# NATURAL DISASTER EARLY WARNING SYSTEM IN ZAMBIA

2018

## PROJECT POST IMPLEMENTATION ASSESSMENT

# NATURAL DISASTER EARLY WARNING SYSTEM IN ZAMBIA




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# INTRODUCTION

This project aimed at providing, at two pilot sites, natural disaster early warning systems for Zambia to be used in disseminating alerts for flooding and impending disasters, for public safety and for enhancing information dissemination in designated areas.

To this end, the International Telecommunication Union (ITU), in cooperation with the Zambia Information and Communications Technology Authority (ZICTA), implemented this project through which disaster early warning systems were installed at Kasaya and Mbeta Island.

## PARTNERS

Zambia Information and Communications Technology Authority (ZICTA)

International Telecommunication Union

# 1 BACKGROUND

Zambia has been negatively affected by floods for many years with more intense occurrences during the rainy seasons. Populations living within the 5 km buffer from the main river systems and wetlands lose their dwellings either due to high levels of river water or structures collapsing due to excess rainfall. Most of the dwellings are built of poor quality building materials such as straw, sticks and mud which can be blown away, eroded and destroyed by wind, rainy storms and floods. Therefore, this Project was designed to minimize losses of lives and assets, where flooding endangers lives and property.

The objective of the project was to establish, at two pilot sites, a natural disaster early warning system for the Republic of Zambia that will be used for disseminating alerts on flooding and impending disasters, for public safety and for enhancing information dissemination in designated areas. The system will also facilitate exchange of information between local communities and government agencies.

The project was launched on 1 December 2014 with an overall budget of CHF 300,000 and completed in December 2017. The project was jointly funded by Zambia Information and Communication Technologies Authority – ZICTA (CHF 100,000) and ITU (CHF 200,000 from operational funds) and it was extended three times, until its completion. By the end of the project, the primary result is the availability of two natural disaster early warning centers. The natural disaster early warning project is primarily for floods and mudslides; however, it will also cover other natural disasters in the affected areas.

During the implementation of this project, the following main activities were undertaken:

- Establishment of a local multi-stakeholder project team. (ZICTA)
- Provision of the inception report by the Project Manager. (ITU)
- Design of the early warning system. (ITU)
- Recording and submitting announcements in both the local language and English, when the system's siren is activated. (ZICTA)
- Requesting and obtaining a radio frequency that has been reserved for the natural disaster early warning system. The data collected by the sensor, is being captured at the control center. (ZICTA)
- Organizing and conducting a workshop on early warning system in Zambia. (ZICTA and ITU)

- Identification of two project locations. (ZICTA in coordination with ITU)
- Identification of suitable premises for the control center. (ZICTA & ITU)
- Development of technical specifications and procurement. (ITU)
- Deployment of the equipment and software. (ITU)
- Training of personnel to run the control center. (ITU)
- Identification of staff and liaison personnel representing all stakeholders and training of trainers from each participating center. (ZICTA)
- Create awareness of the importance and use of the natural disaster early warning system among members of the local project team and surrounding communities. (ZICTA)
- Handover of the early warning systems. (ITU)
- Carry out mock drills with the local communities. (ZICTA)

# 2
# SCOPE OF REVIEW

Zambia is a landlocked country bounded with Tanzania, Malawi, Mozambique, Namibia, Botswana and Zimbabwe. Over the last decade, Zambia has experienced a number of climatic hazards and extreme flooding that represent significant losses of lives and assets. In 2006 and 2007, the already flood prone areas of North Western and Western Zambia, experienced severe floods which impacted its infrastructure, such as the telecommunications infrastructure, roads, schools, homes, agriculture, water, sanitation and the health of the local population.

Subsequently, the 2007 and 2008 floods started earlier than anticipated, affecting the southern half (low lying areas and major river basins) of the country. These floods mainly affected infrastructure such as roads, bridges and culverts. The 2008 and 2009 rainy season saw the Northern, North Western and Western Provinces being the mainly affected regions by the floods. In terms of telecommunication links, the International Telecommunication Union (ITU) provided assistance to the Government of Zambia through the deployment of satellite terminals that were subsequently deployed to assist humanitarian actors which provided relief and basic services to the local population.

The effects and damages of the floods ranged from moderate to high in most parts of the country, thereby causing adverse impacts on several sectors. The immediate impact of the flooding included loss of human life, damage to property, destruction of crops, loss of livestock, and the deterioration of the health conditions, mostly due to waterborne diseases.

Lack of proper running water channels to direct rain waters to rivers, dams and other water reservoirs, are a contributing factor for the increase in flash floods in Zambia. Therefore, populations living within the 5 kilometers buffer from the main river systems and wetlands, lose their dwellings, either to high levels of river water or collapsed structures because of excess rainfall. Most of the dwellings are built with poor quality building materials such as straw, sticks and mud, which can be blown away, eroded and destroyed by the wind, rainy storms and floods.

In view of the continuous disasters and natural threats experienced in the country, the Government set up several permanent response mechanisms to address this matter. As part of this effort, the Zambia Administration decided to invest in the establishment of natural disaster early warning systems in flood prone areas. To this end, this project was developed as a pilot and implemented by ITU. The project aimed to provide natural disaster early warning systems in two pilot sites of the Republic of Zambia. The systems are to be used when flooding was imminent, to quickly alert and warn key public officials and the general population, as well as for public safety and sharing information in designated areas.

The project was implemented between December 2014 and December 2017 with a budget of CHF 300,000. Following the completion of the project activities in December 2017, an evaluation mission was undertaken between 22-26 January 2018, to conduct a post implementation review of the project. The purpose of the post implementation review was to assess the level of achievement of the expected results and the project objectives, based on the KPIs and targets defined in the project document, as well as draw lessons learned, point out challenges encountered, and any other issues related to the project.

The post implementation review was conducted through a visit to one of the project sites and a series of meetings, with the beneficiary country administration and stakeholders that either were involved in the project or had some relation with its success. The below table captures the list of people met during the post implementation review.

| Index | Person Met | Organization | Position |
|---|---|---|---|
| 1 | Mr. Patrick Mutimushi | ZICTA | Director General |
| 2 | Mr. Kabalo Elliot | ZICTA | Acting Director-Tech & Engineering Dept. |
| 3 | Mr. Nyirongo Charles | ZICTA | Manager- Spectrum Engineering & Monitoring (Local Project Manager) |
| 4 | Mr. Kooma Oswald | ZICTA | Spectrum Engineer |
| 5 | Ms. Makwakwa Esnart | DMMU(Disaster Management & Mitigation Unit) | Acting Head- IMS |
| 6 | Ms. Nawakwi Naomy | DMMU(Disaster Management & Mitigation Unit) | System Analyst- ICT |
| 7 | Lt. Col. Muwana Boyd | Zambia Army | Task Force Commander |
| 8 | Mr. Gwen Nscheba | Mwandi District | Agriculture Coordinator and Member of the District Committee |
| 9 | Local villagers at Kasaya | Kasaya Village | Beneficiary community |

Meetings with ZICTA officials at ZICTA Headquarters in Lusaka.

Meetings with project stakeholders at ZICTA premises in Lusaka.

Discussions at Mwandi District.

Kasaya Village.

Kasaya Village and the established early warning system.

# 3 RESULTS/ACHIEVEMENTS

## 3.1 Establishment of natural disaster early warning systems at two sites.

### Key Performance Indicator

Completion of the installations and functioning of the system.

### Remarks

Two systems were installed in Kasaya and Mbeta Island.

### Initial Target

2 sites

### Achieved

Yes

## 3.2 Efficient use and functioning of the system.

### Key Performance Indicator

Reduction in the number of lives lost in the selected regions due to early warning.

### Remarks

Despite the fact that there hasn't been flooding since the installation of the system, the test conducted during the evaluation mission proved that the system is working and likelihood of loss of life has been significantly reduced.

### Initial Target

No loss of life

### Achieved

Yes

## 3.3 Enhanced awareness and training for best use of the system.

### Key Performance Indicator

Number of training sessions and drills.

### Initial Target

At least one at each site.

### Achieved

Partially yes

### Remarks

The local volunteers who will manage the system have been trained on how to operate and use the system. Tests have also been made to make sure that system is working. However operating procedures for an evacuation in the event of an emergency have not yet been developed by DMMU. Residents need to be trained on how to react depending on the type of the alarm. Periodic drills can be planned to familiarize residents with the appropriate actions at times of emergency.

# 4 FINANCIAL STATUS

## Project cash contributions received as planned?

| (Y/N/Not applicable) | Percentage (%) | Explanations |
|---|---|---|
| Yes | 100% | The project was jointly funded by ZICTA and ITU. ZICTA's contribution was CHF 100,000 and ITU contributed an amount of CHF 200,000. In addition to its cash contribution, ZICTA also made in-kind contributions to the project in terms of arrangements and logistics that paved the way for the successful implementation of the project. |

## Is the level of expenditure at the expected level?

| (Y/N/Not applicable) | Percentage (%) | Explanations |
|---|---|---|
| Yes | 70% | Total expenditure: CHF 209,717 |

## Any funds remaining unused?

| (Y/N/Not applicable) | Percentage (%) | Explanations |
|---|---|---|
| Yes | 30% | Total: CHF 90,283. Remaining balance from ZICTA contribution: CHF 37,107. Remaining balance from ITU contribution: CHF 53.176 |

# 5 FINDINGS

The findings of this review are as such provided in the below:

## 1. Project Relevance:

Within the scope of the project, the early warning systems have been installed in Kasaya village, which is located the Kazungula District of Zambia's Southern Province and on Mbeta Island in the Western Province of Zambia. The two areas often experience loss of lives and property as a result of flood waters from the Zambezi River.

Despite of suffering from devastating flood events, these villages did not have a system of any early warning mechanisms that would alert the concerned villagers from the occurrence of a disaster. In that respect, the project has helped to address a genuine need in saving lives and livelihood. The evaluation mission that was undertaken, also confirms this.

## 2. Stakeholder engagement:

The project was an integrated effort of different local stakeholders, namely, ZICTA, DMMU, Zambia Army, water management authority and local district committees, to achieve a common goal of effective management and response to flood occurrences in Kasaya Village and Mbeta Island.

ZICTA took the lead role in bringing all stakeholders together in a common platform, to ensure a smooth implementation of the project. Each stakeholder contributed in its own way within its expertise and resource, thereby enabling a successful completion of the project.

Although ZICTA is the local counterpart of ITU in this project, the equipment provided to ZICTA will be handed over soon to DMMU, which is in charge of managing disaster related matters in Zambia, including the early warning systems.

## 3. Effectiveness of the technical solution:

The early warning system consists of:

- A fully-automated, optionally unmanned control centre.
- Communication infrastructure.

- Monitoring sensors.
- Electronic sirens.

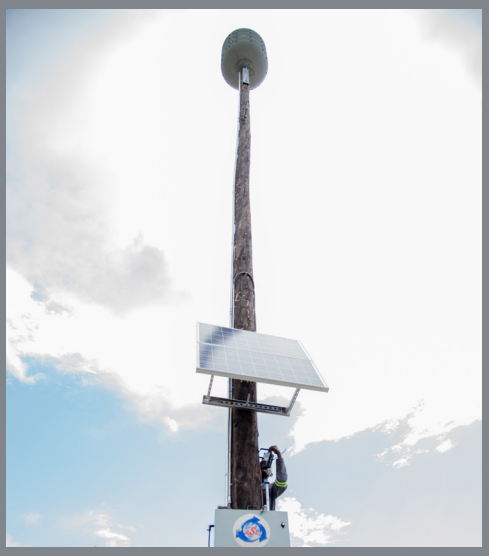
The core of the control centre is a computer equipped with the software connected to the central communication unit, which controls sirens and data collection from monitoring sensors by radio, and other hardware components serving the notification purposes.

The software evaluates the collected data, detects the status of the individual sirens within the system and activates them, monitors the operability of the communication channel, and triggers alarms and/or plays appropriate pre-recorded message in local language, depending on water levels. The control centre may work in an unmanned regime/mode and can also be controlled manually. Depending on the assumed development of emergency situation over period of time, it is possible to configure a variety of system responses.

The control room and solar energy generator.

Kasaya Village early warning system and pole for the siren.

Kasaya Village water level sensor.



A designated two-way VHF radio channel is used as the main communication channel to control sirens and transmit data from monitoring sensors. In some locations where water-level monitoring is required, the power supply might be unavailable. The sensors that are then used, are powered by batteries, which consequently are charged by solar panels.

As shown in the picture, the siren in the Kasaya village has its own solar panel which feeds the siren power supply.

The same is also valid for the siren tower in the Mbeta island site. The siren tower is located on the island whereas the control center is on the main land.

Therefore, the communication between the siren and the control center is by VHF radio and the siren tower also has its own solar panel to charge the battery necessary for the operation of the siren.

Overview of the Mbeta Island site
(the siren tower and the sensor).

The same is also valid for the siren tower in the Mbeta island site. The siren tower is located on the island where the control center is on the main land. Therefore, the communication between the siren and the control center is by VHF radio and the siren tower also has its own solar panel to charge the battery necessary for the operation of the siren.

The review concludes that the system is a suitable one for the selected sites as it has the capability to operate automatically with no human intervention. This is useful and allows the system to be on 24 hours. Another benefit of the system is the modularity of the components making it possible to locate the alarm tower as well as the water level sensor away from the control center. The modules of the system are connected by VHF radio and each unit has its power feed from the solar panel attached to it. Overall the system operates in isolation without any need to connect to a power grid (electricity network). This makes the system suitable for use in rural and remote areas.

On the other hand, the review also revealed some shortcomings of the system as well. During the stakeholders meeting, participants expressed some challenges that they faced during the deployment of the system. These are:

1. The weight of the system (especially the siren): The siren is an important part of the system as it is the main component that spreads the warning announcement and/or the alert sounds. The siren is effective within a radius of 5 km and functions with high pitch with enough clarity to alert the residents in the endangered area. However, the siren itself is quite heavy and bulky to transport and to erect on a tower.

Given the difficulties of transportation in accessing the concerned villages, it was a challenge for local authorities to arrange the shipping of the sirens to their destinations. Furthermore, in the case of Mbeta Island, shipment of the siren over the river was a challenge. This was sorted out with the help of the Zambian Army which used military equipment in passing to the other side of the river.

Furthermore, the sirens needed to be raised on high-rise towers installation, which normally required a crane to be present during the installation. In the case of Mbeta Island, there was no way to have a crane moved on to the island so the erection of the tower and the siren was performed manually despite of the risks involved. ZICTA engineers were successful in finding a way to manually erect the tower with the siren on it. However, it still remains as a challenge for maintenance and repair purposes in the event of a malfunction.

2. Another shortcoming of the system is the lack of remote communication capabilities. The installed early warning systems operate at the local level and do not have the capabilities of sending SMS or connectivity to the regional DMMU stations. If this connectivity could be achieved, it would help DMMU to remotely follow-up rising water levels and be informed of any upcoming emergency, simply by reading the data from the early warning stations and swiftly responding to an emergency. During the discussions, DMMU raised this matter as a challenge for the future integration of the established systems to co-operate with a network of early warning systems, to be deployed on the upstream and downstream locations of the concerned rivers.

# 6 LESSONS LEARNED

- ZICTA as the main focal point for ITU in Zambia, played an important role in facilitating the coordination with other government and local entities. As it was the case in this project, a multi-stakeholder approach was essential for the successful implementation of this project, since ITU's counterparts in the beneficiary countries most often are not in charge of emergency matters. Therefore, the involvement and mobilization of the local and governmental stakeholders were essential and contributed to the success of the project.

- The project was a pilot implementation limited to two sites which are prone to flooding. The installed early warning systems currently operate at the local level and with the possibility to add a connectivity component. The solution is scalable to cover more sites and can be connected to other emergency systems and to the nearest regional DMMU stations for swift action of responders in the event of a disaster.

- The system used in this project can issue warnings in local languages. Hence, the results of the project demonstrate that the use of local language in early warning systems is quite important to ensure proper understanding of the warning messages by all of the local population.

- Standard operating procedures need to be in place and periodic drills need to be conducted in order to ensure that people know how to act at times of disasters and in the event of an emergency.

- Despite the challenges faced in transporting and installing the equipment, the coordination among stakeholders went well throughout the implementation of the project. It is apparent that properties of the selected sites and conditions therein need to be taken into account for effective planning of the installation work.

# 7 CONCLUSIONS

Based on the implementation review and discussions with key persons from the Zambia Administration and the different stakeholders, it can be concluded that:

- While natural hazards and floods may be inevitable, disaster losses can be minimized through adequate measures and deployment of the necessary tools. In this vein, natural disaster early warning systems are recognized as an important tool for saving lives and livelihoods. Governments and local authorities are increasingly interested in the establishment of such tools in disaster prone areas.

- The advancements in sensor technologies enable automated monitoring of water levels and systems to operate 24 hours a day, without requiring any human intervention. Furthermore, wireless communication between remote sensors and control centers, facilitate easier deployment of such systems in terrains where installation is a challenge.

- The project was implemented, activities were completed, equipment procured, shipped and installed therefore the expected results of the project have been achieved with some delay requiring three extensions of the end date due to delays and difficulties faced during shipment and installation of the equipment. Following the installation work in November – December 2017, it is observed during the visit undertaken to Kasaya village that the equipment was in place and in working condition.

- The project addressed a genuine need of preserving lives and property. To this end, all stakeholders underlined the importance of having a natural disaster early warning system in place to deliver alerts on time to the residents living in the immediate vicinity of the hazardous area, as well as coordinate related activities for the safety of communities in the endangered villages.

# 8 RECOMMENDATIONS

The establishment of natural disaster early warning systems help to preserve lives and property. The following recommendations are made concerning the establishment of natural disaster early warning systems in Zambia:

- Although the selected system seems reasonably fit for the needs of the selected sites, over time the expected benefits from these systems will go beyond the current level. With the deployments of further early warning systems, connectivity and interoperability of the existing systems with the new ones can be explored.

- With a view to enable ease of transportation and assembly, various alternative systems can be explored. To this end, site selection needs to be done in advance so that the most appropriate system can be chosen at the procurement stage.

- As such projects require involvement of a number of local stakeholders, project budgets also need to allow for expenses to cover costs involved for the activities undertaken by these stakeholders. In order to do that, it is important to analyze, during the design phase of the project, the role and level of involvement of the chosen stakeholders.

- It is essential that communities understand their risks, respect and follow the warning and know how to react. Education, awareness raising and preparedness programs as well as periodic drills will play an important role in developing skills for an appropriate response at times of floods and other natural disasters. It is imperative to have the community well informed on how to behave safely, which are the available escape routes and how to avoid damage and loss to property. The beneficiary country administration should conduct drills and organize capacity building activities for the beneficiary local communities. The project will be formally closed. A closure report will be prepared by the ITU Project Manager.

This ITU project is contributing to the
achievement of the Sustainable Development Goals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