University of Nairobi

AfriWatSan Project – Kenya

Sustaining Low-Cost Urban Water Supply and Sanitation Systems in Africa

Inception Workshop

Kisumu Hotel

Tuesday 14th June 2016

The Kisumu Inception Workshop Report

Prepared by:

(Kenyan Team led by Prof. Daniel Olago - PI)

JULY 2016

AfriWatSan is supported by the Royal Society-DFID Africa Capacity Building Initiative

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1. Background

This was a one day stakeholder engagement workshop, held at the Kisumu Hotel on 14th June 2016 from 8.00 am to 5.00pm. The mission of the workshop was to engage with the stakeholders from the onset by sharing the project aim, objectives and the expected outcomes, and to build collaborative networks with them.

The overall aim of the AfriWatSan project is to develop the scientific evidence required to inform policies and practices that sustain the quantity and quality of urban, low-cost water supply and sanitation systems exploiting the sub-surface in sub-Saharan Africa through focused studies in a Network of Urban Groundwater Observatories comprising a town (Lukaya, Uganda), a city (Kisumu, Kenya), and mega-city (Dakar, Sénégal).

The workshop was organized by the AfriWatSan Kenya team led by the PI, Prof. D. Olago, CO-PIs, Dr. R. Ayah and Dr. S. Dulo and the PhD student, Mr. J. Kanoti, in collaboration with the Department of Geology, University of Nairobi. The workshop was funded under Africa Capacity Building Initiative of The Royal Society and UK government's Department for International Development.

Plate 1: Group photograph during the AfriWatSan Inception Workshop. Front row from left is Dr. R. Ayah, Ms. S. Kanga, Prof. N. Opiyo, Dr. D. Ichang'i, Prof. B. Aduda, Prof. C. Nyamai, Prof. D. Olago and Ms. J. Ogonda.

2. Structure of the Workshop

The workshop consisted of presentations by the AfriWatSan team followed by group discussions. Participants were taken through the Global Overview of AfriWatSan Project & Workshop Objectives, followed by the Situation Analysis of the Kisumu Observatory by Prof. D Olago. This was followed by a presentation by Dr. S. Dulo on Water Supplies and Sanitation Infrastructure. Dr R. Ayah presented a paper on Water, Sanitation and Health and finally the PhD student, Mr J. Kanoti made a presentation on the Urban Aquifers Characterization. The paper presenters highlighted the major concerns of water and sanitation in Kisumu.

3. Official opening of the Workshop

Following an opening prayer, Dr. D. Ichang'i, the Chairman of the Department of Geology, University of Nairobi and Prof. C. Nyamai, the Dean, School of Physical Sciences, University of Nairobi, made their opening remarks at the workshop. The workshop was then officially opened by Prof. B. Aduda, The Principal, College of Biological and Physical Sciences, University of Nairobi.

Plate 2: Official opening of the AfriWatSan Inception Workshop in Kisumu by Prof. B. Aduda, Principal, College of Biological and Physical Science. On the background is Dr. W. Ichang'i, Chairman, Department of Geology.

In his opening remarks, the Principal eloquently elaborated upon the role water plays and the importance of sustainably using this finite resource. Climate change, increase in population, rapid urbanization and vulnerability to pollution were the key issues facing the water resource

managers today. The only solution to these challenges is to bring the stakeholders and researchers together to find sustainable solutions.

4. Workshop Presentations

4.1 Overview of Project & Workshop Objectives – Speaker: Prof. D. Olago, Principal Investigator

Introduction

The AfriWatSan consortium comprises a cross-disciplinary team of scientists from University College London, UK (the lead institution), Université de Cheikh Anta Diop (UCAD), Senegal, Makerere University, Uganda, and University of Nairobi (UoN), Kenya. It is funded under the Africa Capacity Building Initiative that is supported by The Royal Society and the UK Department for International Development (DFID). This is a five-year research and capacity-strengthening collaboration focused on sustaining low-cost water supply and sanitation systems in urban Africa that conjunctively use the subsurface as a source of safe water and repository of faecal waste. It is the first, multi-scale (small town, Lukaya Uganda – city, Kisumu, Kenya – megacity, Dakar, Senegal) analysis of urban groundwater and sanitation and its links to human health in Sub-Saharan Africa.

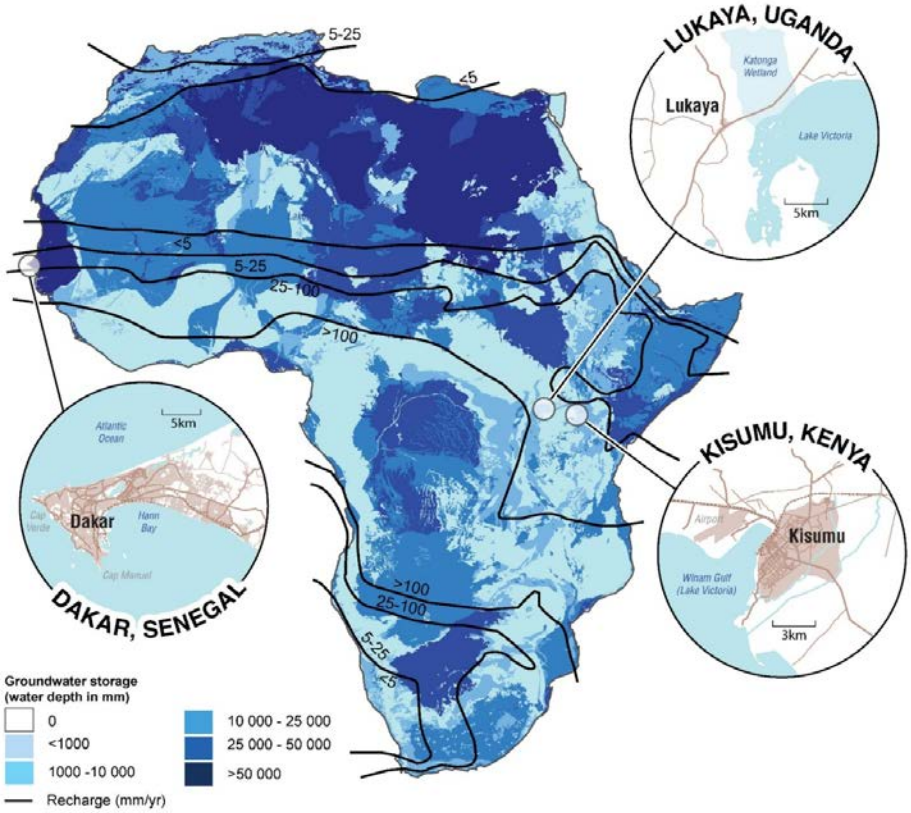

Figure 1: Network of AfriWatSan groundwater observatories in Africa

Plate 3: Prof. D. Olago making his presentation on Global Overview of AfriWatSan Project & Workshop Objectives during the Workshop.

AfriWatSan recognises that Sub-Saharan Africa is the most rapidly urbanising region in the world and that progress towards SDGs 6.1 and 6.2 of universal, equitable access to safe water and sanitation by 2030 will not be achieved by conventional infrastructure (sewerage, piped water supplies) alone. Indeed, the energy requirements, costs and waste associated with conventional infrastructure may be undesirable. Reducing poverty in African cities by sustainably expanding the provision of safe water and sanitation will depend upon using the shallow subsurface as both a receptacle of human sewage and a source of water. The goal of improving access to safe and sanitation is to reduce infant and child mortality and malnutrition that are associated with waterborne and water-related diarrheal diseases.

The proposed outcomes of this project

1. An integrated body of cross-disciplinary research outputs in the form of scientific publications in top-ranked international peer-reviewed journals that comprise the scientific evidence base required to sustain low-cost water supply and sanitation systems in Sub-Saharan Africa;
2. A network of regional centres of excellence in research and training related to low-cost water supply and sanitation systems;
3. A physical network of urban groundwater observatories in Sub-Saharan Africa;
4. A new cadre of very strong post-doctoral scientists who have trained within an international network of scientists and will thus provide a foundation for the sustainability of the intellectual and physical networks developed above;

5. Improved post-graduate training environments including personnel, teaching materials, infrastructure (e.g. laboratory equipment), and international vision;
6. Establishment of a south-south and south-north research network sustained through collaborative research (international grant competitions) and teaching (short courses, distance-learning);
7. An online (YouTube accessible), distance-learning course on low-cost urban water supply and sanitation systems in Sub-Saharan Africa connecting disciplines of hydrogeology, geochemistry, microbiology, water management and public health; and
8. An international forum on evidence-based urban groundwater management for policy and decision makers.

Conclusions

AfriWatSan research seeks to develop the scientific evidence required to inform policies and practices sustaining the quantity and quality of urban, low-cost water supply and sanitation systems that exploit the sub-surface. The project addresses identified skills gaps and explicitly connects scientific research to policy outcomes through the direct engagement of stakeholders that includes government ministries, basin management organizations, private-sector water suppliers, non-governmental organisations (NGOs), and civil society organisations (CSOs). The project features an exceptionally strong, cross-disciplinary team of African and UK scientists with substantial experience and track records of research delivery and policy engagement.

4.2 Situational Analysis - Speaker: Prof. Daniel Olago, Principal Investigator

Introduction

The world's population has urbanized rapidly, driven mainly in recent decades by the very large expansion in the world's economy and by changes in its structure. Most new investment, economic value and employment have been in industry and service enterprises and most such enterprises have chosen to locate in urban areas. Urbanization has also been influenced by the locations chosen by multi-national corporations for their production and for the centers where they concentrate their management. The urban population of Sub-Saharan Africa (SSA) is growing at a faster rate than any other region in the world. Efforts to improve access to safe water in rapidly urbanizing towns and cities commonly target groundwater because its resilience to climate variability and generally high quality that avoids the prohibitive costs of treatment associated with surface-water sources.

Plate 4: Kokelo Springs. Community water point in Kisumu

Issues

Efforts to expand access to sanitation in urban areas of SSA primarily involve low-cost, on-site technologies such as pit latrines and septic tanks that rely upon the subsurface to contain faecal wastes. In towns and cities across SSA, the conjunctive use of the subsurface to provide both a source of safe water and repository of faecal effluent, has not been rigorously assessed. Faecally derived nitrate has been observed to exceed WHO drinking-water guidelines in cities employing on-site sanitation across SSA.

The main groundwater challenges are poor water quality, low investment in the sector and contamination due to poor waste disposal management and sanitation services. Others are climate variability, environmental degradation, floods, poor management of water supply, contamination through liquid and solid waste and increase in population in the slums. Poor sanitation and indiscriminate disposal of faecal waste on the land surface have been observed to increase the vulnerability of shallow aquifers to episodic microbiological contamination from heavy rainfalls and led to outbreaks of diarrheal diseases including cholera. Despite legal and regulatory reforms in the African water sector, groundwater resources have been neglected and there remains an absence of scientific evidence and regulatory structures to sustain the quality and quantity of groundwater used for urban water supplies, and to reconcile this with the continued use of the subsurface for low-cost sanitation.

Plate 5: Dilapidated pit latrine in Ojuok Slums near Kisumu Airport. In the background is a community water point supplied by KIWASCO.

Conclusions

AfriWatSan will map and characterise urban aquifers, water-supply well catchments, and on-site sanitation systems. The project will also assess the vulnerability of urban aquifers and water-supply wells to microbiological and chemical faecal pollution and will quantitatively assess the impact of different low-cost, on-site sanitation strategies on urban groundwater. Ultimately, AfriWatSan will develop with stakeholders implementable, evidence-based strategies for sustaining low-cost water supply and sanitation systems in African cities.

4.3 Water Supplies and Sanitation Infrastructure – Speaker: Dr. S. Dulo, CO-PI

Introduction

The population of Kenya is about 46.7 million. Approximately 17.3 million lack access to safe water and 32.7 million lack access to improved sanitation. Access to safe water supplies throughout Kenya is 59% and access to improved sanitation is 32%. About 43% of the total population lives below the national poverty line, less than a dollar per day.

Table 1: Access to improved water source and sanitation from WASREB and JMP

Access to an improved water source	63% (JMP 2015) 37% (WASREB)
Access to improved sanitation	30% (JMP 2015) 50% (WASREB)
Continuity of supply	18 hours on average

Plate 6: Dr. S. Dulo explaining a point to the participants during the AfriWatSan Inception Workshop

Water supply and sanitation

The Millennium Development Goals dealt more on water than sanitation issues, but sanitation is picking up with the new Sustainable Development Goals. Separate planning for sanitation and water leads to installation of piped supply long before proper disposal and treatment of wastewater. The strong emphasis on water supply has led to the perceptions that water "will do the trick", everyone wants water, that water supply is a public concern and therefore attracts public and private investments because it is easy to charge for the water - if the supply is regular.

Sanitation attracts less attention from the government and private investors. It is viewed as less important, people are assumed to be uninterested, it is less of a public concern, and attracts little

public investment in poor urban areas up to now. Residents do not perceive that they pay for sanitation by e.g. poor health.

Challenges facing water and sanitation

The main challenges facing water and sanitation sector in Kenya are: water source quality and quantity, technology, operation and maintenance, institutional arrangements and financing. The growing water demand and the discharge of mostly untreated wastewater pose a huge challenge. Direct reuse of wastewater as well as the use of freshwater resources polluted by wastewater is very common throughout urban and peri-urban settings. The scarce fresh water can be utilized sustainably by minimizing loses at household level e.g. when brushing teeth, hand washing, shaving, flushing toilets, and by water reuse. Where water reuse defines the required degree of treatment, and where technical solutions must match African capacities, urban source treatment will be partially "outsourced" along a multiple barriers approach combining different health protection measure.

Urban agriculture

Sustainable urban agriculture should be encouraged. The challenge is to integrate agriculture into urban sanitation concepts. This has the additional advantage of water and nutrient recycling as two of the major ways of closing the water and nutrients loops in the urban- rural interface addressing the targets on sanitation and hunger simultaneously. The major challenges are the the capacity to design a more sustainable urban and rural development that will limit rural-urban migration and put an end to informal settlement. It is, therefore, paramount to ensure that proposals for technological solutions are based on holistic scientific, economic and social overviews of the entire urban water system where e.g. limitations in water supply are fully considered in setting sanitation targets, and where local communities can express their needs and suggestions in open multi-stakeholder platforms.

Conclusion

Sustainable water supply is faced with several challenges and the main one is whether to undertake large, interconnected complex systems, or small, distributed simple solutions? Are intermediate solutions in water and sanitation possible? Small inter-agency schemes in Kisumu include Awach, Seme and Kisian. These small intakes are either from small streams and boreholes powered by solar or installed with hand pumps. There is need for sanitation ladder upgrading.

Plate 7: Kajulu water intake. This intake supplement water from the Dunga water works on the shores of Lake Victoria. The intake suffers high turbidity during rains and low volumes and high contents of cations during dry seasons.

The provision of water services in Kisumu faces challenges that include; protection of our health and the environment, management and organization, incorporation of residents´ views and actions, and physical arrangements including technology. These challenges can be addressed if the county management, residents, policies, technology and engagement are in place. We need to measure the right parameters to be able to draw useful conclusions.

4.4 Water, Sanitation and Health Water – Speaker: Dr. R. Ayah, CO-PI

Introduction

Poor sanitation and access to clean water is a major health problem. Diseases associated with poor sanitation mostly linked with poverty and infancy and account for 10% of global disease burden. Unsafe water and sanitation is the second leading risk factor and contributor to all mortality and morbidity burden in Kenya (WHO, 2009). Pit latrines are the most common human excreta disposal systems and unfortunately, this practice discharges chemicals and microbial contaminants into groundwater that may negatively affect human health.

Plate 8: Dr. R. Ayah explaining a point during his presentation on water, sanitation and health during the AfriWatSan Inception Workshop in Kisumu.

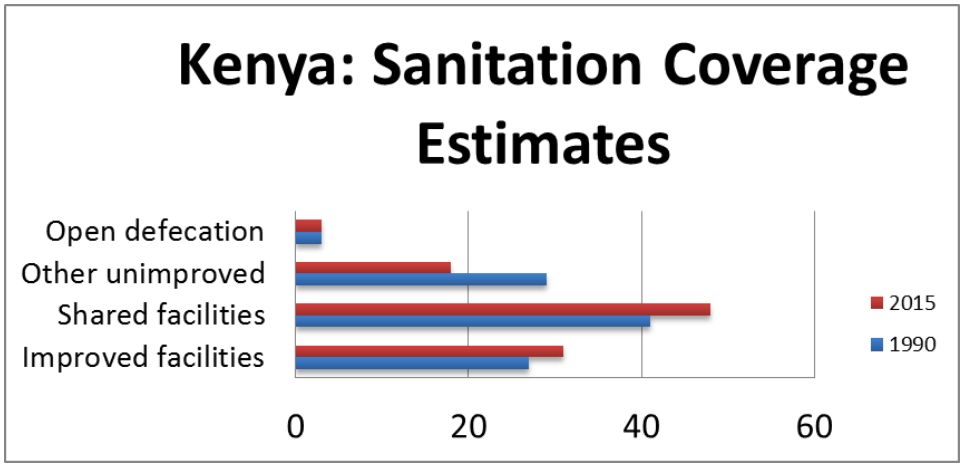

Figure 2: Sanitation Coverage Estimates in Kenya

Long-term changes in groundwater contamination hazards and hand-dug well water quality in two informal settlements in Kisumu city have been noted by researchers (e.g. Okotto-Okotto et al. 2015). The researcher mapped the buildings, pit latrines, and wells were mapped in 1999 and 2013–2014 in Kisumu and noted that the pit latrine density and sanitary risk scores for wells increased.

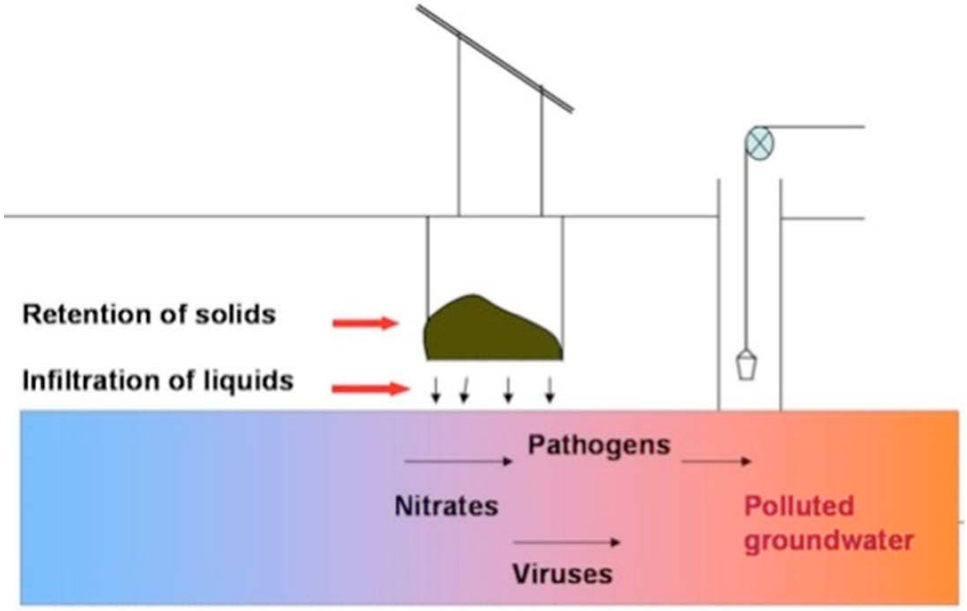

Figure 3: Risks that exist for groundwater contamination

Key Health questions

Q1. What is the prevalence of recurrent diarrheal diseases in the study areas?

- Among children, adults? Vulnerable populations e.g. HIV?
- How does this relate to seasonality in rainfall? Specific conditions associated with outbreaks?
- How is this related to the sanitation coverage or mode of employed sanitation (Sewerage, pit latrine, septic)?
- Investigate the relationship between bulk scores and individual components to disease incidence and observed groundwater quality

Q2. What are the relationships among rainfall seasonality (and extreme rain events), land use, pit latrine/septic tank densities, and groundwater quality in the area of study?

Q3. What are the relationships between urban aquifers, water-supply well catchments, on-site sanitation systems and health care morbidity and mortality patterns?

Q4. How vulnerable are our aquifer systems to faecal contamination/pollution and extreme climate events?

Q5. What is the relationship between chronic diseases and groundwater contamination?

- Emerging organic contaminants & Type2 Diabetes
- Tetracycline Resistance (antibiotic resistance)
- Trace elements:
  - Manganese & preeclampsia, Low birth weight
  - Mercury & renal and cardiovascular disease
  - Selenium & chronic kidney disease

- Fluoride & hypertension
- Arsenic & cancer, cardiovascular, neurological conditions

Methodology

Map and characterize urban aquifers, water-supply well catchments, and on-site sanitation systems

- Data abstraction from HMIS and health facilities
- Review of reports, policy documents, KII
- Field investigations to establish water quality with respect to faecal contamination of water.
- Conducting Sanitary Risk Surveys
- Conducting socio-demographic investigations for underlying factors for the disease prevalence.

Expected Results application

- Inform policy and planning at county and national governments level
- What should be the practice for sanitation in urban areas?
- What indicators should be monitored?
- How should the health care delivery system prepare for climate change?

4.5 Urban Aquifer Characterization – Speaker: Mr. J. Kanoti, PhD student

Introduction

This is a pan-African (Francophone Anglophone), capacity-strengthening and cross-disciplinary research collaboration tackling a fundamental water and sanitation challenge: sustaining low-cost water supply and sanitation systems in Africa that conjunctively use of the subsurface as both a source of safe water and a repository for faecal waste. It will develop the requisite knowledge base and tools as well as strengthen the capacity of African scientists to sustain use of the subsurface in Africa cities for climate-resilient water supplies and sanitation. The target is young and upcoming scientists in Africa.

Characterization of Kisumu aquifer

This is one of the key outcome expected at the end of five years and has three outputs –

1. the conceptual model and map of Kisumu aquifer
2. Delineation of shallow wells capture zones
3. Development of hydrodynamics and contaminants transport models at urban scale

The conceptual model and map of Kisumu aquifer

To achieve this output, several activities will be undertaken:

- literature review and collation of available data (relevant physical, chemical, microbiological, health, etc.)
- Field and digital mapping of land-use, geology, groundwater sources, and on-site sanitation facilities
- Construction and installation of field monitoring sites (piezometers, rainfall)
- Field sampling of groundwater sources, grey water, and urban runoff
- Analysis and interpretation of hydrochemical, isotopic and microbiological data to determine urban recharge sources and rates as well as magnitude and distribution of groundwater contamination

Capacity strengthening activities related to this outcome are:

- well/piezometer construction
- water sampling and water quality analyses and interpretation
- aquifer mapping

This will be done through training workshops for PhD students and laboratory technicians from the participating institutions.

Delineation of wells/borehole captures zones

Several activities planned:

1. By pumping test (tricky since most wells are shallow)
2. Using hydrochemistry and residence-time of water indicators – tracer information (environmental tracers using water isotopes)
3. Through analytical modelling of pumping tests and tracer information
4. Numerical modelling involving particle tracking of borehole capture zones

The related capacity strengthening activities Include:

- Capacity building in analytical and numerical modelling of pumping-tests
- Interpretation of environmental tracers to ascertain flow paths, residence time, water mixing etc.

These activities will be done by UCL/local experts.

Hydrodynamic and contaminant transport models at urban aquifer scale

This will include the development and translation of conceptual model from output 1 into analytical and numerical modelling frameworks (well equations, MODFLOW). It also entails running scenarios of hydrodynamic and mass transport to evaluate impacts on urban groundwater of competitive abstraction (quantity issue) and faecal transport. To attain this output:

- Capacity strengthening in groundwater modelling; and
- Application of latest software to run scenarios.

Conclusion

It is hoped that AfriWatSan Kenya will unveil the groundwater hydrodynamics and contaminant transport modes, and propose solutions to sustainable management of the sub-surface in Kisumu.

4.5 Questions and Answers

Situational Analysis – Prof. D. Olago

Question 1: What is the current water resources data and chemical composition and other existing baseline data scenario in Kisumu?

Answer: Existing data very patchy and lacks major indicators and parameters. Environmental isotope data very scarce and were studies have been done, it is not freely sharable.

Question 2: Why is surface water abstraction, treatment and distribution from Lake Victoria very expensive?

Answer: This is partly due to accounted for water (leakage from dilapidated water infrastructure, unpaid for bills). This leads to unnecessary huge power bills. High levels of pollution near Dunga, water hyacinth and fluctuating water levels are also blamed.

Water Supplies and Sanitation Infrastructure – Dr. S. Dulo

Question 1: Why can't technology be used to solve water and sanitation challenges?

Answer: Technology does not always offer solutions, e.g. automated technology for hand washing or flushing toilet in developing countries does not always work. The best alternative is the green technology based on research

Question 2: What does the sustainable water supply imply?

Answer: Very subjective. Does it mean walking distance, hours of supply, volumes or what? This can then be interpreted to mean a source that meets the demands.

Water, Sanitation and Health – Dr. R. Ayah

Question 1: Why is water given more priority than sanitation?

Answer: The impacts of lack of water are immediate while those of poor sanitation normally have incubation periods and some, like poisoning due to heavy metals take a long time to manifest.

Question 2: Comment on women/disposables and clogging of drainage pathways

Answer: The baby diapers and sanitary towels and emerging treat if not well disposed of. Drainage channel are most of the time clogged in the urban centers by solid waste.

Urban Aquifer characterization – Mr. J Kanoti

Question 1: How are you going to study non-point source contamination of groundwater e.g. Kisumu dump site
Answer: By sampling groundwater from wells/borehole surrounding the site along a profile.

Question 2: Why have labs in Nairobi and not Kisumu?
Answer: The project does not have a component for equipping labs in the field. The institutional labs capacity to be enhanced.

Comments and issues raised by participants

- Involve the LVEMP Kisumu laboratory in training. Research on pollution from point sources has been done but much less so for non-point sources. The impact of the dumpsite at Kachok on groundwater should be assessed.
- There is need to develop financial models for sustaining low cost watsan systems.
- There is access to sanitation facilities but it is inadequate; most pit latrines in Kisumu are full or abandoned. Consequently, other options are used, e.g. bush. Most people use pit latrines, and only a few have septic tank systems.
- There is need for boreholes to be equipped with solar pump systems since the communities can't afford the rates for piped water.
- There is need to identify partners to work with.

5. Group Discussions

5.1 GROUP 1 - Water supply infrastructure and technologies.

What are the on–site low cost sanitation options that are employed in Kisumu and what is the evidence for this?

1. Biological toilets done by LVEMP at Obunga and Kibuye; community members are paying ksh. 3/- to use the facility.
2. Ecosan – Umande Trust; SANA in Manyatta A and B, Obunga
3. VIPS – Kendu Bay.

What are the challenges of site low cost sanitation options that are employed in Kisumu?

1. Lack of community involvement and full participation during project initiation.
2. Capacity was a problem
3. SANA plant system done in Obunga and Manyatta by interlocking blocks is not functioning effectively.
4. Septic tank in Obunga is not functioning.

Plate 9: Group 2 Discussion on urban water supply led by Dr. S Dulo

What opportunities are there to examine the efficacy of different interventions?

Mostly biological interventions are being used; there is an influx of consumers e.g. in Kibuye and Obunga.

1. Ecosan – functional in Manyatta and Obunga - No service due to lack of government involvement and no provision of sanitation allocation. 60% is being used in Manyatta A and B.
2. Use of exhauster services provided by LVEMP II to the County and community is charged at low cost.

NB: Lack of enough training to community on how to use the human waste. Lack of service to the community when needed.

What monitoring infrastructure (e.g. waterpoint sampling surveys) are there to assess sanitation performance?

1. Water infrastructure are metered - Piped water and some borehole are metered
2. Sampling and analysis of water samples should be done because laboratories exist in Kisumu. These include:
    a. Kisumu Forensic (GOK)

b. Lake Victoria South Water Services Board.
c. Public Health Department in Kisumu East office handling ecoline.
d. KEBS
e. KEMRI

What are the priority capacity – strengthening needs for sanitation research?

1. Norms and culture
2. Behavioral change
3. Technical staff should be trained
4. Gaps in design standards
5. Develop operational manuals

What are the skills gaps and capacity development needs?

1. Policy formulation and legislation
2. Capacity building/strengthening to staff on waste composting e.g. public health technician and water technician.
3. Developing water and sanitation champions as heads of the programs and roll it down to the community members.
4. Form a task force for training community on water and sanitation.
5. Laboratories in Kisumu should be equipped.
6. Training to facilitate analyses and community programmes
7. Decisions should be implemented – build capacity for implementation.

5.2 GROUP 2 – Urban Groundwater Systems

How is ground water used for local water supply in Kisumu?

1. Shallow wells available around the informal settlements (Migosi, Nyalenda, Manyatta, Obunga, Otonglo) which are individually owned.
2. Most wells are not well protected and water is drawn manually
3. Deep water bore hole available in Wandiege (120m)
4. Some areas are characterized by high water table
5. Deep bore holes also available in town serving industries/malls
6. Protected springs available in Nyalenda and Bandani serving community (there is need to determine the source of the springs)

What ground water data exists to explore the quality and quantity of ground water fed suppliers?

1. LBDA - DHV (Program between Kenya and Netherlands)
2. WRMA
3. Maji House

4. Maseno University

Plate 10: The group on Urban Groundwater Systems discussing issues in Kisumu during the group discussion

What monitoring infrastructure will be implemented to improve understanding of urban ground water?

1. Piezometer
2. Need to improvise an automated monitoring infrastructure
3. A modern water assessment laboratory is available at WRMA (partnership recommended)
4. Build capacity for WRMA to ensure quality

What are the priorities capacity strengthening needs for ground water research?

1. Isotopic studies (Most experts only advice on the depths)
2. Funding challenges

Skills Gaps

1. Need for more hydrogeologists
2. Need for more technical staff/assistants e.g. water chemists

5.3 GROUP 3 - Health and Sanitation

What evidence is there of the health outcomes of inadequate access to sanitation, safe water and hygiene in Kisumu?

1. Outbreak of cholera, May 2015, 52 cases in Manyatta.
2. Long term use of mercury – in Migori. What about in Kisumu – Kajulu area?
3. Fluorosis – in children.
4. Sand harvesting hazard as after digging the areas left uncovered forming pools of water and may lead to childhood injuries.

What epidemiological data exist in Kisumu that might be interrogated?

1. MOH 513 data set done by Community health volunteers from 2006 that is updated every 6 months with supported by Great Lakes University Kenya.
2. Health Management Information Systems (HMIS) and health facilities data.
3. Baseline surveys done by NGOs (Kisumu has high number of NGOs). There is almost always a component on water & sanitation.
4. KIWASCO, Lake Victoria Services Board and water service providers. Have water quality indicators, and handle complaints. They also collect demographic data, e.g. when one is applying for connections.
5. SANA International did some project with school going children (2012?), SAFEWater, Plan International, CARE International may also have health data.

What field research (e.g. household surveys) might be conducted to assess health impacts/benefits?

1. Qualitative studies e.g. KIIs to assess trends - include Water users, household survey, health practitioners.
2. Prevalence survey, patient survey e.g. fluorosis.
3. Observational studies of pit latrines.

What are the priority capacity-strengthening needs for groundwater health research?

1. Technical people need capacity to engage politicians/policy makers on water and sanitation issues.
2. Institutes need capacity strengthening e.g. Kenya Water Institute does training. Skills in water engineering. Water management to improve graduates. Laboratories for the trainees.
3. Community Health Worker training on water and sanitation for households.
4. Media engagement, dissemination of information.
5. Cross-disciplinary interaction/overlap: ensure that geologists, sanitation engineers and public health specialists can communicate.

Plate 11: Group 3 discussion led by Dr. R. Ayah on water, sanitation and health.

What are the skill gaps? Capacity?

1. Skills in policy maker engagement – related to the capacity building
2. Laboratory techniques
3. Community Health Worker's skills in water and sanitation

6. Official closing of the workshop

The Workshop was officially closed by the Kisumu County Minister for Water, Environment and Natural Resources, Hon. Prof. Barrack Abonyo. The minister informed the participants that Kisumu County faces sanitation challenges and most residents rely on pit latrines and septic tanks for sanitation. The Minister highlighted some measures he had taken for the last three years to ensure that the residents of Kisumu got enough and quality water. The Minister's slogan is "clean water for health and water for food security". The main achievements attained by the County Government under his leadership are: Expansion of the Kajulu water intake to supplement the Dunga intake plant, drilling of boreholes in peri-urban areas (20 this year), and use of solar powered pumping system to lower power costs.

Plate 12: Official Closing of AfriWatSan Inception Workshop in Kisumu by Kisumu County Executive for Water, Hon Prof. B. Obonyo. To his left is Prof. C. Nyamai, Dean, School of Physical Sciences, University of Nairobi.

Workshop Programme

Time	Activity	Speaker	Session Chair
8.00 – 9.00	Registration of participants	Mr. J. Kanoti	Prof. D. Olago, University of Nairobi
9.00 - 9.30	Welcome Remarks and Introductions	Prof. N. Opiyo-Akech	
9.30 - 10.00	Workshop opening Remarks	Chairman, Geology, UoN	
		Dean, SPS, UoN	
		Principal, CBPS, UoN	
		County Executive for Water, Kisumu County	
10.00 - 10.30	**Health Break**		
10.30 - 10.50	Global Overview of AfriWatSan Project & Workshop Objectives	Prof. D. Olago	Prof. C. Nyamai, Dean School of Physical Sciences, University of Nairobi
10.50 - 11.20	AfriWatSan - Kenya: Situation Analysis	Prof. D. Olago	
11.20 - 11.50	AfriWatSan - Kenya: Water Supplies and Sanitation Infrastructure	Dr. S. Dulo	Ms. Susan Kanga, Water and Sanitation for the Urban Poor (WSUP)
11.50 - 12.20	AfriWatSan - Kenya: Urban Aquifers Characterisation	Mr. J. Kanoti	
12.20 -12.50	AfriWatSan - Kenya: Water, Sanitation and Health	Dr. R. Ayah	
12.50 - 1.00	Plenary		
1.00 - 2.00	**Lunch**		
2.00 - 3.00	Group Discussions: Group 1: Water Supplies, Infrastructure & Technologies; Group II - Urban Groundwater Systems; Group III - Water and Health	Chairs: Group 1 - Dr. S. Dulo; Group II - Prof. D. Olago; Group III - Dr. R. Ayah	Prof. Boniface Oindo, Dean, College of Environmental and Earth Sciences, Maseno University
3.00 - 3.30	Presentation of Group discussions		
3.30 - 4.00	**Health Break**		
4.00 - 4.30	Skills Gaps and Capacity Development	Plenary	Prof. N. Opiyo-Akech, University of Nairobi
4.30 - 4.45	Networking and Collaboration	Plenary	
4.45 - 5.00	Closing remarks	Prof. C. Nyamai	

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