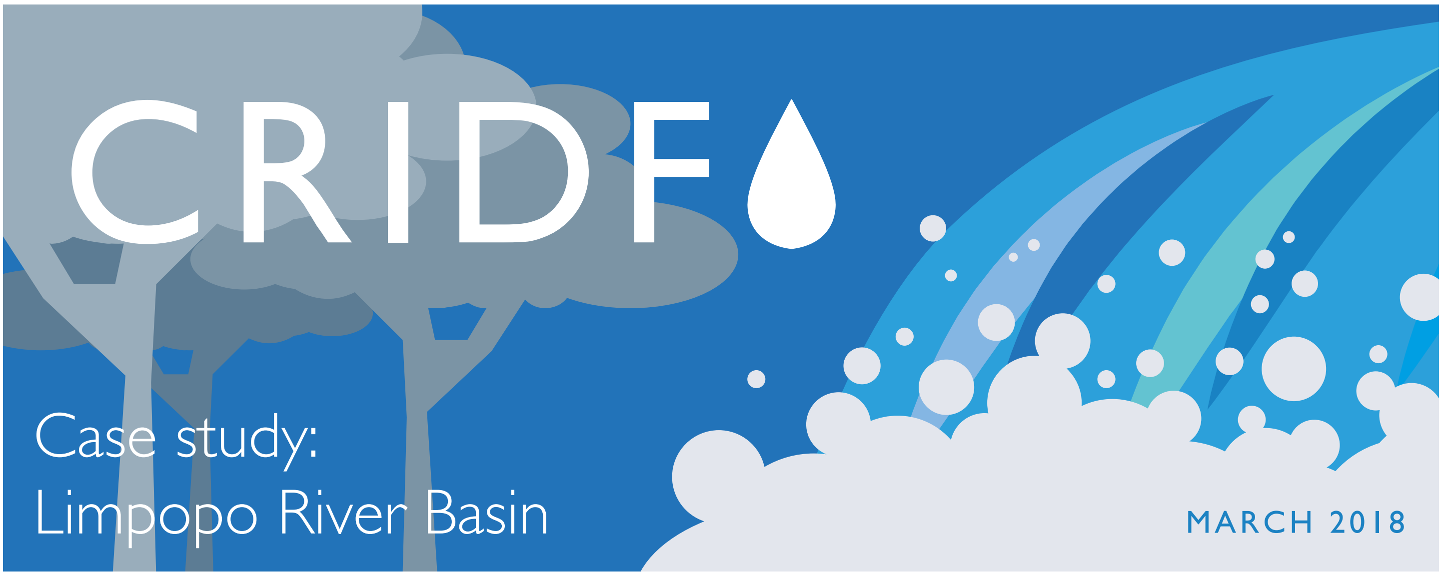

INVESTING £24,000 IN FLOOD FORECASTING SYSTEMS IN THE LIMPOPO RIVER BASIN SAVES £140,000 PER ANNUM IN FLOOD DAMAGE

Data sharing and early warning flood forecasting in the Limpopo River Basin

In the transboundary Limpopo River Basin, the riparian states of Botswana, Mozambique, South Africa and Zimbabwe can now share real-time water-level and flow gauge data. Fed into a hydraulic model of the Limpopo River, the shared data can predict flood flows. Such forecasts will enable authorities to issue early warnings to over 1.5 million people, sometimes up to seven days in advance. A public–private partnership involving members of the Limpopo River Commission Flood Task Team and companies in Mozambique's agricultural sector will be able to deliver benefits to all parties in flood-prone areas of the Basin.

Four countries, Botswana, Mozambique, South Africa and Zimbabwe, share the Limpopo River Basin. Floods in the Basin particularly affect low-income communities and the main economic activities – agriculture, forestry, mining and tourism. Early warning of impending floods gives those at risk time for preparation. Cross-border cooperation on forecasting river flows could provide advance warning of floods to 1.5 million people in the Limpopo floodplain in Mozambique.

THE CHALLENGE

Severe floods in the Limpopo River Basin have been recorded in the past 60 years, in 1955, 1967, 1972, 1975, 1977, 1981, 2000 and 2013. Heavy rain upstream can cause damaging floods downstream. The system for issuing warnings to people in flood-prone areas in the Basin, however, is slow and unreliable. When levels in the river rise upstream, South African officials inform their counterparts downstream in Mozambique by telephone. But, as the South Africans have no way of predicting the timing and volume of river flows in specific areas, flood warnings are often not reliable or come too late.

At the Southern African Development Community (SADC) Regional Water Infrastructure Investment Conference in Maseru, in 2011, water users petitioned governments to take action along the stretch of the Limpopo shared by Botswana and South Africa. The petition succeeded in securing an in-principle agreement to assess current water management along this stretch, an agreement which was expanded by the Limpopo Watercourse Commission to also include the Limpopo in Mozambique and Zimbabwe, thus covering the whole Basin.

It is in this context that the Climate Resilient Infrastructure Development Facility (CRIDF), a programme funded by the UK Department for International Development (DFID) that delivers sustainable infrastructure across 12 SADC countries, supports the Limpopo Water Monitoring Project. To improve the timing and accuracy of flood forecasting, the CRIDF project team designed a system to automate the collection of water-level data at crucial points along the rivers in Botswana, Mozambique and Zimbabwe, and developed a model of areas likely to be affected by mild, moderate and severe floods.

ADDRESSING THE CHALLENGE

While floods cannot be prevented, it is possible to limit their effects given sufficient warning. Accurate flood forecasting can predict when river levels will rise at particular locations. The flood forecasts can then be assessed, and early warnings issued to areas likely to be inundated, saving lives, property and livelihoods, and building climate resilience.

Designing an early warning system

The key considerations in designing a sustainable early warning flood forecasting system for the Limpopo River Basin were that it should be robust, relatively inexpensive to install and operate, easy to maintain and, above all, should deliver credible results. Accuracy is particularly important for warnings to be believed and acted upon. The pilot system that CRIDF designed:

- continuously measures and logs water levels at key gauging stations on the main Limpopo tributaries to provide near real-time data;
- converts water-level data from gauging stations into river flow;
- aggregates data from upstream stations to predict channel flows and when these flows would arrive at various locations; and
- provides an internet cloud platform for sharing real-time water-level data and forecasts.

The pilot system will collect data from eight existing automated water gauges (six in South Africa and two in Mozambique) and feed it into a hydraulic flood routing model to forecast changes in the rate of flow at specific points as water moves down the Limpopo.

Installing new gauges

The installation of new gauges to measure water levels in Botswana and Zimbabwe will soon be completed. As an interim measure, real-time rainfall runoff data for the Botswana and Zimbabwe Limpopo River Basin catchments, while not as accurate as water-level data, is being used to assess channel flows.

Automating flood warnings

The pilot system forecasts when river levels will rise at certain points downstream and can be set up to automatically text warnings to appropriate parties, for example, local communities in the floodplain, police forces, disaster response units and agribusinesses. Subscribers can receive regular text or email updates and warnings when water levels are forecast to rise above thresholds that they have specified, or when floods are anticipated in areas that they have identified.

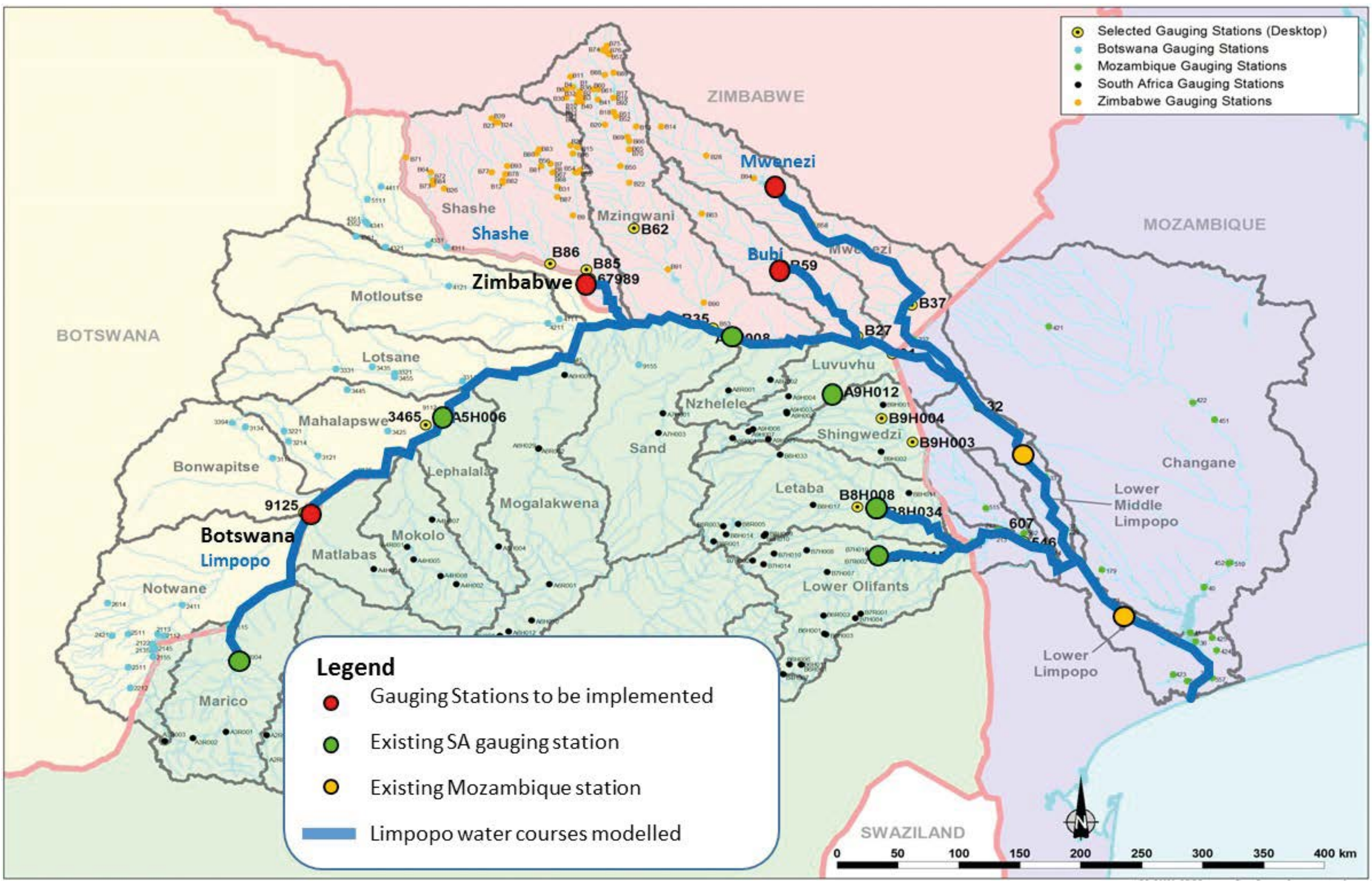

Figure 1: Water-level gauging stations, existing and planned, in the Limpopo River Basin

RESULTS OF THE LIMPOPO WATER MONITORING PROJECT

Assessed options

The CRIDF team assessed two investment options for a flood warning system under three scenarios: mild, moderate and severe flooding. The first option was to invest in a flood early warning system, cover the operational costs and transfer the system technology. The second, more costly option was similar to the first option, but included enhancing the hydraulic model for floods in the Limpopo River Basin by installing additional stations for measuring water levels along tributaries.

Analysed costs and benefits

An analysis of the costs and benefits of each option showed that the first option – invest in a flood early warning system, cover the operational costs and transfer the system technology – would deliver a positive net present value, a positive benefit–cost ratio and a positive internal rate of return in all three flood scenarios. Moreover, the more severe the flood, the more positive the impact. The net present value would be £1,700,000, and the benefit–cost ratio would be 5. A benefit–cost ratio greater than 1 means that benefits outweigh costs; the higher the ratio, the greater the benefits compared to the costs. The cost–benefit ratio of 5 shows that a relatively small capital investment could deliver significant positive benefits. The annual cost of operating and maintaining the early warning system at £24,000 a year would be far less than the cost of flood damage, which amounts to at least £140,000 a year.

Developed a business case

CRIDF developed a business case for private sector and parastatal investment in establishing and maintaining a flood forecasting early warning system. The business case sets out the financial and social benefits and describes the beneficiaries. The population of the Limpopo River Basin is projected to grow to around 22 million by 2040. Estimates indicate that an early warning system will lessen flood damage, directly benefitting around 800,000 people and indirect benefits to an additional 1.7 million others by the year 2040.

Focused on securing commitment

In order for early warnings to be effective, appropriate institutional arrangements need to be in place. The project team thus focused on securing commitment and financing for investment in adopting and managing a flood forecasting and early warning system. Embedding the system in a public-private partnership involving members of the Limpopo River Commission Flood Task Team and Mozambican agribusinesses promises to secure sufficient resources to carry the system forward and ensure its sustainability.

Invest **£24,000**
a year in an
early warning flood forecasting system
to prevent losses of £140,000 a year

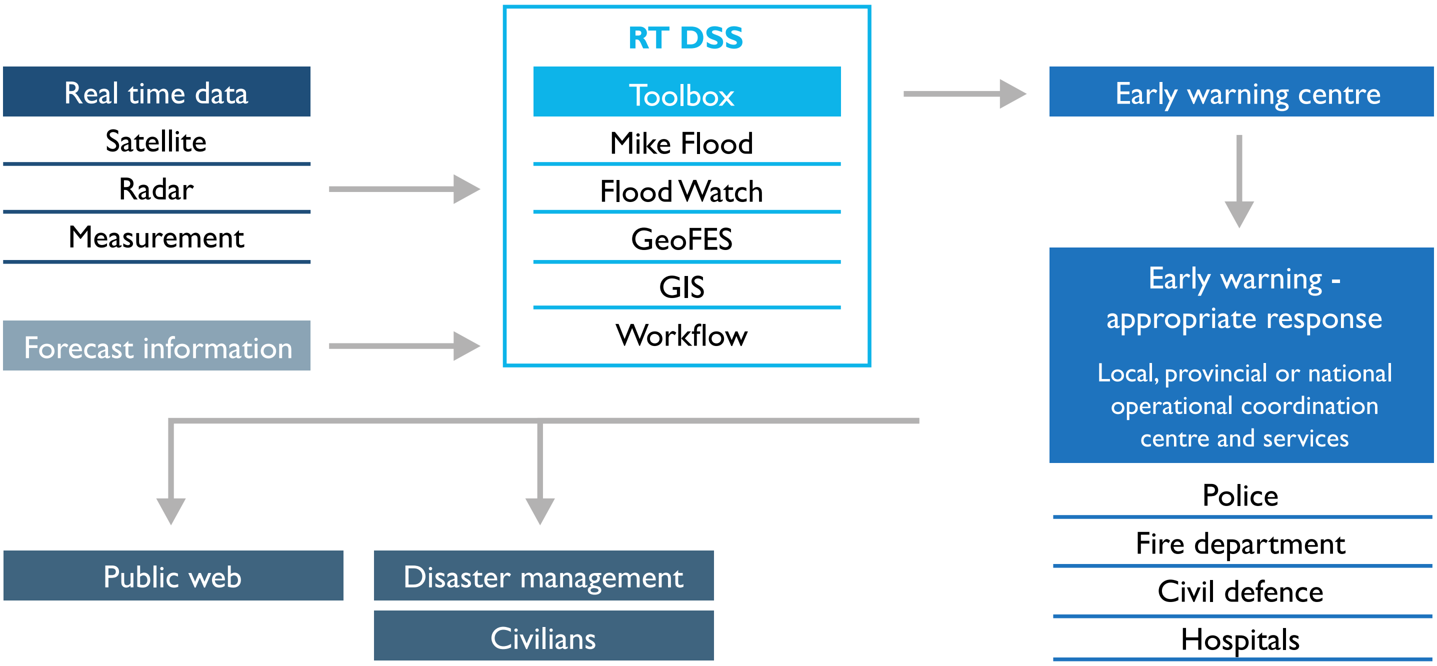

Figure 2: Framework for the Limpopo River Basin early warning flood forecasting system (RT DSS - real-time decision support system)

INVESTMENT OPPORTUNITIES

The project has identified opportunities for investment in establishing an early warning flood forecasting system in the Limpopo River Basin.

Institutional investments include:

- developing buy-in from stakeholders to set up and operate a basin-wide system to deliver timely, accurate flood warnings that populations in the Limpopo River Basin can have confidence in.

Technical investments include:

- developing systems to collect reliable, accurate data on river levels and share it with cooperating parties without delay; and
- refining and developing the pilot Limpopo River Basin early warning flood forecasting system to include additional rivers.

Financial systems investments would involve:

- developing business plans for early warning flood forecasting systems tailored to meet the requirements of SADC countries.

Direct costs

Physical damage to capital assets and inventories that are valued at same-standard costs of replacement

Indirect costs

Flow effects that include output losses and foregone earnings

Relief costs

Provision of life support services including food aid, healthcare and water and sanitation

Assistance to impacted populations to enable them to resume sustainable livelihoods

Reconstruction costs

Costs for rebuilding damaged infrastructure to standards optimally designed to reduce vulnerability and risk of loss through future disaster

Figure 3: Costs that can be minimised by investing in a Limpopo River Basin early warning flood forecasting system

Baseline
Do nothing

Technical option
Pilot project with technology transfer and O&M

Mild flood — Flood occurrence = 1:10 years

- Directly impacted population that are located within the area of inundation in 2040
- 183, 000 people
- Located in 60 villages

Moderate flood — Flood occurrence = 1:25 years

- Directly impacted population that are located within the area of inundation in 2040
- 520,000 people
- Located in 75 villages

Severe flood — Flood occurrence = 1:100 years

- Directly impacted population that are located within the area of inundation in 2040
- 759,000 people
- Located in 100 villages

Figure 4: Flood scenarios and technical option

Contact us

If you are interested in the services CRIDF offers, please contact us at:

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