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WASH Factsheets FS/06/2019

Groundwater Early Warning System for the South of Madagascar

SUMMARY BOX

- The chronic lack of water in the semi-arid regions of southern Madagascar has been exacerbated by frequent droughts which lead to food insecurity and malnutrition crises most affecting children. An early detection of groundwater depletion is important for better planning of water resources and the preparedness of responses to drought emergencies.
- In collaboration with its partners, UNICEF is implementing a groundwater early warning system (GEWS) for the southern regions of Madagascar. Results of two pilot sites highlighted the existence of issues of declining water levels and intrusion of saline water in the region of Androy. Therefore, it recommended to scale up this initiative to the eight drought-affected districts of southern Madagascar to ensure the provision of continuous clean and safe water to local population.

Introduction

The south of Madagascar has the country's lowest water supply coverage and is strongly impacted by the effects of climate change such as the increase in frequency/intensity of droughts and a chronic lack of water. This situation results in severe food insecurity and malnutrition crises which mostly affect children.

Currently, there is no national monitoring system in Madagascar to estimate risks of groundwater depletion and provide information to water and humanitarian actors for better planning of water resources use.

Measuring groundwater levels is critically important for identifying long-term trends including declining water levels and saltwater intrusion, seasonal variations and aquifer recharge. The groundwater early warning system (GEWS) implemented by UNICEF will allow adaptation practices such as water trucking to be triggered at district-level. The GEWS is funded by EU/ECHO HIP under the proposal "*Disaster Risk Reduction, Preparedness and Resilience Building in Madagascar*".

Objectives

- Develop a GEWS to monitor the resource quantity and quality in the three drought-affected regions of southern Madagascar (Atsimo Andrefana, Androy and Anosy).
- Through GEWS, track groundwater fluctu-ations at three levels: 1- community-based; 2 - manual piezometric; 3 – telemetric monitoring.
- Link the GEWS to a drought monitoring system to improve drought emergency responses in the southern regions.

KEY POINTS

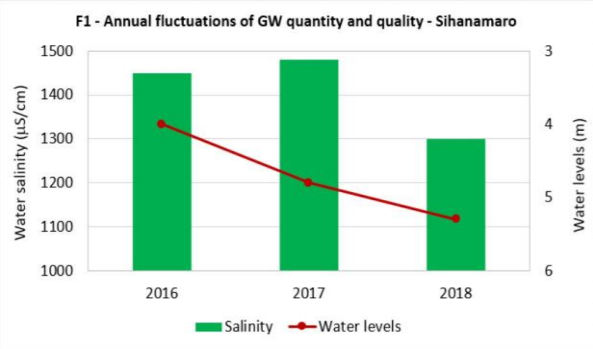
- A groundwater early warning system is an essential tool for reducing vulnerability to frequent drought events in the south of Madagascar.
- Pilot sites in Androy, a drought-affected region, showed issues of intrusion of saline water and possible depletion of groundwater in a shallow aquifer.
- The GEWS under implementation will rapidly inform on possible water resource shortages, water quality and quantity issues and allow taking timely actions for the provision of continuous water services.

Key information

Current situation

In 2017, spot check data collected in the drought-affected district of Ambovombe (Androy region) highlighted issues of water quantity and quality for two water supply systems providing safe water to 1,500 to 2,500 beneficiaries. As a result, regular monitoring was undertaken in 2018 to track fluctuations in water levels and salinity as summarized below.

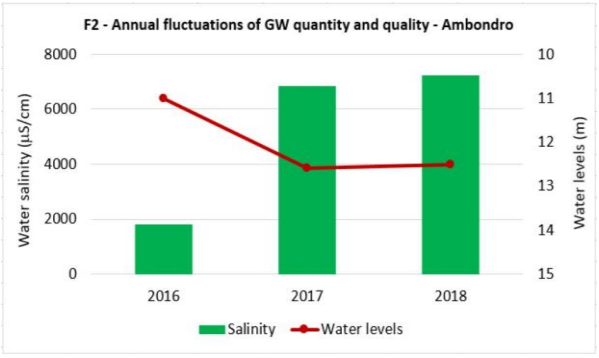
a) Declining water levels (Sihanamaro)



KEY OBSERVATIONS

- Since 2016, the groundwater level in the Sihanamaro site is gradually declining (1.5 m below the initial level) likely due to frequent drought events in this region.
- The water salinity fluctuates moderately, but it remains in a normal range below the 3000 µS/cm national limit.
- To avoid the depletion of this shallow aquifer, UNICEF installed a low-yield water pump to reduce the withdrawal of water (from 8 m^3/h to 2 m^3/h) and discontinued use of this borehole for water trucking purposes. For now, it provides water only to the local community and monthly monitoring is ongoing.

b) Intrusion of saline water (Ambondro)



KEY OBSERVATIONS

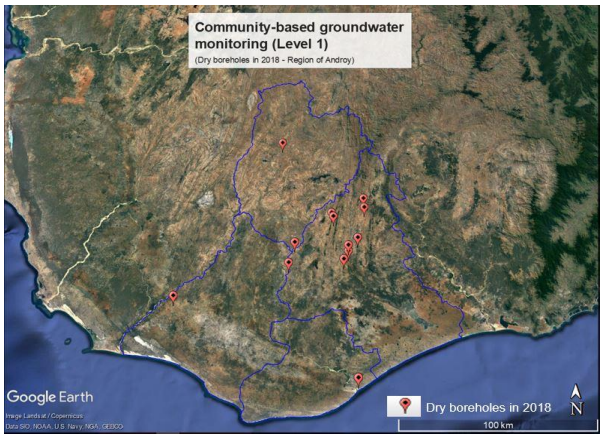
- While water level decrease stabilized since 2017 in the Ambondro site, the salinity of the water increased rapidly one year after the installation of the water supply system.
- The high salinity of the water in Ambondro is caused by an intrusion of saline water into the aquifer. Indeed, Ambondro is surrounded by saline aquifers in the north-east (according the salinity map of Androy) and is located less than 15 km from the Indian ocean to the south.
- The water supply system in Ambondro is no longer used for drinking/cooking. UNICEF provided filters to the school canteen to filter surface water. Alternative solutions are under consideration, such as drilling new boreholes and/or building a desalinization unit.

The groundwater monitoring system

To ensure the continuous provision of clean and safe water to the local populations, a reliable system is required to monitor fluctuations in the quality and quantity of groundwater in the south of Madagascar. Below we briefly describe the three components of the groundwater monitoring system under implementation by UNICEF in the eight drought-affected regions of southern Madagascar.

a) Level 1: Community-Based Monitoring

- A contractor, in collaboration with the local community, monitors the functioning of the handpumps in high risk areas. They provide UNICEF with qualitative information on the availability and quality of water (dry/saline). Thus, corrective actions are taken in the event of drying or malfunctioning handpumps.
- The four districts of Androy are under monitoring. During the 2018 dry season, thirteen (13) handpumps were reported temporarily dry due to the drought. More than 4,000 beneficiaries were affected by this situation.
- In addition to water trucking to respond to the lack of water during the drought period, UNICEF undertook the rehabilitation of eighteen (18) handpumps across the region of Androy to increase water flow in the corresponding boreholes.

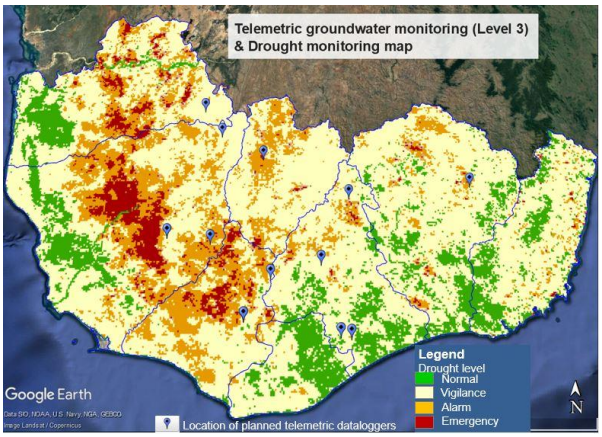


b) Level 2: Manual Piezometric Monitoring

- Manual piezometric probes are used to monitor groundwater fluctuations for small and middle scale water systems providing water to more than 1,000 persons living in drought-affected regions.
- Fifteen (15) manual piezometric probes with conductivimeters will be deployed in the coming weeks across the four districts of Androy to monitor seasonal fluctuations of water levels and salinity.
- In 2018, monthly groundwater fluctuations were monitored during the rainy and dry seasons for the two pilot sites of Sihanamaro and Ambondro. The water systems of these sites provide clean and safe water to 1,500 and 2,500 beneficiaries respectively.

c) Level 3: Telemetric Monitoring

- The level 2 monitoring is upgraded to level 3 for a reliable real-time data transmission of groundwater data. Telemetric dataloggers are at the core of the level 3 monitoring. They perform the following key tasks: data collection, processing, storage, control limit values and data transmission. They use GPRS/GSM technology for remote data transmission.
- Ten (10) telemetric dataloggers are being installed in the regions of Androy, Anosy and Atsimo Andrefana. The level 3 monitoring will be scaled up to 20 water systems in 2019 for the monitoring of groundwater levels, conductivity and temperature over the three drought-affected regions of southern Madagascar.



Conclusion

The GEWS is an essential tool to monitor the availability and quality of water resources in the eight drought-affected districts of southern Madagascar. This pilot mechanism will quickly inform on possible water resources shortages during dry seasons and allow for taking rapid and adequate actions to preserve water services. In addition, linking GEWS with existing groundwater suitability maps (Godfrey *et al*. 2018), the drought monitoring system and food security assessments will improve targeting of vulnerable populations affected by drought events and strengthen climate-resilient solutions for the south of Madagascar.

References

Godfrey S., Paba M. and Serele C. (2018) Using GIS and Remote Sensing to Access Water in the Drought-Prone Areas of Ethiopia and Madagascar, UNICEF WASH Bulletin, October 2018.

Acknowledgements

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Charles Serele is a hydrogeologist and RS/GIS specialist. He joined UNICEF Madagascar in May 2017 as a WASH Specialist. He provides management and technical support in sustainable groundwater development with focus on the professionalization of mechanical/manual drilling, increasing access to climate-resilient drinking water supply and development of innovative approaches to reduce vulnerability to drought through WASH risk-informed solutions. Charles is the author of several technical notes that provide guidance on boreholes siting, mapping of groundwater suitability areas, and development of drought/groundwater monitoring systems. Additionally, he delivers capacity building activities for UNICEF WASH staff and key partners to raise their skills and knowledge in drilling sustainable and cost-effective boreholes.

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