

Report on Lusaka City Dialogue 1: Lusaka Water Resources and Climate Change



Lusaka, Zambia

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Acronyms and abbreviations

CMIP5	Coupled model comparison model 5 th Phase
CSAG	Climate systems analysis group
DMMU	Disaster management and mitigation unit
DWRD	Department of water resource development
FRACTAL	Future resilience for African cities and lands
GCM	General Circulation Model
LuWSI	Lusaka water security initiative
PPHPZ	Peoples process on housing and poverty in Zambia
UCT	University of Cape Town
WRMA	Water resources management agency
ZESCO	Zambia electricity supply company
ZPPHPF	Zambia homeless Federation
ZMD	Zambia meteorological department



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Introduction and background to the workshop report

The following is a report on the city dialogue engagements planned and hosted by the Future Resilience for African CiTies and Lands (FRACTAL) in Lusaka.

The city dialogue is a follow up engagement after the learning lab held in September 2016. At the learning lab, climate change issues were discussed with various stakeholders who were drawn from the water, energy and food sector. It was after this meeting that it was decided that stakeholders in Lusaka would have to be engaged in between the learning labs to keep the dialogue around climate change alive. The idea is to have discussions around specific issues that are affected or influenced by climate change.

The first dialogue was held on 25th January, 2016 at Mika lodge in Jesmondin, Lusaka. The topic of discussion was Lusaka water resources and climate change. The workshop began at 9:00 hours.

The planned dialogue programme was as follows:

1. Opening - including official opening by HOD, Department of Environmental Science, UNZA, and introduction of objectives by P.Wolski (CSAG)
2. Introduction of participants and expression of individual expectations
3. Presentations from invited institutions followed by questions and discussion
4. Session discussing "knowns and unknowns" related to Dialogue's topic, i.e. climate change and water resources, as contextualized by the earlier presentations.
5. Formulation of "communicable messages" from the workshop.
6. Reflection and closing

Workshop process and outcomes

Setting up the Dialogue's objectives and formula

After opening the proceedings, Piotr Wolski from the University of Cape Town (UCT) explained that FRACTAL had decided to hold city dialogues to have in-depth discussions around specific climate change themes. He explained the overall objective of the first city dialogue on Lusaka **water resources and climate change** were as follows:

1. To invigorate the conversation around climate change and water resources in Lusaka amongst institutions and individuals.
2. To bring together researchers and practitioners to increase understanding amongst them of available information, limitations and constraints around climate change issues.
3. To formulate needs-driven points of engagements where FRACTAL will meaningfully contribute.
4. To co-create informative communicable outputs which would be shared with other stakeholders.

He explained that in the process of planning of the Dialogue, a number of institutions were invited to present their work that relates to the topic of the Dialogue, i.e. climate change and water resources in Lusaka. These presentations were to provide a platform for realizing the Dialogue's objectives. He explained that the presentations and discussions were to lead to a broader discussion focussing on what is already collectively known about impacts on and implications of climate change to broadly understood water resources base of Lusaka. This in turn were to be summarized in the form of a short, communicable message that would be the outcome of the Dialogues.

Expectations of participants

A number of expectations were raised during introductions of participants. The one that occurred most often was:

to learn about what others are doing

A number of participants expressed expectations around:

learning about challenges of water resources management and water supply in the context of Lusaka, including institutions, their perspectives, roles and linkages, and information gaps

as well as around:

learning about how to translate research into practice, including into policies, and into effective water supply, in the context of information flow and cross-institutional collaboration

Apart from these broadly-scoped expectations, several participants expressed a more specific ones, for example:

to learn about CC impacts on one's activities (institutions' and individuals') and how to adapt,

to find out needs for (climate, meteorological) data of different (types of) users

Summary from the Dialogue's objectives perspective

The expectations were very diverse, and covered a range of topics from access to information, to processes of institutional collaboration, and were not necessarily rooted in the objectives of the Dialogue, i.e. were usually larger in scope than the issues of climate change and water resources. That diversity was clearly rooted in the diversity

of backgrounds of participants, as well as their professional needs. Relatively few participants expressed expectations focused on climate change.

Presentations from invited institutions

Below is the summary of each presentation where different presenters explained their work in the water sector and how climate change affects their work, as well as a summary of main points raised in discussion. A comprehensive summary of several presentations is included in the Appendix at the end of this document.

Department of Engineering, University of Zambia

Mr Joe Kabika presented work conducted in the department that focused on understanding of surface water-groundwater interactions in Chongwe river catchment. Chongwe is one of sources of water to Lusaka (10% of supply), and the river has experienced episodic drying in recent years. The study is a first step towards understanding drivers of the dynamics of water flows in that river, and attributing them to local anthropogenic or climate change-related causes. Its results highlighted complexity of the hydrology and dynamics of the river, and the fact that short data series prevented from developing their better understanding. The study was not conclusive about the causes of the recent episodic drying.

Department of Physics, University of Zambia

Mrs Suman Jain outlined the analyses of climate projections and regional model simulations carried out by her group in UNZA. These analyses were performed in collaboration with Zambian Meteorological Department, and were conducted in the context of agricultural impacts. She stressed that from her perspective, the major limitation in conducting further analyses of this type is the limited access to datasets, hardware and lack of software support.

Lusaka Water Security Initiative (LuWSI)

Mr David Mwamba has presented the recent activities and the general objectives of the LuWSI project. The project focuses on facilitating institutional interactions around water security and targets several aspects that are critical to Lusaka water, such as sanitation, uncontrolled groundwater abstractions, institutional collaboration. The project has conducted several activities, and is amongst others releasing results of mapping of Lusaka water-related institutional landscape. It is planning to conduct more detailed work on groundwater modelling, and is also interested in regional context, including Kafue basin.

Department of Water Resources Development

Mr Mukuka outlined the general water resources situation of Zambia and Lusaka, noting that scarcity of water was as a result of the expansion of industries and agriculture sectors

and increased demand from the general population, as well as recent trends in available resources (Zambezi and Kafue, as well as groundwater). He outlined strategic steps the department is taking to ensure future supply, which focus on users' education, water conservation, development of alternative resources such as deep groundwater, rainwater harvesting etc.

Zambian Meteorological department

Mr Edson outlined the role of ZMD in the country, and highlighted various data products that the department is generating. This included short-term and seasonal forecasts, agricultural situation bulletins, flash flood warning, and provision of data, including long-term observations.

The discussion evolved around the access to observational data by various researchers and institutions

Zambian Poor and Homeless People's Federation and People's Processes

The activities of the two NGOs were outlined by Veronica Katulushi and Farai Shumba. The two organizations focus on work at household and community level in the poorest neighbourhoods of Lusaka, and introducing robust solutions to immediate needs. These activities are to result in building climate-resilient "slum" communities, and include such practical actions as introduction of water kiosks, introduction of eco-friendly toilets, facilitating household connections to municipal water etc.

Zambia Electricity Supply Company (ZESCO)

Mr Chansa outlined the role and activities of the Hydrology Section of ZESCO, which is one of the units supporting electricity generation services. That role focuses on advising on operation of dams and turbines based on assessment of current and foreseen water availability, and integrating generation water use within the broader water resources management framing. ZESCO is collecting data and performing analyses and forecasts that are relevant from the operations point of view, but is also involved in strategic planning and water management policy formulation at the country level. Although analysing future climate change impacts on power generation in the country, and in particular in Kafue basin, is broadly in the interest of ZESCO, and they are planning to do this in the future, so far no work of this nature has been carried out.

Water Resources Management Agency (WRMA)

Mr Rector has outlined activities and mandates of WRMA. WRMA is a relatively new institution and is responsible for water allocations and day to day management of water resources. It operates through water boards. It carries out monitoring of water resources, and develops Integrated Water Resources Information System.

Climate System Analysis Group

Piotr highlighted results of recent work carried out at CSAG for Lusaka and its region. He showed long term rainfall patterns in Lusaka and Kafue in the last 30 years. He noted that

in both places, rainfall has increased over the last 30 years, which is in contradiction to the effects noted in earlier presentations that the surface and groundwater resources are diminishing. He emphasised the need to investigate and uncover why this could be happening.

He also presented rainfall projections for Lusaka and the region, based on CMIP5 GCM simulations, and highlighted the issues of uncertainty and robustness of such results. These results indicate a general lack of long-term change in total annual rainfall although show a tendency towards later onset of the rainy season.

Summary from Dialogue's objectives perspective

The presentations focused on activities of institutions in general, not necessarily those that are related to climate change and water resources. While this was a good response to the participant expectations to "learn about what others are doing", it was not strongly beneficial from the Dialogue's objectives point of view, and the information that was emerging was not enough to formulate "state of knowledge" about climate change and water resources in Lusaka. What emerged from the presentations and discussions was that, undoubtedly, there was a reduction of water resources (both surface water and groundwater) observed in the recent years. That reduction was often attributed to climate change, although very little evidence (if any) was presented to that extent. A few presentations and discussions pointed out that a more comprehensive picture of change was needed, that would include assessment of water abstractions in the context of sustainable rates, as well as other changes such as land cover changes. No evidence of such activities, reports, results was given by Dialogue's presenters and participants.

Discussion after individual presentations focused on availability of and access to long-term data hosted and generated by institutions, on the need for better monitoring (of climate, water resources, water abstractions etc), on the need for better institutional collaborations, and on a broad water supply landscape - outlooks for water recycling and rainwater harvesting in Lusaka, as well as the role of water use in industry, and its impact on domestic water supply.

Overall, it was clear that there is very little evidence-based "hard" results and information available to the presenters and participants that would speak directly to the topic of the Dialogue, i.e. climate change and Lusaka's water resources. That made it difficult to formulate the "communicable message" that was intended to be one of the outcomes of the Dialogue, as well as to conclude about the critical points of engagement for further activities of FRACTAL.

Exploring the “knowns and unknowns” of climate change implications to water resources in Lusaka

Jess Kavonic from ICLEI led a discussion into participants were supposed to identify the gaps as well as available information about Lusaka water resources and climate change.

1. It came to light that there is need for more information on abstraction of water as well as more mapping
2. There is need for long term observed rainfall and temperature data
3. There is need to increase understanding on whether the changes in climate were due to human or natural effects.
4. There is need for easier access to information by all rather than only being between partnered organisations.
5. Research institutes and departments in Lusaka need installation of better software programmes and technology in order to conduct better research.
6. Need for public awareness campaigns
7. Need to enhance links between the students and the government) to reduce costs of research as well as have relevant research being conducted to inform decisions for development in the city.
8. Need to promote water harvesting and recycling as a way of life or culture
9. Identify the water risk sources

It was discussed that the city and its decision makers need:

- a. To know the rate at which we are depleting ground water.
- b. Know how many boreholes are in Lusaka with classifications for commercial and private boreholes.
- c. Need easy to access information from institutions

The following recommendations were made;

10. To open a data platform under Disaster management and mitigation unit (DMMU) which is collecting data on climate change and the effects it has on water resources
11. LuWSI to create a data platform for easy information access by stakeholders.
12. Government departments need to create repositories where people can gain access to information
13. Increase the dissemination of research findings
14. To identify what other factors are contributing to low water levels apart from climate change
15. Develop future projections on ground water, rainfall patterns and general sustainability of water resources especially in Lusaka, as this would help in planning.
16. Collaboration between ZESCO and WRMA on the management of the Itezhi Tezhi dam and the river.

Summary from Dialogue's objectives perspective

This session's focus, similarly to the earlier one, gravitated towards the issues of data access and information sharing, particularly wrt. to data and information generated within the governmental institutions such as DMZ, WRMA, DWRD, which unfortunately is an issue that is systemic and much larger than can potentially be solved within the time frame of FRACTAL project. Again, it was clear that there is so far not much being done in term of assessing impacts of climate change on water, health and general livelihoods, currently, as well as in the future. On the positive side, a need was articulated for evidence-based assessment of drives of current/recent trends in water resources.

Reflections

Reflections from participants

1. Piotr said he thought not everything had been exhaustively covered, but he was glad with all matters and issues raised
2. Edson from the Meteorological department said they would ensure to pass the word in their department to improve service delivery
3. Mrs. Jain from the mathematics department at UNZA emphasised need for proper equipment and modern workstations. She stressed that climate change and ways of life are directly interrelated. They should both work together.
4. Veronica from ZHPPF she said she had a concern on strategies from the dialogue. She asked about what it is she was practically taking to the people on the ground? She requested for solutions from decision makers.
5. Farai Shumba from PPHPZ said there was need for information sharing between stakeholders. Emphasis was made for the need of the dialogue report to be shared.
6. Another participant said the feedback on the presentations was good, especially that there were other researches tackling the same research areas who can work together
7. There was need for private boreholes drilled around the city to be monitored, especially in terms of ground water measurements
8. Need to engage in more dialogue in terms of recycling, of water, rain water harvesting to make local level arrangements on water harvesting
9. Concerns were raised on the fact that so many terms were used, but were not defined. It was requested that that in another similar forum words be defined so that everyone could have similar understanding.
10. There was an emphasis on the need for practical measures to emerge from the dialogues rather than just discussing issues.
11. There should be serious consideration taken into projections of what should happen in the future in regards to water levels in Lusaka as it is the pioneer city

12. Request for a database to be created for information dissemination.
13. Requests were then made that the next dialogue should have organisation showcasing what has been implemented since the last city dialogue.
14. Requested that information and presentations made at the dialogue be shared via email. Expectations should be managed much better by FRACTAL so they are all not an independent learning lab

Overall reflections on the 1st Dialogue, and the Dialogue's concept in general

Overall, the Dialogue was a success. there were ~30 participants, representing a wide range of institutions. There were quite a few presentations about various institutions' activities. Discussions that followed up were engaging and vibrant. From broader project's perspective, it was a good way to maintain contact and demonstrate engagement.

However, what was happening at the Dialogue wasn't entirely what the Dialogue's concept envisaged. The concept called for focus on a topic (i.e. climate change and water resources) and depth, leading to generation of informative and communicable messages. What emerged, however, was shallow and broad. One of the participants actually commented that that the workshop is not pushing things forward, just repeating the first learning lab.

The presentations rarely touched on climate change directly. Rather they were broad sweeping overviews of institutions' activities, mandates, issues, and some general results of tangential research. Overall, that was a bit like the discussions during the first learning lab, although indeed focused on water, but rather due to the nature of the institutions that were presenting – DWRD, WRMA, ZMD, researchers from UNZA working on hydrology - than due to the conscious effort of the presenters. Most of presentations missed depth and focus on climate change.

The most heated discussion were about data access issues (but not climate projection data, just hydrological, meteorological, water use etc. that are held at various governmental agencies), and access to reports, literature, information generated in earlier studies by other institutions. In essence, the Dialogue established that what is missing and needed in Lusaka institutional/research circles, is what the intended output of the Dialogue was. I.e. some basic, but informative facts about Lusaka climate and water resources (in the past and in the future), and pointers to sources that unpacked and extended those basic facts.

There are several factors that lead to the Dialogue missing its mark, likely as follows:

1. - the idea behind the Dialogue might not have been conveyed appropriately, and thus somewhat misunderstood, perhaps because there was no precedent, so no examples of what was expected.

2. - the number and background of participants was not appropriate for the task, (smaller, more focused group, e.g. hydrologists/water resources people, would be better, but then what about transdisciplinarity and co-generation etc.?)
3. - the in-depth information that I envisaged to be forthcoming did not exist, or was not available to the participants.

The positive aspects emerging from the Dialogue:

1. There is a need to re-think an approach of achieving depth while working in a trans-disciplinary group, particularly in the context of next dialogues.
2. It becomes clear that climate change-related research in the context of Lusaka is minimal, and awareness of its results is even less. There isn't much on-going either. So there is lots of room for us to fit into.
3. There are several products that Fractal can relatively easily generate that would be definitely of help to the Lusaka Fractal group and Lusaka decision-makers in general, such as:
4. "How to access data" - an inventory of all relevant environmental/climate/etc. data, and institutions that hold them, contact persons, data request procedures, perhaps extended to the list of major "international"/free data sources (that relates to the data catalogue created within the Climate Cluster, but focus is on local & observational data)
5. A literature-based overview of Lusaka water resources, and results of relevant research, including the climate change aspects - something like the city background document, but with more depth, in the form communicable to the wider "community".

Annex 1: List of participants and details

NO	NAME	ORGANISATION	EMAIL	PHONE NUMBER
1.	Chibulu Luo	University of Toronto	chibulu.luo@mail.utoronto.ca	+61477894972
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Annex 1: Presentations at the workshop

Department of Engineering, University of Zambia

A presentation on the surface and groundwater interaction in Chongwe river basin was given by Joe Kabika from the school of engineering at the University of Zambia. A background to the research that the Chongwe River had started to dry up and researchers wanted to understand why this was happening. Joe explained that there is a degree of connection between surface water and groundwater. He explained that there are gaining streams, losing streams and a mixed type.

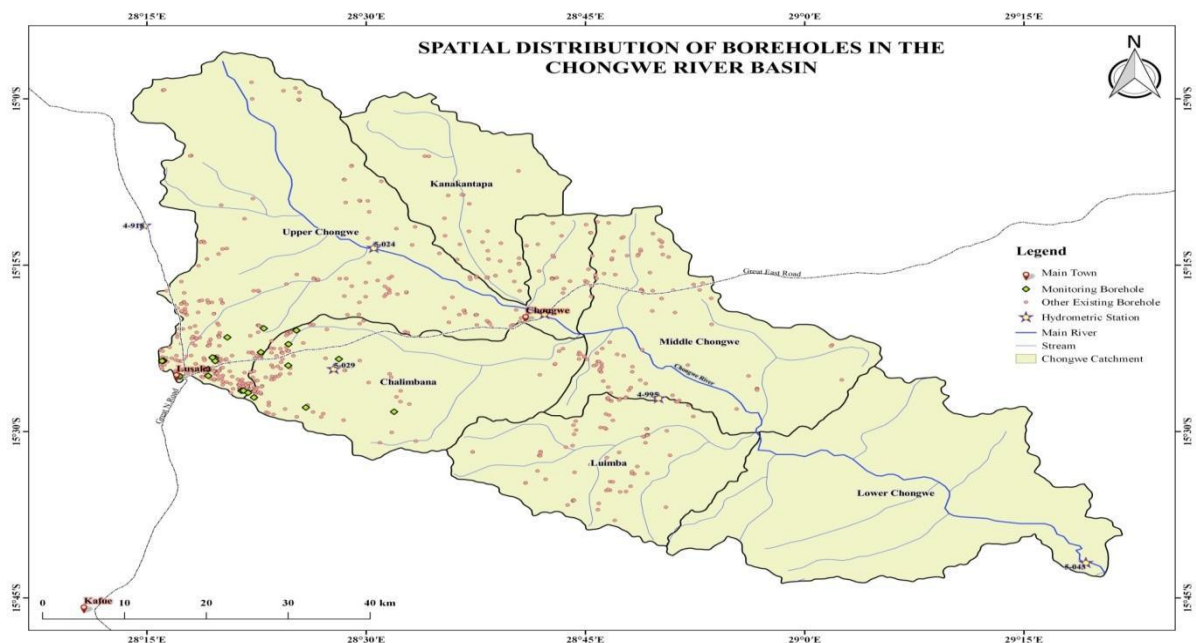
He explained the Chongwe River had been drying up in the recent years and so the objectives of the research were to assess surface and groundwater interaction in Chongwe River Basin.

SPECIFIC OBJECTIVES

- a) To conduct field experiments to determine exchange process through measurement of stream and piezometric water levels.
- b) To collect, analyze and establish the relationship between stream flows and groundwater levels from groundwater monitoring boreholes.

Joe explained that the results of the assessment were;

1. Chongwe river is a gaining system
2. The groundwater measurement and isometric, water measurement gave two different scenarios
3. They monitored the water levels in boreholes and streams



Analysis based on the regional groundwater flow indicated the river was a gaining system. The river stage and piezometer level measurement showed that the type of interaction is a losing system, while the streamflow and groundwater monitoring levels analysis approach indicated that there is interaction between surface and groundwater. The study concluded that the type of interaction between surface and groundwater in the basin was found to be both *gaining and losing system*. This means that along the river section there are points where water moves from the stream into the surrounding aquifer and in some sections, water moves from the aquifer into the river.

The following recommendations were made based on the above findings.

- To extensively investigate the types of interactions along all the streams in the Basin.
- To provide more groundwater monitoring boreholes in the Basin by the responsible authority.
- To install more gauging stations on Chongwe River and its tributaries by the responsible authority.

Lusaka Water Security Initiative (LuWSI)

David Mwamba provided an update on how far the Lusaka water security initiative (LUWSI) had made since September, 2017 at the learning lab. He explained that the LuWSI project had four functions;

- I. Understanding water provision in Lusaka
- II. Education, advocacy and awareness
- III. Building multi-stakeholder operation capacity and collaboration in collective action.
- IV. Project identification and development.

The meeting was informed that the second steering board meeting was held on 30th November, 2016 where it was decided that National water and sanitation council (NWASCO) would be the secretariat. A launch was held on 2nd December, 2016 where 16 organisations signed the memorandum of understanding.

The LuWSI project was in the process of:

1. Project development
2. Research mobilisation
3. Delineation of well fields
4. Conducting education and awareness being implemented in collaboration with Lusaka City Council, UNICEF and GIZ
5. Discussing and planning for the construction of a Pipeline from Lusaka west to Lilayi with Zambia Breweries, GIZ and Lusaka water and Sewerage Company for the purpose of increasing water supply.
6. Water risk and institutional assessments
7. Publishing the report that was written after the desk review of literature on

ground water, water supply and other water related issues in Lusaka. Water supply and other water issues in Lusaka.

The update on the LuWSI project was followed by a presentation by Mukuka Chimba from the department of water resource development under the Ministry of water, sanitation and environmental project.

Department of Water Resource Development

Mukuka informed participants that the department provides data on water usage, discharge and river flows. He explained that the scarcity of water was as a result of the expansion of industries and agriculture sectors and increased demand from the general population. Furthermore, climate change had had an impact on water resources and the mitigation and recommendation to this by the department were;

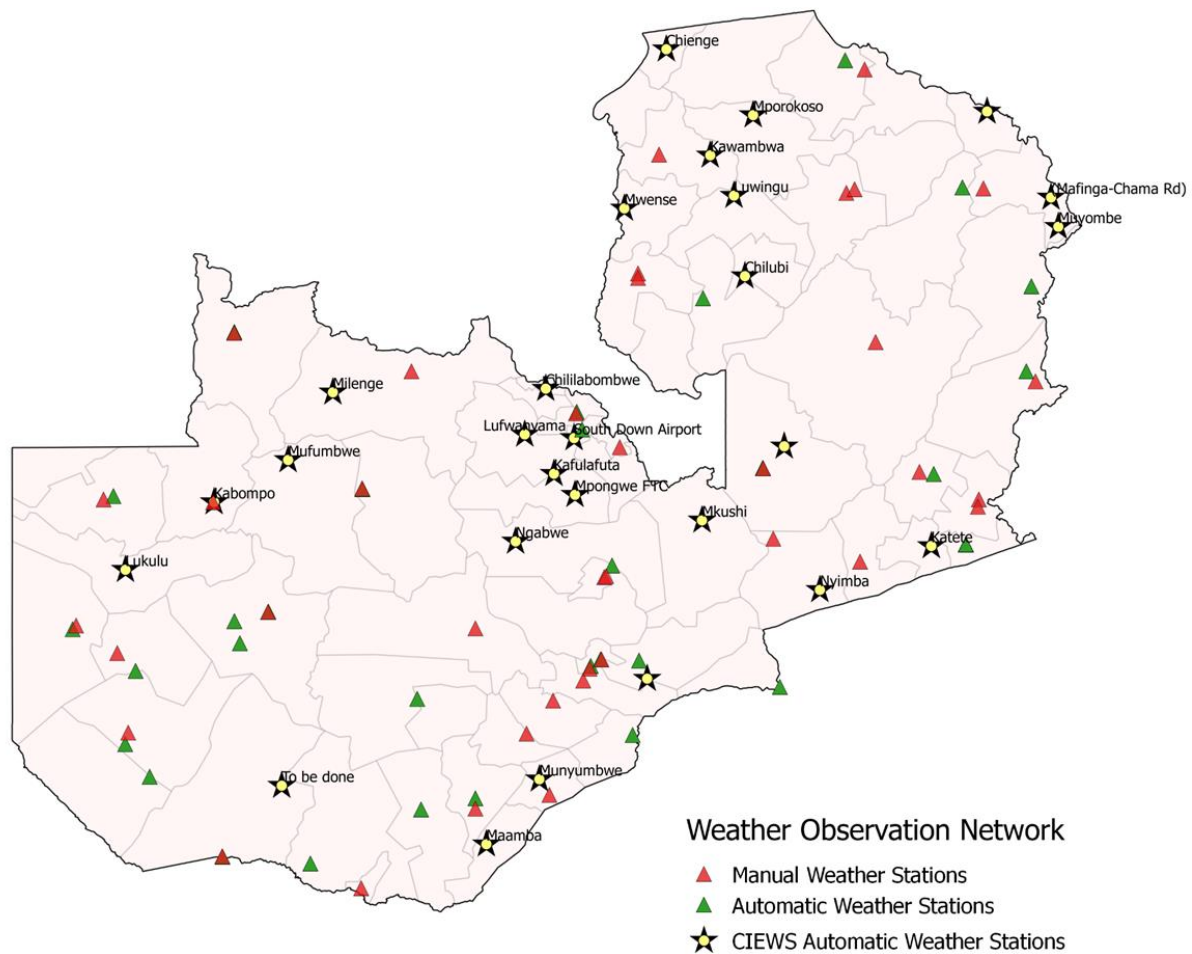
1. Conducting public awareness campaigns
2. Implementation of water conservation strategies
3. Promoting the use of water efficient systems like sprinklers and furrows to efficiently use water
4. Promoting water recycling
5. Rehabilitation of boreholes and dams
6. Exploration and development of deep groundwater resources
7. Catchment/watershed protection as a measure to reduce deforestation and soil erosion
8. The meeting was informed that the future plans of the department of water resource development were to construct dams and manage inter-basin transfers.

Zambia Meteorological Department

Edson informed the participants that the mandate of the department was to

1. Monitor climate
2. Generate climate information
3. Disseminate climate information to different sectors of the country

He informed the meeting that there are 39 manual stations across the country. In the recent past they have expanded with automatic weather stations. So far, 58 automatic weather stations have been installed with up to five years of data.



Department of Meteorology, 2017.

He explained that some of the products that the meteorological department provided were

- Rain season focus every September
- A 10 day crop weather bulletin during the rainy season
- Daily weather focus twice a day
- Early warning advisories, that is flood guidance system
- Climate data sets
- Aviation products and services (ISSO certified) to all airlines
- Enhancing national climate stations (ENACTS platform) blended data sets
- Early warning:
- Drought monitoring, field fire monitoring, flash floods

Edson explained that the sectors that they concentrated in were agriculture, water, energy and health as these were national priorities. He explained that the department also provided web services and climate forecast on www.zmd.gov.zm

The goals of the department was to enhance service delivery through projects such as CIEWs and SASSCAL which help them disseminate proper climate information. The Climate systems analysis in the department of agriculture helps them produce reliable

agricultural information. The RANET project is a radio project where radio stations are being established to reach all rural areas.

Zambia Homeless and Poor People's Federation (ZHPPF) and People's Process on Housing and Poverty in Zambia

BY VERONICA KATULUSHI AND FARAI SHUMBA

The presentation by the Zambia homeless and poor people's federation (ZHPPF) was to provide the perspective of how climate change is affecting the community. The federation receives technical support from the People's process on housing and poverty in Zambia (PPHPZ). PPHPZ is under the affiliation of Slum Dwellers International. She explained that the federation assists in building climate resilient slum communities. The methodology used by the federation is that of individual loans, collection of data and information on the community and using this to create community profiles. The federation also conducts community mapping of socio-economic data and enumerations. With this information the federation has been able to engage the government on community development initiatives.

Veronica explained that the federation has a partnership with the Lusaka city council, University of Zambia (UNZA) and non-governmental organisations such as CARE Zambia

Veronica then went on to show case practical examples of what the federation had done in Lusaka. In the community of George, Lusaka, they have negotiated with the water utility company to reduce water connection fees. They have built water kiosks and are managing them. They have seen a reduction in the number of people using shallow wells as a result of the sensitisation campaigns they carry.



Under sanitation, they have built ecological sanitation toilets (ecosan) and eco-wash toilets where harvested water is used for the toilet and bathroom. They are promoting

the use of waste as fertiliser for urban agriculture. The federation is also teaching the community on the greening of slums and sack gardening



To promote sustainable use of energy, the federation members have been trained to install solar panels. They have also given solar lighting units on loan. They have partnered with CARE Zambia to support community based enterprises (CBEs) to collect solid waste in slums. Federation members are trained to conduct risk mapping and also participate in drainage construction. The women in the federation have been mobilised to construct drainages in the community to reduce flooding...



Under housing, they are promoting the use of eco-friendly soil stabilised blocks which are cheaper than concrete blocks. They are also using locally available materials such as sand. In areas that have a lot of sand like Mongu and Senanga, where they are using the sand bag technology. She explained that slums are generally susceptible to the impacts of climate change due to inadequacy or lack of basic service provision.

Zambia Electrical Supply Company (ZESCO)

Chansa explained that ZESCO's core activity is to generate power. There are 3 functions of the company;

1. Generate
2. Transmit
3. Produce

He mentioned that ZESCO relies on hydrological data from department of Water Resources Development and Lusaka water and Sewerage Company.

ACTIVITIES IN HYDROLOGY DEPARTMENT

1. Hydrometric analysis
2. Information management
3. Focus team on rain and stream flows

The department also advises management on how much power generation is possible.

Chansa highlighted some of the challenges being faced by ZESCO as stated below:

- The demand for power has increased, yet improvement of infrastructure and technology to increase generation has not moved at the same pace.
- Load shedding due to the fact that most power stations are running below 50% capacity.
- Uncertainty about the amount of water available for generation of power in the future.
- Uncertainty and minimal capacity on how to deal with the natural reservoir in Itezhi-Tezhi
- Need for more data and specific software so as to manage the water resource in a more efficient manner.

Water Resource Management Authority (WRMA)

Rector informed the participants that WRMA was formed five years ago and operates in six catchment and sub-catchment areas. He explained that the authority is also affected by climate change through the loss of ground water. He informed the meeting that currently WRMA was evaluating commercial companies on their use of water. If they detect overuse by the company, the department enforces a reduction in the volume of water that the company can access. WRMA has also mapped commercial boreholes to create a database of existing boreholes since ground water is decreasing.

Rector explained that they also conduct flood and water level monitoring. They have 65 stations for transmitting real time data. They also conduct groundwater monitoring is also done every 10 days

Climate System Analysis Group, University of Cape Town

Piotr showed long term rainfall patterns in Lusaka and Kafue in the last 30 years. He noted that in both places, rainfall has increased over the last 30 years, yet in recent findings, the rivers are drying up. He emphasised the need to investigate and uncover why this could be happening.

He presented projected rainfall patterns that projected up to 2080. His graphs showed that in the future rainfall might reduce or start later than September.