

TITLE

**CHALLENGES IN TRANSITION FROM MERCURY
MEASURING INSTRUMENTS TO ALTERNATIVE
MEASUREMENT TECHNOLOGIES IN ZIMBABWE.**

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**ENSURING SUSTAINABILITY OF
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INTRODUCTION

Mercury metal has many uses. Its properties of high density, high boiling point and stability has enabled it to have a wide range of applications such as artisanal and small scale mining, health institutions, manufacturing industry, meteorology among others. Because of its high rate of expansion and fairly constant over a wide range of temperatures, it is extensively used in thermometers.

However, Mercury and its compounds are among the top priority chemicals of major environment and public health concern globally. The Minamata Convention on Mercury is an international treaty designed to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. The effective protection of human health through the implementation of the Minamata Convention requires adequate capacities in the health sector at national level.

To meet the objectives of the Minamata Convention and fulfil the responsibilities of the health sector as a user of mercury-containing products, adequate capacities should be established in ministries of health and in all other institutions which contribute to the harmful effects of mercury to the health system. In developing countries the implementation of the Minamata convention proves to be more challenging owing to limited resources and capacities.

2. BACKGROUND STUDY

Zimbabwe Meteorological Services Department has Forty seven manual weather stations situated around the country with a province having at least 5 stations among which 14 feed into the Global Telecommunication System. As a user of mercury added products and a member state of WMO, Zimbabwe has the mandate to fulfil its obligations of the Minamata convention to meet the 2020 deadline.

Since the establishment of the department weather forecasting and climate researches largely depended on observations done using mercury instruments. Currently Approximately 80 per cent observations of the 14 GTS stations are done using manual measuring instruments to include mercury barometers, thermometers and hygrometers. The other 33 stations use manual measuring instruments such as barometers, hygrometers, rain gauges, thermometers etc. The phasing-out of mercury-containing thermometers, barometer and hygrometers gauges in ZMSD requires the implementation of a number of activities.

These activities involve availability of human and technical resources, including but not limited to: conducting an inventory to identify the number and uses of mercury-containing devices. In addition, it requires evaluating alternatives, safe removal and disposition of mercury-containing devices. It also involves educating meteorological observers, users, technical personnel and those who are involved in waste management, maintaining and calibrating the alternative equipment as well as monitoring to ensure continuity as far as data collection is involved.

The transition process means the Department has to embark on automation and other alternative measurement techniques such as digital barometers, hygrometers and thermometers. The major drawbacks to this transition include telecommunications infrastructure that is the Mobile Cellular network, satellite communication system, fibre links and copper wire systems, Power supply network design, Failures or outages. The other challenge is the Computer network design, technical assistance and knowledge in technology transfer as well as financial resources. The transition, if not effectively implemented has a risk of causing a large data gap which is contrary to WMO requirements.

3. CHALLENGES

3.1 Financial Resources

Zimbabwe Meteorological Services Department is not a private entity. It is a government department that falls under the Ministry of Lands, Agriculture, Water, Climate and Rural resettlement. The department offers a service to the nation and hence does not generate revenue. For capital expenditure it entirely relies on fiscal budget that is allocated once a year.

After carrying out an equipment assessment on mercury added products in the department , not less than USD 1,2 million dollars is required to replace these instruments if we are to meet the 2020 deadline. As a low income country the figure is too big considering that purchasing of meteorological instruments may not be a priority.

ZMSD has control over a meteorological fund which is paid by the Civil Aviation Authority of Zimbabwe for the services we offer at airports. The department used to rely on revenue generated from selling climate and seismology data. The money is not enough to purchase equipment. Currently a climate policy was put in place that give access to free data for students and this has a negative impact on sales. Industry activity for the past two decades was very low and hence purchase of data reduced significantly and revenue raised was only enough for administrative tasks.

3.1.1 Priority given to Artisanal and small scale mining

In Africa, mercury is extensively used by artisanal and small gold miners posing great danger to the environment and Zimbabwe is not an exceptional. The mandate to manage FUNDS channelled for Minamata implementation vests in the hands of Environmental Management Agency which then directed the fund to artisanal and small scale mining sector deemed as of higher priority.

3.2 Automation / digitization

Technology is fast advancing and the world is moving from analogue to digital. The transition from mercury simply means as a department we have to use digital instruments and automatic weather systems and the first point of call is the airports. Implementing the Minamata convention requires capacity building and this involves skills training, infrastructure development, and computerization. This means a lot of training for technicians and engineers in installation, maintenance, calibration and repairing of digital instruments and automatic systems.

Users require training in ICT skills as well as maintenance of these instruments to ensure accuracy and continuity. In Africa there are 3 regional Training Centres where people can be trained in Instruments, maintenance and calibration. These Issues point back to the issue of limited financial resources.

3.3 Telecommunications Infrastructure

In Zimbabwe we have 3 main cellular companies which provide voice and internet services. Internet services are better in towns and cities where the coverage is also good and is limited in rural areas owing to a fewer base stations and topography. Few people in rural areas require more of voice service compared to internet services. As a result the base stations coverage for these cellular companies is very poor to an extent of having one base station covering more than 50km in other areas.

Considering the operation of Automatic Weather stations, where data is collected, logged and uploaded on the internet, it is a great challenge for those stations in remote areas to utilize them .Since AWS sent real time data, it is very difficult if the network is limited or poor. As an example, in 2014 ZMSD went into partnership with OXFAM to do a project that requires ZMSD to install 3 AWS, I in Midlands province and others in Masvingo. A technical team carried the site surveys for the 3stations. It was found that Econet, one of the cellular companies had better network coverage. SIM cards for this provider were purchased and modems were configured.

Installation was done, communication was tested successfully. Everything went well for more than a year but eventually we started to have communication problems, interruptions. Sometimes a station will go for several days without sending data. We visited the sites to check and everything was well. After a thorough investigation we discovered that the network provider had downgraded a number of base stations from 3G TO 2G a big blow for data communications.

As a result we are now relying on data stored in the SD card of the stations and it means regular visits are to be done to the sites if we are to maintain consistency in data collection. Alternative way is to use satellite communication however in Zimbabwe it is still expensive.

3.4 Infrastructure

According to the Quality Management System standard ISO 9001. 2015 infrastructure includes buildings and associated utilities, equipment including hardware and software, transportation resources, information and communication technology

3.4.1 Buildings

It is stated in the standard that the organization shall determine, provide and maintain the infrastructure necessary for the operation of its processes to achieve conformity of products and services. Having an efficient AWS network also calls for construction, fabrication and refurbishment of existing structures to ensure they meet the required standards thus providing a conducive environment for the operation of equipment.

3.4.2 Hardware and software

Servers, backup servers, workstations and maintenance laptops are a requirement for effective transition from analogue to digital. Software, software licences, strong anti-viruses and firewalls are a pre-requisite for security reasons to avoid the risk of losing or corrupting data.

Even if we opt for digital instruments computers are needed for displaying and storage of data. Some digital instruments such as the Intellisense Data measurement module provides for data collection from the internal memory via USB/ RS232 to a computer. This type of logger also has a facility to connect automatically to the server using GPRS.

3.4.3 Information and Communication Technology

Currently various stations in different provinces send data to their respective provincial centres which in turn send to a national centre and this is mainly over telephone conversation initiating some delays .

Real time data communication requires a good internet connectivity to avoid delays. Remote stations require Asymmetric Digital Subscriber Lines for them to be able to transmit observed data daily however this service is not available in many stations.

Wide area network should be established to facilitate easy communication transferring and sharing of data .These needs will always point to limited financial resources

3.5 National grid coverage and Power outages

Power supply is the backbone for telecommunication systems using GPRS. In Zimbabwe there are other areas which are not connected on national grid where our Meteorological stations are located. For security reasons, in other areas which are connected to national grid the base stations do not have back up power supplies. In the event of power failure transmission of data will be interrupted.

Although AWS and other digital instruments require power supply from the solar for collection and storage of data, there is still need to communicate the data therefore there is need for stations to have an efficient solar system to ensure continuity.

3.6 Training and awareness

The transition process requires all people involved in the department to be aware of the potential hazards of mercury to both health and the environment. People should be trained on the operation, maintenance and calibration of digital instruments and Automatic Weather stations. There is need for people to be committed and get involved in the process therefore more resources should be channelled towards training

4. Opportunities

4.1 Training through WMO Fellowships

Migration from mercury measuring instruments to digital instruments and AWS gives an opportunity for technical personnel and observers to acquire training in maintenance and calibration of instruments. The course is run at Regional Training Centres in Kenya, Morocco and Egypt.

4.2 Public Private Partnerships

There is a great opportunity for ZMSD to partner with private and Non-Governmental organizations in the implementation of Minamata convention. The department can be assisted in personal skills development, infrastructure expansion, equipment purchasing and financially.

4.3 Increased Demand for weather stations by schools

The department has the capacity to manufacture Stevenson screens using local material and sell to these schools however it doesn't have the resources to do so. If the department could get initial capital to start manufacturing own screens, the funds generated will go a long way in reducing the burden of purchasing digital instruments

5. Threats

5.1 Risk of losing jobs

Automation has more advantages such as real-time transfer, reduced error rate, reduced human effort, scalability among others however there is also a risk of workers being retrenched. Let us consider for example a manual station which is manned by four men and eventually replaced by an AWS. The big question is 'What will happen to the men who were manning the station'

6. Conclusion and Recommendations

After considering all of the challenges there is no doubt that all the challenges eventually point to the main one of Financial Resources. I recommend WMO to consider the issues of low and middle income countries to address the financial crisis. Meeting the deadline will remain a dream in a pipeline if financial crisis is not addressed.

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