below I agree to participate in this study.

I freely agree to participate in this research and allow my household to join the study.

Name of Interviewee/Guardian.....

Signature.....

Date.....

Name of Interviewer / Health worker.....

Signature.....

Date.....

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If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about

the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

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Appendix 2: Household questionnaire

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Informed Consent: Go through informed consent as indicated

IF RESPONDENT AGREES TO BE INTERVIEWED 1
Thank her / him for accepting to participate.

CONTINUE ↓

IF RESPONDENT DOES NOT AGREE TO BE INTERVIEWED 2
Thank her / him & go to the next household (i.e. household of the next sampling interval) →**END**

Questionnaire No.
GPS READING: _____ **HOUSE HOLD ID NUMBER**_____

DIVISION:
SUB COUNTY (LCIII):
PARISH:
VILLAGE/ZONE (LC1):
TEAM NO:
INTERVIEWER'S NAME: **SIGNATURE & DATE** _____

DATE OF INTERVIEW ……/……../2010
TIME OF INTERVIEW: START _____ **END** _____
SUPERVISOR'S NAME:

ARE ALL QUESTIONS COMPLETED? NO ..... 1 YES 2

IF NOT WHY REFUSED..... 1 OTHER (SPECIFY)……. 2

SUPERVISORS NAME _____ **SIGNATURE & DATE** _____

DATA ENTRANT'S NAME _____ **SIGNATURE & DATE** _____

1.0 HOUSEHOLD DATA COLLECTION FORM ☐

1.1 Respondent particulars

Name of respondent: _____

Sex of respondent	**Marital status of Head of HH**	**Age of respondent (years)**	**Religion of respondent**	**Education level of respondent**	**Region (District) of origin/birth of respondent**	**Period respondent has been living in area (years)**	**Is respondent the household head?**	**If respondent is not household the household head, what is the relationship of the respondent to the household head?**
1=Male 2=Female	1=Never married 2=Married/cohabiting (monogamy) 3=Married/ cohabiting (polygamy) 4=Widowed 5=Divorced 6=Separated	1=19-24 2=25-34 3=35-44 4=45-54 5=55-64 6=65+ 99=Don't know	1=Catholic 2=Protestant 3=Pentecostal 4=Muslim 5=Other (specify)	1=None 2=P1-P7 3=S1-S4 4=S5-S6 5=College (post S4) 6=College (post S6) 7=University (post S6)	1=Kampala 2=Central 3=Eastern 4=Northern 5=West Nile 6=West 7=Out of Uganda	1=< 1 2= 1 –3 3= 3-5 4=>5 99= Don't know	1=Yes 2=No	1=Spouse; 2=Son/daughter; 3=Step child; 4=Grand child; 5=Sister/brother; 6=Niece/nephew; 7=Other relative; 8=other (specify)

1.2 Household head particulars

☐

1.2.1 Socio-demographic characteristics of household head

Who is head of HH?	**Sex of Head of HH**	**Marital status of Head of HH**	**Age of Head of HH**	**Religion of Head of HH**	**Education level of head of HH**	**Region (District) of origin/birth of head of HH**	**Period HH head has been living in Banda (years)**
1=Male adult 2=Female adult 3= Male child 4=Female child 5= Other (specify)	1=Male 2=Female	1=Never married 2=Married/cohabiting (monogamy) 3=Married/ cohabiting (polygamy) 4=Widowed 5=Divorced 6=Separated	1=19-24 2=25-34 3=35-44 4=45-54 5=55-64 6=65+ 99=Don't know	1=Catholic 2=Protestant 3=Pentecostal 4=Muslim 5=Other (specify)	1=None 2=P1-P7 3=S1-S4 4=S5-S6 5=College (post S4) 6=College (post S6) 7=University (post S6)	1=Kampala 2=Central 3=Eastern 4=Northern 5=West Nile 6=West 7=Out of Uganda	1=< 1 2= 1 –3 3= 3-5 4=>5 99= Don't know

1.3 Household water/sanitation

1.3.1 Household main water source, cost and usage

What is main source of water for the household? (Give only one)	How far is the main source of water from the HH?	Amount of water used in household per day (Indicate estimated number of 20litre Jerrycans)	Do you pay for this water?	If water is paid for, how much does it cost per jerrycan? (Indicate cost in Ugshs)	Who uses more water in the household?	Who is responsible for collection/fetching water for domestic use?
1=Borehole 2=Protected spring 3=Unprotected pond (river/stream/well) 4=Rain water harvesting 5=Piped water 6=Other (*Specify*)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km	1= 1 2= 2-3 3= 4-5 4= >5	1=No 2=Yes	1=<50 2=50/= 3=75/= 4=100/= 5=150/= 6=200/= 7=>200/=	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)

1.3.2 Household drinking water source, treatment and storage

What is main source of water for drinking? (Give only one)	Do you do anything to your water before drinking?	Where do you store your drinking water?	How often is the container for drinking water cleaned?	How is the container for drinking water cleaned?
1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Boiling 2=Use traditional herbs 3=Use chemicals (water guard tablet/liquid) 4=Filter/Sieve 5=Decant 6=Nothing	1=Traditional pot with cover 2=Traditional pot without cover 3=Plastic jerrycan with cover 4=Plastic jerrycan without cover 5=Other (specify)	1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5=Every month 6=Rarely 7=Other (specify)	1= Rinsed with plain water 2=Rinsed with soapy water 3=Scrubbed and rinsed with plain water 4=Scrubbed and rinsed with soapy water 5=Other (specify)

1.3.3 Household general domestic water source and disposal

What is main source of water for cooking? (Give only one)	What is main source of water for bathing? (Give only one)	What is main source of water for laundry? (Give only one)	What is main source of water for dishwashing? (Give only one)	How do you dispose of waste water from your house?
1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=Borehole 2= House tap 3=Public tap 4=Water vendor 5=Spring 6=River/stream 7=Well 8=Rain water 9=Other (*Specify*)	1=In soak pit 2=On the road 3=In the backyard 4=In the drainage 5=Other (specify)

1.3.4 Household bathroom and latrine

What type of bathroom does this household use?	If the household bathroom is outside, how many households use the bathroom?	Has your household got a latrine?	If you do not have a latrine, where does the household dispose off their feces?	If community latrine is used, how many households use the latrine?
1=Inside the house 2=Outside (built with blocks) 3=Outside makeshift 4=None	1=1-5 2=6-10 3=11-20 4=21=30 5=>30	1=No 2=Yes	1=Community latrine 2=Neighbor's latrine 3=Bush 4=Bury in the yard 5=Throw outside yard/dwelling 6=Not disposed off 7=Other (specify)	1=1-5 2=6-10 3=11-20 4=21=30 5=>30

1.3.5 Household rubbish disposal

Where do you dispose of your rubbish? (List all)	At household level, who is responsible for disposing off the rubbish?	If rubbish collection is paid for, how much does it cost per week? (Indicate cost in Ug.Shs)	Which company/Whom do you pay to collect your rubbish?(specify)	How often is the rubbish collected?	Are you satisfied with the rubbish collection services in the area?	If no, why are you not satisfied with the rubbish collection services in the area?
1=In KCC skip 2= Open pit (Communal/personal) and buried 3=Open pit and burnt 4=Open pit/trench 5=Any where around the house 6= Bush 7=Pay for rubbish collection 7=Other (Specify)	1=Female spouse 2=Male spouse 3=Female children 4=Male children 5=Female relatives 6=Male relatives 7=Other (specify)	1=<500 2=500-1,000 3=1,000-2,000 4=2,000-3,000 5=3,000-4,000 6=4,000-5,000 7=>5,000		1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5=Every month 6=Rarely 7=Other (specify)	1=No 2=Yes	

1.4 Household health seeking behavior

Health care services: Generally, if household members are sick, where is treatment sought first?	If first source of treatment is health facility (1-3), how far is this health facility from your household	Are you satisfied with the services at the health facility?	If no, why are you not satisfied with the services at the health facility?	If first source of treatment is other health care service (4-5), how far is this service from your household?
1. Hospital 2. Health center 3. Private Clinic 4. Traditional healer/herbalist 5. Others (indicate)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km	1=No 2=Yes	1=Inadequate medicines 2=Staff unavailable 3=Wait long in lines 4=Others (specify)	1= <1 Km 2= 1-2Km 3= 2-3Km 4= 3-5Km 5= >5Km

1.5 Household food sources and storage

Household food sources	Household food storage	Child food storage

Where do you normally get the household vegetables and fruits?	Where do you normally get the household meat/fish?	Where do you normally get the household milk products?	Where are the household vegetables and fruits stored?	How is the household meat stored?	How are the household milk products stored?	How is the food for the child less than five years stored?
1= Vendors at main market in area 2=Kikulu road side vendors 3= Other (specify)	1= Vendors at main market in area 2=Area road side vendors 3= Other (specify)	1= Grocery shops in area 2=Area road side vendors 3= Other (specify)				

1.6 Information accessibility

Do you have any access health, hygiene and sanitation information?	If yes, what is your major source of health, hygiene and sanitation information?	How often do you access health, hygiene and sanitation information?	What language do you prefer access health, hygiene and sanitation information?
1=No 2=Yes	1=Radio 2=Newspaper 3=TV 4=Health worker 5=Seminars/meetings 6=Other	1=Every day 2=Twice a week 3=Weekly 4=Every two weeks 5= Monthly 6=Rarely 7=Other (specify)	

1.7 Mortality information

In the past three months, have you lost any child aged less than 5 years? 1=No 2=Yes	If yes, how many children aged less than five have you lost?		Cause* of death for children aged less than 5 years (0-59 months)(Verbal autopsy)
	Number female	Number male	
			Child 1-
			Child 2-
			Child 3-
			Child 4-
			Child 5-

*1=Watery diarrhea; 2= Bloody diarrhea; 3= Measles; 4= Malaria/fever; 5= Cough/ARI; 6=Malnutrition; 7= Accident ; 8= Delivery complications; 9= Others (specify); 10= Unknown

2.0 INDIVIDUAL QUESTIONNAIRE

2.1 Child Immunization , supplementation and de-worming information (Children 6-59 months)

HH No.	**Child No.**	**Child Sex**	***Ask for Child's Health Card*** **Is child health card present?**	**Has the child received any of the following:**(Check child health card)			
				Measles immunisation (Left hand side)	**De-worming**	**Vitamin A Supplementation**	**BCG/Scar** (Right hand)
				1=Yes with card 2=Yes without card 3=No with card 4=No without card 5=Not applicable			
		1=Male 2=Female	1=No 2=Yes	Child>=9 months only	Within past 3 months	Within last 6 months	At birth

2.2 Child morbidity information

2.2.1 Morbidity in past 2 weeks

HH No.	**Child No.**	**Child Sex**	**Does the household have a mosquito net (s)?**	**Did the child sleep under a mosquito net last night?**	**Recent illness (last 2 weeks)**

		1=Male 2=Female	1=No 2=Yes	1=No 2=Yes	**Has child suffered fever in past two weeks?** 1=No 2=Yes	**If child has suffered from fever, what treatment was given?** 1= Chloroquine, Quinine, Coartem (Malaria treatment) 2=Other treatment (not malaria) 3=No treatment	**Has child suffered diarrhea in past two weeks?** 1=No 2=Yes	**If child suffered diarrhea in past two weeks, what was the nature of diarrhea?** 1=Watery diarrhea 2=Bloody diarrhea 3=other (specify)	**Other illness experienced in past two weeks** 1=measles 2=Malnutrition 3=Cough/RTI/Difficulty in breathing 4=Skin diseases 5=Vomiting 6=Eye infection 7=Intestinal parasites 8=Other (specify) 9=No illness

Diarrhea= any episode of more than three stools per day; **Bloody diarrhea =** any episode of more than three stools per day in which there is presence of blood in stool; **Measles =** Any episode of fever accompanied by cutaneous eruption, rhino-pharyngitis or conjuntivitis;

Fever= Elevated body temperature; **Respiratory Tract infection =** any episode with associated fever & cough with signs of; sputum, thoracicpain, dyspnoea , or wheezing

2.2.2 Health seeking behavior for diarrhea

HH. No	Child No.	If child had diarrhea in past two weeks, how long did the diarrhea last?	Was the diarrhea treated?	If diarrhea was treated, where was treatment sought?	If treatment was sought at a health facility (1-3), what type of treatment was given for the diarrhea?	If diarrhea was managed at home, (4), what type of treatment was given for the diarrhea?
		1=1-3 days 2=4-7 days 3=8-14 days 4=> 14 days 5= don't know	1=No 2=Yes	1= Hospital 2= Health center 3= Private Clinic 4= Managed at home 5= Traditional healer/herbalist 6= Others (specify)	1= Oral rehydration fluids 2= Antibiotics (specify) 3=Intravenous fluids (specify) 4=Other (specify) 99= Don't know treatment given	1= Oral rehydration fluids 2 = Home based fluids (specify) 3=Other (specify)

2.2.3 Malnutrition diagnosis and health seeking behavior

HH. No	Child No.	Has the child ever been diagnosed to be malnourished or have illnesses related to malnutrition?	If child has ever been diagnosed to have malnutrition, was the malnutrition treated?	If malnutrition was treated, where was treatment sought?	What type of treatment was given for the malnutrition?
		1=No 2=Yes	1=No 2=Yes	1= Hospital 2= Health center 3= Private Clinic 4= Managed at home 5= Traditional healer/herbalist 6= Others (specify)	1= Medication 2= Dietary advise 3=Other (specify) 99= Don't know treatment given

STOOL EXAMINATION TABLE

HH No.	**Child No.**	**Birth Date** (Day/Month/Year)	**Age** (Months)	**Sex** 1= M 2= F	**Stool analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

SOIL ANALYSIS TABLE

VILLAGE/ZONE (LC1):	**SOIL SAMPLE SOURCE:**	**Soil analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

WATER ANALYSIS FORM

VILLAGE/ZONE (LC1):	**WATER SAMPLE SOURCE:**	**Water analysis results:** Micro-organisms found

1=Salmonella 2=Shigella 3=Vibrio cholera 4=Entamoeba histolytica 5=Giardia lamblia 6=Escherichia coli 7=Others (specify)

Appendix 3: Consent form for Key Informants

10-138

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The University at Albany

MAKERERE UNIVERSITY
P.O. Box 7072 Kampala Uganda
Website: http://www.musph.ac.ug
Tel: 256-41-532207/543872/541437
Fax: 256-41-531807

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF DISEASE CONTROL AND ENVIRONMENTAL HEALTH

CONSENT FORM FOR KEY INFORMANTS

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074.

INTRODUCTION AND WHAT WE ARE DOING

I am _____, and I work at Makerere University School of Public Health. We are conducting a research on Drinking Water Supply, Sanitation, and Hygiene Promotion in your area. This survey is being conducted in two urban communities of Kampala and Mukono districts.
Your contribution during our discussion will be appreciated and helpful in highlighting issues that only a person of your experience can bring forth.

PURPOSE
This research aims at finding out the water supply, sanitation and hygiene status in urban communities, so as to help identify what approaches could be instituted to reduce the incidence of specific illnesses among such communities that are associated with water, sanitation and hygiene. As a person who is engaged in the water/sanitation/hygiene promotion/health and with good working knowledge, we therefore kindly request you to participate as a Key informant.

PROCEDURES
During the interview, you will be asked questions and have an opportunity to share your opinions on issues of socio economic, water, sanitation and hygiene promotion, environmental and health issues in relation to your work and the study area.

The expected duration of the interview will be 1hour. The answers and opinions from the interview will be kept confidential.

RISKS, STRESS, OR DISCOMFORT
We do not anticipate any risk in your participation in the interview.

BENEFITS

There may not be direct benefit to you, but your participation is likely to help us understand the water and sanitation status in these communities, and consequently enable us contribute to the improvement of the community members health and well being.

CONFIDENTIALITY

The information that we collect from this interview will be kept confidential. Information from the interview will be stored in a file that will not have your name on it, but numbers assigned to it instead. No names will be collected from you during this interview.
The information collected will only be used for research purposes.

CONTACT INFORMATION

_____ (Research Assistant) has described to you what is going to be done, and can be contacted at telephone number _____. If you have any other questions or concerns about this study, you may contact the Principal Investigator Dr. John C. Ssempebwa at telephone 0772-963074.

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

VOLUNTARY PARTICIPATION

You do not have to take part in this interview if you do not wish to do so, and refusing to participate will not affect you in any way.
Your participation in this survey is voluntary. Even after you agree to participate, or sign the consent document, you may decide to stop the interview at any time.

SIGNATURES

I have read, or been informed of the information about this research. I have had the opportunity to ask questions about it and any questions I had have been answered to my satisfaction. I hereby consent voluntarily to participate in the interview and understand that I have the right to withdraw at any time without any consequences.

_____ Date _____ _____
Participants signature Participants Code

_____ Date _____ _____
Signature of Research Ass. Name of Research Ass.

_____ Date _____ _____
Signature of Principal Investigator Name of Principal Investigator

Appendix 4: Key Informant Interview guide

Drinking Water Supply, Sanitation, and Hygiene Promotion:
Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

KEY INFORMANTS INTERVIEW GUIDES

Sub-county…… Parish……. Zone ……

Title of Respondent …….……

Name of interviewer…….…… Date of the interview……

1. What water sources are available in your community?
……
……
……
……
……..…

2. Is the community able to tell whether water is safe / unsafe for drinking or home use? Explain……
……
……
……..……

3. Mention any common dangers associated with consumption of unclean water in the community.
……..……
……
……

4. What sanitation facilities are available in your community? (shared/ unshared)
……
……
……

……
……..…

5. Is the community able to tell whether a sanitary facility is hygienic or not? Explain……
……
……

6. Mention any common dangers associated with use of unsanitary facilities in the community.
……..……
……
……

7. What is involved in water quality surveillance?
……
……
……

8. Do you think community involvement in Water Quality surveillance and sanitary inspections of excreta facilities is necessary? Explain.
……
……
……
……

9. Do you think the present water quality surveillance system is adequate? Why?
……..……..…
……
……

10. Do you think the current hygiene inspections on excreta facility inspection are adequate? Why?
……
……
……

11. How do you rate the involvement of the District leaders, NGOs/CBOs, Communities and Women in the safe water provision, sanitation and hygiene promotion in your area?
……..……
……
……

……
……

12. Do you have water user committees in your area? What is the composition of these committees? How long ago in months was this committee created? Are you a member of the water use committee?

……
……
……

13. Has the community had any health talks/workshops/seminars on water, sanitation and hygiene promotion?

……
……
……

14a. What factors might influence the community participation in safe water, sanitation and hygiene promotion activities in your area?

……
……
……

14b. How can these challenges be overcome?

……
……
……
……

Thank you!

Appendix 5: Consent form for Focus Group Discussions

MAKERERE UNIVERSITY
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Website: http://www.musph.ac.ug
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SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF DISEASE CONTROL AND ENVIRONMENTAL HEALTH

CONSENT FORM FOR FOCUS GROUP

DRINKING WATER SUPPLY, SANITATION AND HYGIENE PROMOTION HEALTH INTERVENTIONS IN TWO URBAN COMMUNITIES OF KAMPALA CITY AND MUKONO MUNICIPALITY, UGANDA

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074

INTRODUCTION AND WHAT WE ARE DOING

I am _____, and I work at Makerere University School of Public Health. We are conducting a research on Drinking Water Supply, Sanitation, and Hygiene Promotion in your area. This survey is being conducted in two urban communities of Kampala and Mukono districts.

PURPOSE
This research aims at finding out the water supply, sanitation and hygiene status in your area, so as to help identify what things can be done to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene. As residents of this area, we therefore kindly request you to participate in the focused discussion.

PROCEDURES
During the discussion, you will be asked questions and have an opportunity to share your opinions on issues of socio economic, water and sanitation, environmental and health issues in relation to your area with other members in your area. The discussion will be audio and video recorded. If you so wish not to have any part of the video or audio recording be done, you can ask for that part to be erased.

The expected duration of the discussion will be 1hr 30min. There will be two sessions of such discussions, one at the beginning of the study, and the second during the third (last) year of the study. The answers and opinions from the focus discussions will be kept confidential.

RISKS, STRESS, OR DISCOMFORT
We do not anticipate any risk in your participation in the discussions.

BENEFITS
There may not be direct benefit to you, but your participation is likely to help us understand the water and sanitation state in your community, and consequently enable us improve health in your community.

CONFIDENTIALITY
The information that we collect from this discussion will be kept confidential. Information from the discussion will be stored in a file that will not have your name on it, but numbers assigned to it instead. No names will be collected from you during this interview,and you should not mention any ones names or identifying information about another individual.
The information collected will only be used for research purposes.

CONTACT INFORMATION

_____ (Research Assistant) has described to you what is going to be done, and can be contacted at telephone number _____. If you have any other questions or concerns about this study, you may contact the Principal Investigator Dr. John C. Ssempebwa at telephone 0772-963074.

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

VOLUNTARY PARTICIPATION
You do not have to take part in this discussion if you do not wish to do so, and refusing to participate will not affect you in any way.
Your participation in this survey is voluntary. Even after you agree to participate in the discussion or sign the informed consent document, you may decide to leave the discussion at any time without penalty or loss of benefits to which you may otherwise have been entitled.

SIGNATURES
I have read, or been informed of the information about this research. I have had the opportunity to ask questions about it and any questions I had have been answered to my satisfaction. I hereby consent voluntarily to participate in the discussion and understand that I have the right to withdraw at any time without any consequences.

_____ Date _____ _____
Participants signature Participants Code
_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

_____ Date _____ _____

Signature of Research Ass. Name of Research Ass.

_____ Date _____ _____

Signature of P.I Name of P.I.

10-138

Approved by IRB
Valid Thru:

JUL 20 2011

The University at Albany

Appendix 6: Focus Group Discussion guide

Drinking Water Supply, Sanitation, and Hygiene Promotion: Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

FOCUS GROUP DISCUSSION GUIDE

Group Composition……....
Facilitator……..

Date of Discussion…….. Venue of Discussion……..

INTRODUCTION:

Good morning/afternoon/evening Sir/Madam. Our names are ……..(mention your names). We are a team from Makerere University School of Public Health and would like to discuss with you about Water, Sanitation and Hygiene promotion in yout area. The purpose of our discussion is to help identify what interventions can be put in place to reduce the incidence of specific illnesses among the community related to the water, sanitation and hygiene promotion status in your area.

Please feel free to ask for clarifications where needed. You do not have to reveal any personal information if you do not want to. All information given will be used develop community interventions only. Your name will be strictly confidential and will not be directly quoted in the report.

Before we begin I ask that we all introduce ourselves. I request that you speak one at a time as well as loudly and clearly when answering a question so that all your views are understood and written down. When making a point during the discussion, you may choose either to use your name or not. To help us capture the whole discussion and ensure that we do not miss anything that you say, I kindly request that we use this tape recorder here. May I use the tape recorder? May I continue with the interview? Thank-you

Moderator requests all participants to introduce themselves

GUIDE QUESTIONS:

A. Overview (Socio economic, environmental and health issues in area)

A1. Socio-economic issues

A1.1 What are the main socio-economic problems faced by people in this area?

A1.2. What categories of people in the community are affected most by these socio-economic problems? (Probe children, adults, boys, girls, males, females)

A1.3. What do you think are the causes of these socio-economic problems?

A1.4. In your opinion what are the main signs/manifestations of socio-economic problems in the area?

A1.5. In your opinion, during the last five years, do you think socio-economic problems in this area have decreased, remained stable of worsened?

- Give reasons why you think socio-economic problems have decreased, remained stable of worsened?

A1.6. What do you think should be done to improve the socio-economic situation of the affected people in this area. (Probe for best means for alleviating proverty)

A2. Environmental issues

A2.1 What are the main environmental problems faced by people in this area?

A2.2. What categories of people in the community are affected most by these environmental problems? (Probe children, adults, boys, girls, males, females)

A2.3. What do you think are the causes of these environmental problems?

A2.4. In your opinion what are the main signs/manifestations of these environmental problems in the area?

A2.5. In your opinion, during the last five years, do you think these environmental problems have decreased, remained stable of worsened?

- Give reasons why you think socio-economic problems have decreased, remained stable of worsened?

A2.6. What do you think should be done to alleviate the environmental problems of the affected people in this area.

A3. Health issues

A3.1 What are the main health issues/diseases faced by people in this area?

A3.2. What categories of people in the community are affected most by these health issues/diseases? (Probe children, adults, boys, girls, males, females)

A3.3. What do you think are the causes of these health issues?

A3.4. In your opinion what are the main signs/manifestations of health problems in the area?

A3.5. In your opinion, during the last five years, do you think these health problems in the area have decreased, remained stable of worsened?

- Give reasons why you think these health problems have decreased, remained stable of worsened?

A3.6. What do you think should be done to improve the health status of the affected people in this area?

B. Diarrhoea

B1. Would you say diarrhoea is a big problem in this area? Yes/No

- If yes, why?
- If no, why do you say diarrhea is not a big problem in this area?

B2. What are the common types of diarrhea you have seen in this area? (Probe watery/bloody diarrhea)

B3. Do the residents normally seek treatment for diarrhea? Yes/No

- If yes, where do community members normally seek treatment for diarrhea?
  - In your opinion, why do you think they seek treatment in this place?

- What is the common type of treatment given for diarrhea?
- If no, why do you think they do not seek treatment for diarrhea?

B4. In your opinion, what do you think is the cause of diarrhea in this area? (Probe for water, sanitation, and hygiene conditions)

B5. What are some of the factors influencing community members to adopt good water, sanitation and environmental hygiene practices?

B6. What are some of the barriers hindering community members from adopting good water, sanitation and environmental hygiene practices?

B7. Are you aware of any organisations who have been working in this area to address the issue of diarrhea? Yes/No

- If yes which are these Organisations?
- What were these Organisations doing?

B8. Are you aware of any community efforts in the area to address the issue of diarrhea? Yes/No

- If yes, what are the community efforts in place?
- If no, what community efforts do you think should be done to reduce the incidences of diarrhea in this area?

B9. Who do you think should put into place these interventions to reduce diarrhea and why?

C. Water

C1. What water sources are available in your community?

a) Are all of them functioning? If no why?
b) Which ones are used most by the community? Why?

C2. What is involved in water quality surveillance?

a) Do you think community involvement in Water Quality surveillance is necessary? Explain.
b) Do you think the present water quality surveillance system is adequate? Why?

c) How do you rate the involvement of the District leaders, NGOs/CBOs, Communities and Women in the safe water provision and water quality surveillance processes in your area?
d) Have you had any sensitization workshop/seminar on water quality surveillance?
e) How do you tell that water is not safe for drinking or home use?
f) Discuss any dangers associated with consumption unclean water.
g) How do you think the community and women can be involved in water quality surveillance?

C3. Do you have Water User Committees in your area?

a) What is the composition of these committees?
b) How long ago in months was this committee created?
c) How often do committee members meet?
d) How often do the committees change leadership?
e) Have the committees got any training in Operation & Maintenance of water facilities ?
f) What are the roles and responsibilities of the committees?
g) How do the committees raise funds for running their activities?

D. Do you have any questions or comments regarding our topic of discussion?

THANK YOU FOR YOUR TIME AND COOPERATION

END

Appendix 7: Assent form

Drinking Water Supply, Sanitation, and Hygiene Promotion: Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

Assent Form

10-138
Approved by IRB
Valid Thru:
JUL 20 2011
The University at Albany

PRINCIPAL INVESTIGATOR
John C. Ssempebwa, BSc, MSc, PhD
Makerere University School of Public Health,
Kampala, Uganda
Telephone 0772-963074

My name is ..... I am trying to learn about Drinking Water, Sanitation, and cleanliness in your area because. This exercise wants to find out the safety of the water consumed in your area, and the cleanliness of the surroundings, so as to help identify what things can be done to reduce the incidence of specific diseases, particularly diarrhea.

If you decide you want to be in my research, I will collect a small amount of your feces when you go for a long call. You will defecate in a potty, from which I will remove a small amount of the feces to take back with me to the laboratory. In the laboratory, we shall look for small organisms that are contained in the feces to find out whether they are the ones causing you to have diarrhea. I might come back after 3 or 6 months to collect another feces sample if you will still be having diarrhea.

If you are found to have organisms that that cause diarrhea, you will be given medicine to make you feel better, so that you can once again play with your friends. Where water is found to be unsafe for use, I will advise your parents on how best to treat the water so that you don't get diarrhea and to also clean around your home. You will experience no pain from this study.

Other people will not know if you are in my research. I will put things I learn about you together with things I learn about other children in your area, so no one can tell what things came from you. When I tell other people about my research, I will not use your name, so no one can tell who I am talking about.

Your parents or guardian have to say it's OK for you to be in the research. After they decide, you get to choose if you want to do it too. If you want to be in the research now and change your mind later, that's OK. Iit's okay to stop at any time and no one will punish you.

My telephone number is 0772-963074. You can call me if you have questions about the research or if you decide you don't want to be in the research any more.

I will give you a copy of this form in case you want to ask questions later.

Agreement

I have decided to be in the research even though I know that I don't have to do it.

.....(Name of Research Assistant) has answered all my questions.

Code of Study Participant Date

Signature of Research Assistant Date

If you have any questions concerning your rights as a research participant that have not been answered by the investigator or if you wish to report any concerns about the study, you may contact the University at Albany Office of Regulatory Research Compliance at 518-442-9050 (toll free 800-365-9139) or orrc@uamail.albany.edu.

OR The Chairperson, Higher Degrees, Research and Ethics Committee, Makerere University School of Public Health, P. O. Box 7072, Kampala, Telephone: 256-414-532207.

10-138

Approved by IRB
Valid Thru:
JUL 20 2011
The University at Albany

Appendix 8: Communal / household latrine observation checklist

Drinking Water Supply, Sanitation, and Hygiene Promotion:

Health Interventions in Two Urban Communities of Kampala City and Mukono Municipality, Uganda

COMMUNAL/HOUSEHOLD LATRINE OBSERVATION CHECKLIST

1. Zone (LC 1):…… 2. Code Number ……

3. Date of Visit ……

1.	Does the household have no latrine?	Y/N
2.	Is the latrine > 5 meters from the house?	Y/N
3.	Has the latrine got no proper access leading to it ?	Y/N
4.	Has the latrine lack a door?	Y/N
5.	Does the latrine lack a roof?	Y/N
6.	Does the latrine lack a hole cover	Y/N
7.	Does the latrine lack a ventilation pipe?	Y/N
8.	Is the bottom of the latrine seen?	Y/N
9.	Is there presence of fecal matter/urine on the slab?	Y/N
10.	Is the latrine smelly?	Y/N
11.	Is the latrine infested with flies?	Y/N
12.	Are the latrine walls smeared with fecal matter?	Y/N
13.	Is there no hand washing facility near the latrine?	Y/N
14.	Is there no soap near latrine hand washing facility?	Y/N

Total Score of Contamination Risks ……../14

Contamination Risk Score: 10-14 = Very high; 7-9 = High; 4-6 = Medium; 1-3 = Low 0 = None

Results and Recommendations:

The following important points of risk were noted:

Name and signature of Research Assistant:

……..…

COMMUNAL / HOUSEHOLD ENVIRONMENTAL HYGIENE

OBSERVATION CHECKLIST

1. Zone (LC 1):…… 2. Code Number ……

3. Date of Visit ……

Environmental hygiene

1. Is the household environment dirty? (litter around the house) Y/N
2. Is there no dustbin for household rubbish? Y/N
3. Is the dustbin dirty and overflowing? Y/N
4. Is there fecal matter around the household? Y/N

Drainage

5. Is there no drainage around the house? Y/N
6. Is the drainage around the house clogged? Y/N

Utensils

7. Is there no utensil drying rack present? Y/N
8. Are the household utensils dirty and left unclean in the open? Y/N

Water container

9. Does the drinking water container have a wide mouth/opening? Y/N
10. Has the drinking water container got no lid/cover? Y/N
11. Is the drinking water container kept on the floor level? Y/N
12. Is the inside of the container dirty? Y/N
13. Is the outside of the container dirty? Y/N

Total Score of Contamination Risks …….../12

Contamination Risk Score: 10-12 = Very high; 7-9 = High; 4-6 = Medium; 1-3 = Low 0 = None

Results and Recommendations:

The following important points of risk were noted:

Name and signature of Research Assistant:

……..……

Appendix J. Partnerships Performance Data

FY2010—FY2011: Performance Data for the Partnerships between Cornell University, Tompkins Cortland Community College, and Bahir Dar University (Ethiopia) and State University of New York, Albany, Tuskegee University, and Makerere University (Uganda)

Performance Indicator	Unit of Measure-ment	Disaggregation (if any)	FY2010__ October 1, 2009 to March 31, 2010		FY2010__ April 1, 2010 to September 30, 2010		FY2011__ October 1, 2010 to March 31, 2011		FY2011__ April 1, 2011 to September 30, 2011	
			Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University
Number of HCNs receiving USG scholarships (including cost-share scholarships)	# of host-country nationals	By sex (male, female) By type of individual (faculty, student, other) By location (U.S., host country)	13 (male: 11; female:2) (student: 13; faculty: 0; other: 0) (U.S.: 1; HC: 12)	0	1 (male: 1; female: 0) (student: 1; faculty: 0; other: 0) (U.S.: 0; HC: 1)	1 (male: 1; female: 0) (student: 1; faculty: 0; other: 0) (U.S.: 1; HC: 0)	data not available	0	data not available	0
Number of HCNs completing USG-funded exchanges (including cost-share exchanges)	# of host-country nationals	By sex (male, female) By type of individual (faculty, student, other) By location (U.S., host country)	0	0	2 (male: 2; female: 0) (student: 0; faculty: 2; other: 0) (U.S.: 2; HC: 0)	0	0	1 (male: 1; female: 0) (student: 0; faculty: 1; other: 0) (U.S.: 1; HC: 0)	2 (male: 2; female: 0) (student: 0; faculty: 2; other: 0) (U.S.: 2; HC: 0)	0
Number of HCNs participating in partnership-related internships	# of host-country nationals	By sex (male, female) By type of individual (faculty, student, other) By location (U.S., host country)	0	0	0	1 (male: 1; female:0) (student: 1; faculty: 0; other: 0) (U.S.: 1; HC: 0)	0	0	0	0
Number of HCNs receiving short-term non-degree training – workshops, seminars, special classes (not exchanges, not internships, not certificate programs)	# of host-country nationals	None	0	0	70	0	0	0	0	17 (male: 8; female: 9) (age 25 or under: 11; age 26 or above: 6) (student: ; faculty; other staff:)

Performance Indicator	Unit of Measure-ment	Disaggregation (if any)	FY2010__ October 1, 2009 to March 31, 2010		FY2010__ April 1, 2010 to September 30, 2010		FY2011__ October 1, 2010 to March 31, 2011		FY2011__ April 1, 2011 to September 30, 2011	
			Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University
Number of HCNs participating in long-term training participation lasting six months or longer which leads to academic degrees or professional certificates (not certificates of attendance or completion)	# new enrollees and # graduates	By sex (male, female) By degree program (certificate, baccalaureate, Master's, doctorate, dual degree, joint degree) By age (age 25 or under, age 26 or above) By enrollment/ completion status (new enrollee, graduate) By location (U.S., host country/third country)	15 (male: 12; female: 3) (certificate: 0; baccalaureate: 0; Master's: 14; doctorate: 1; dual degree: 0; joint degree: 0) (age 25 or under: 7; age 26 or above: 8) (new enrollee: 14; graduate: 0) (U.S.: 1; HC: 14)	0	data not available	1 (male: 1; female: 0) (certificate: 0; baccalaureate: 0; Master's: 1; doctorate: 0; dual degree: 0; joint degree: 0) (age 25 or under: 1; age 26 or above: 0) (new enrollee: 1; graduate: 0) (U.S.: 1; HC: 0)	0	0	2 (male: 2; female: 0) (certificate: 0; baccalaureate: 0; Master's: 2; doctorate: 0; dual degree: 0; joint degree: 0) (age 25 or under: 0; age 26 or above: 2) (new enrollee: 0; graduate: 2) (U.S.: 0; HC: 2)	2 (certificate: 0; baccalaureate: 0; Master's: 1; doctorate: 1; dual degree: 0; joint degree: 0) (new enrollee: 2; graduate: 0) (U.S.: 2; HC: 0)

FY2012—FY2013: Performance Data for the Partnerships between Cornell University, Tompkins Cortland Community College, and Bahir Dar University (Ethiopia) and State University of New York, Albany, Tuskegee University, and Makerere University (Uganda)

Performance Indicator	Unit of Measurement	Disaggregation (if any)	FY2012__ October 1, 2011 to September 30, 2012		FY2013__ October 1, 2012 to March 31, 2013	
			Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University
Number of host-country institution faculty and/or teaching staff who enrolled in long-term training programs for qualifications strengthening	# of host-country institution faculty enrolled	By sex (male, female) By type of degree program (certificate, associate, bachelor, Master's, doctorate)	1	0	0	0
Number of host-country individuals (faculty and/or teaching staff, students, and administrative/other staff) affiliated with the host-country institution who completed long-term training programs for qualifications strengthening	# of host-country institution individuals graduated	By sex (male, female) By type of degree program (certificate, associate, bachelor, Master's, doctorate)	7	0	1 (faculty: 1; student: 0)	0
Number of host-country individuals (faculty and/or teaching staff, students, and administrative/other staff) affiliated with the host-country institution who completed short-term training programs	# of host-country institution individuals	By duration (1 day to 1 week, greater than 1 week)	data not available	data not available	16	22
Number of individuals from underserved and/or disadvantaged groups accessing tertiary education programs	# of host-country individuals	By sex (male, female) By type of degree program (certificate, associate, bachelor, Master's, doctorate)	0	0	5	0
Number of higher education institution outreach/extension activities in the host-country community	# of activities	None	5	8	2	14
Number of U.S. - host country institution joint development research projects	# of research projects	None	2	0	3	0
Number of new or improved policies and/or procedures that support increased access of underserved and/or disadvantaged groups to certificate and/or degree programs	# of policies/ procedures	By type of policy (admission, testing, conditional based on academic merit, remedial, other)	1	0	0	0
Percent of curricula newly developed and/or revised with private and/or public sector employers' input or on the basis of market research	% of curricula	none	100% (1 curriculum revised with input out of 1 curriculum revised)	100% (1 curriculum revised with input out of 1 curriculum revised)	0%	100% (1 curriculum revised with input out of 1 curriculum revised)
Percent of academic certificate and/or degree programs supported through the partnership that include new and/or enhanced experiential and/or applied learning opportunities	% of programs	none	100% (1 program supported with experiential learning out of 1 program supported)	100% (1 program supported with experiential learning out of 1 program supported)	0%	100% (1 program supported with experiential learning out of 1 program supported)
Number of new academic certificates and/or degree programs	# of programs	By type of degree program (certificate, associate, bachelor, Master's, doctorate)	1	0	0	0
Percent of academic research initiatives whose findings have been applied, replicated, or taken to market	% of research projects	none	0%	75% (3 research projects applied out of 4 started since partnership inception)	0%	75% (3 research projects applied out of 4 started since partnership inception)
Placement of students after graduation	# of host-country institution students	none	11		1	

Appendix J. Partnerships Performance Data

FY2010—FY2011: Performance Data for the Partnerships between Cornell University, Tompkins Cortland Community College, and Bahir Dar University (Ethiopia) and State University of New York, Albany, Tuskegee University, and Makerere University (Uganda)

Performance Indicator	Unit of Measure-ment	Disaggregation (if any)	FY2010__ October 1, 2009 to March 31, 2010		FY2010__ April 1, 2010 to September 30, 2010		FY2011__ October 1, 2010 to March 31, 2011		FY2011__ April 1, 2011 to September 30, 2011	
			Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University
Number of HCNs receiving USG scholarships (including cost-share scholarships)	# of host-country nationals	By sex (male, female) By type of individual (faculty, student, other) By location (U.S., host country)	13 (male: 11; female:2) (student: 13; faculty: 0; other: 0) (U.S.: 1; HC: 12)	0	1 (male: 1; female: 0) (student: 1; faculty: 0; other: 0) (U.S.: 0; HC: 1)	1 (male: 1; female: 0) (student: 1; faculty: 0; other: 0) (U.S.: 1; HC: 0)	data not available	0	data not available	0
Number of HCNs completing USG-funded exchanges (including cost-share exchanges)	# of host-country nationals	By sex (male, female) By type of individual (faculty, student, other) By location (U.S., host country)	0	0	2 (male: 2; female: 0) (student: 0; faculty: 2; other: 0) (U.S.: 2; HC: 0)	0	0	1 (male: 1; female: 0) (student: 0; faculty: 1; other: 0) (U.S.: 1; HC: 0)	2 (male: 2; female: 0) (student: 0; faculty: 2; other: 0) (U.S.: 2; HC: 0)	0
Number of HCNs participating in partnership-related internships	# of host-country nationals	By sex (male, female) By type of individual (faculty, student, other) By location (U.S., host country)	0	0	0	1 (male: 1; female:0) (student: 1; faculty: 0; other: 0) (U.S.: 1; HC: 0)	0	0	0	0
Number of HCNs receiving short-term non-degree training – workshops, seminars, special classes (not exchanges, not internships, not certificate programs)	# of host-country nationals	None	0	0	70	0	0	0	0	17 (male: 8; female: 9) (age 25 or under: 11; age 26 or above: 6) (student: ; faculty; other staff:)

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			Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University	Cornell University, Tompkins Cortland Community College & Bahir Dar University	State University of New York-Albany & Makerere University
Number of HCNs participating in long-term training participation lasting six months or longer which leads to academic degrees or professional certificates (not certificates of attendance or completion)	# new enrollees and # graduates	By sex (male, female) By degree program (certificate, baccalaureate, Master's, doctorate, dual degree, joint degree) By age (age 25 or under, age 26 or above) By enrollment/ completion status (new enrollee, graduate) By location (U.S., host country/third country)	15 (male: 12; female: 3) (certificate: 0; baccalaureate: 0; Master's: 14; doctorate: 1; dual degree: 0; joint degree: 0) (age 25 or under: 7; age 26 or above: 8) (new enrollee: 14; graduate: 0) (U.S.: 1; HC: 14)	0	data not available	1 (male: 1; female: 0) (certificate: 0; baccalaureate: 0; Master's: 1; doctorate: 0; dual degree: 0; joint degree: 0) (age 25 or under: 1; age 26 or above: 0) (new enrollee: 1; graduate: 0) (U.S.: 1; HC: 0)	0	0	2 (male: 2; female: 0) (certificate: 0; baccalaureate: 0; Master's: 2; doctorate: 0; dual degree: 0; joint degree: 0) (age 25 or under: 0; age 26 or above: 2) (new enrollee: 0; graduate: 2) (U.S.: 0; HC: 2)	2 (certificate: 0; baccalaureate: 0; Master's: 1; doctorate: 1; dual degree: 0; joint degree: 0) (new enrollee: 2; graduate: 0) (U.S.: 2; HC: 0)

FY2012—FY2013: Performance Data for the Partnerships between Cornell University, Tompkins Cortland Community College, and Bahir Dar University (Ethiopia) and State University of New York, Albany, Tuskegee University, and Makerere University (Uganda)

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Number of host-country institution faculty and/or teaching staff who enrolled in long-term training programs for qualifications strengthening	# of host-country institution faculty enrolled	By sex (male, female) By type of degree program (certificate, associate, bachelor, Master's, doctorate)	1	0	0	0
Number of host-country individuals (faculty and/or teaching staff, students, and administrative/other staff) affiliated with the host-country institution who completed long-term training programs for qualifications strengthening	# of host-country institution individuals graduated	By sex (male, female) By type of degree program (certificate, associate, bachelor, Master's, doctorate)	7	0	1 (faculty: 1; student: 0)	0
Number of host-country individuals (faculty and/or teaching staff, students, and administrative/other staff) affiliated with the host-country institution who completed short-term training programs	# of host-country institution individuals	By duration (1 day to 1 week, greater than 1 week)	data not available	data not available	16	22
Number of individuals from underserved and/or disadvantaged groups accessing tertiary education programs	# of host-country individuals	By sex (male, female) By type of degree program (certificate, associate, bachelor, Master's, doctorate)	0	0	5	0
Number of higher education institution outreach/extension activities in the host-country community	# of activities	None	5	8	2	14
Number of U.S. - host country institution joint development research projects	# of research projects	None	2	0	3	0
Number of new or improved policies and/or procedures that support increased access of underserved and/or disadvantaged groups to certificate and/or degree programs	# of policies/ procedures	By type of policy (admission, testing, conditional based on academic merit, remedial, other)	1	0	0	0
Percent of curricula newly developed and/or revised with private and/or public sector employers' input or on the basis of market research	% of curricula	none	100% (1 curriculum revised with input out of 1 curriculum revised)	100% (1 curriculum revised with input out of 1 curriculum revised)	0%	100% (1 curriculum revised with input out of 1 curriculum revised)
Percent of academic certificate and/or degree programs supported through the partnership that include new and/or enhanced experiential and/or applied learning opportunities	% of programs	none	100% (1 program supported with experiential learning out of 1 program supported)	100% (1 program supported with experiential learning out of 1 program supported)	0%	100% (1 program supported with experiential learning out of 1 program supported)
Number of new academic certificates and/or degree programs	# of programs	By type of degree program (certificate, associate, bachelor, Master's, doctorate)	1	0	0	0
Percent of academic research initiatives whose findings have been applied, replicated, or taken to market	% of research projects	none	0%	75% (3 research projects applied out of 4 started since partnership inception)	0%	75% (3 research projects applied out of 4 started since partnership inception)
Placement of students after graduation	# of host-country institution students	none	11		1	