



Improving the Professionalism in the Drilling Sector for Cost-Effective Boreholes in Madagascar

Drilling Techniques and Supervision - Training Course

*Understanding professional drilling, boreholes siting, construction, supervision
and management of drilling data*

Antananarivo, February 7th to 23rd, 2018



Final Report

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Charles Serele, PhD.
WASH Specialist
UNICEF Madagascar

Summary

In collaboration with the Ministry of Water, Sanitation and Hygiene (MWSH) of Madagascar, UNICEF organized a training on "*Drilling Techniques and Supervision*" with a view to building the capacity of the drilling sector in Madagascar. The training run over three weeks in February 2018 (three sessions of three days each), and targeted various stakeholders in the water sector, including government departments, drilling companies and consultancy firms who manage water supply projects, supervise or drill boreholes. Fifty-four participants attended the training course, including fifteen women.

To enhance individual knowledge and ensure sharing of experiences among participants, the overall approach used to deliver the course involved a mixture of lectures, interactive discussions, group exercises and presentation of drilling videos. The participants actively engaged in the discussions and group activities. The course review showed that participants' technical knowledge in boreholes drilling and supervision greatly improved. The training provided an opportunity to learn from each other and to reflect on what can be improved. Participants also expressed their satisfaction with the course content and the relevance of the topics that were covered. Forty-five participants (83%), including fourteen women passed the evaluation test conducted on the last day of the training. During the official closing ceremony of the training on March 28th, 2018, each successful participant received a certificate signed by the Minister of the MWSH and the representative of UNICEF Madagascar. As a next step, a field-based training should be organized to better illustrate best practices in drilling professional and sustainable boreholes.

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Figure 3: Evaluation of the training by participants

List of acronyms

GIS: Geographic Information Systems

MWSH: Ministry of Water, Sanitation and Hygiene

RS: Remote Sensing

RWSN: Rural Water Supply Network

UNICEF: United Nations Children's Fund

WASH: Water, Sanitation and Hygiene

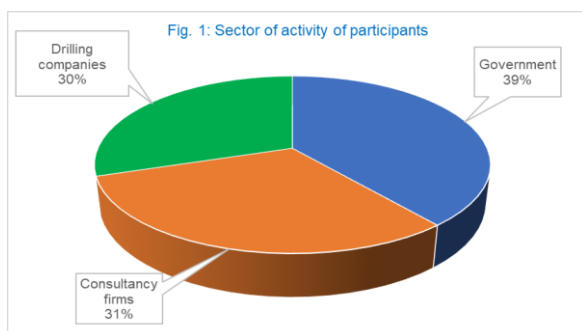
1. Introduction

Hundreds of thousands of people in Madagascar continue to use unimproved water sources and consume unsafe water; with women and children being the most affected. It is therefore essential to increase the number of drinking water sources and improve the quality of drinking water. It is worth noting that even when the sources of drinking water supply are sufficient their functioning can be interrupted due to various reasons. A study¹ conducted by UNICEF in four countries in sub-Saharan Africa found that about 15% to 30% of boreholes become non-functional within 1-3 years after completion and that in many cases the premature malfunction is not a result of mechanical failure, but due to the design and construction of the borehole. Thus, these boreholes provide poor quality water and are eventually abandoned by users.

As part of its WASH program in Madagascar, UNICEF is committed to supporting the Ministry of Water, Sanitation and Hygiene (MWSH) to build the capacity of the drilling sector. With this in mind, UNICEF organized a training on "*Drilling Techniques and Supervision*" in collaboration with the MWSH. The training targeted various stakeholders in the water sector, including government departments, drilling companies and consultancy firms who manage water supply projects, supervise or drill boreholes. The training was held in Antananarivo, Madagascar and organized in three different sessions of three days each, from February 7th to 23rd, 2018.

2. Course participants

A total of fifty-four (54) participants working in three sectors of activity (government departments, drilling companies and consultancy firms) attended the training course (Figure 1). The proportion of female participants was 28%. The training was facilitated by Charles Serele, an experienced WASH Specialist from UNICEF Madagascar.



¹ Tincani L. et al. (2015), *Regional assessment of the operational sustainability of water and sanitation services in Sub-Saharan Africa, Project VFM-WASH, August 2015.*



3. Course opening

The first training session held from 7 to 9 February 7th to 9th, 2018 was opened by the representative of UNICEF Madagascar, Elke Wisch and the former Director General of the MWSH, Luciano Andriavelojaona. They welcomed all participants and encouraged them to engaged in the discussions and share their experiences. Before the training opening, Silvia Gaya, the Chief of WASH of UNICEF provided the background of the course. The second session conducted between 14-16 February 2018 and the third and final session conducted between 21-23 February 2018 were opened by UNICEF's Deputy Representative, Jean Benoit Manhes and Chief of Operations, Benoit Vonthron.



4. Learning objectives

The learning objectives of the training were that by the end of the course, the participants would:

- Gain skills and knowledge to strengthen the professionalism in the drilling sector;
- Understand causes of non-sustainability of boreholes;
- Know the essential elements of the design and construction of good quality boreholes;
- Know how to develop boreholes and perform various pumping tests;
- Understand the roles and responsibilities of supervisors and drillers;
- Understand the importance of collecting and sharing drilling data.

5. Course structure and activities

The course was delivered in five modules for each three-days training:

- Professionalization of the drilling sector,
- Methods of boreholes siting,
- Construction of boreholes,
- Supervision of boreholes,
- Management of drilling data

To enhance individual knowledge and ensure sharing of experiences among participants, the overall approach used to deliver the course involved a mixture of lectures, interactive discussions, group exercises and presentation of drilling videos. Additionally, group discussions were proposed to get participants to answer to the following questions:

- What are the most common causes of boreholes failure?
- What can be done to improve boreholes siting in Madagascar?
- Why are some boreholes better than others?
- What can be done to improve the professionalism of the drilling sector in Madagascar?
- What are the key elements that a borehole supervisor should pay attention to?
- What is the cycle of drilling data, and what actions should be taken to facilitate collection, storage and sharing of drilling data?

Participants were organized in four (4) working groups and engaged in focus group discussions to highlight challenges, weaknesses and strengths of the drilling sector in Madagascar based on their own and/or their organization's experiences. Below are the summaries of the group findings.



■ Module 1: Professionalization of the drilling sector

This module presents causes of unsustainable drilling, the code of best practices for cost effective boreholes, and the actions to be implemented to achieve a professional drilling sector.

Box 1: What are the most common causes of boreholes failure?

- Poor siting of boreholes
- Low groundwater potential
- Lack of detailed hydrogeological studies
- Inappropriate design and construction of boreholes
- Insufficient filter pack or non-adapted to aquifer type
- Incompetence of drilling companies
- Unavailability of spare parts
- Lack of supervision during the construction

■ Module 2: Methods of boreholes siting

Module 2 proposes detailed guidance and techniques for boreholes siting.

Box 2: What can be done to improve boreholes siting in Madagascar?

- Collect good quality data during drilling
- Create a national drilling and groundwater database
- Categorize and map risk of drilling negative boreholes
- Conduct detailed hydrogeological studies before borehole siting
- Identify potential sources of contamination
- Undertake field visits and involve local communities in the siting process
- Train drillers on how to properly sit boreholes

■ Module 3: Construction of boreholes

This module reviews the essential elements of the design and construction of good quality boreholes. It presents recommendations to be followed for the development of boreholes, the performing of pumping tests and the installation of pumps and screens.

Box 3: Why are some boreholes better than others?

- Sited in favorable hydrogeological conditions
- Drilled away from potential sources of contamination
- Constructed with good quality materials
- Deep enough and with a screen installed in the permeable formation
- Pump is installed at the right depth
- Insensitive to seasonal fluctuations
- Made with a filtering pack of good quality
- Borehole is well sealed to avoid surface contamination
- Well-developed borehole to extract drilling waste
- Borehole tested to verify that it provides enough water for the needs of the community

Box 4: What can be done to improve the professionalism of the drilling sector in Madagascar?

- Strengthen the technical and financial capacities of drillers
- Regular evaluation of the technical skills of drillers
- Create drillers' association for a better synergy between all actors
- Create a national drilling database and make drilling data accessible to all partners
- Harmonize drilling manuals and procedures
- Fight against corruption during the award of contracts and during the supervision of drilling projects
- Implement a program for periodic monitoring and maintenance of boreholes
- Improve national regulations and procedures of borehole drilling

Module 4: Supervision of boreholes

The fourth module describes the roles and responsibilities of the supervisor at the various stages of drilling construction, and presents the checklist of drilling steps for supervisors and drillers.

Box 5: What are the key elements that a borehole supervisor should pay attention to?

- Inspection of the drilling equipment's
- Make sure the driller respects the technical specifications of the contract
- Ensure that the filter pack is positioned at the right depth and suitable for the type of aquifer
- Ensure that the development of the borehole is properly performed and water is cleaned
- Ensure that the borehole is tested (pumping test) and that the flow is sufficient
- Ensure water quality meets standards
- Ensure that drilling data is collected and recorded in appropriate forms

Module 5: Management of drilling data

This last module describes the importance of the collection, quality control, storage, valorization and sharing of drilling data.

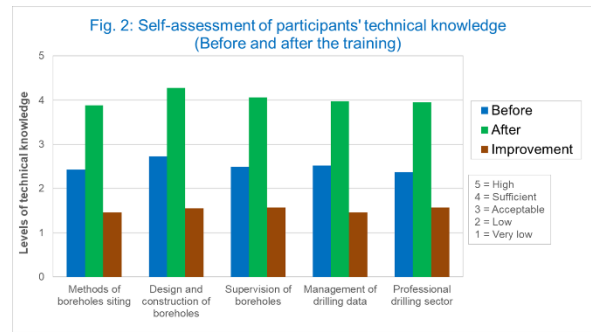
Box 6: What is the cycle of drilling data, and what actions should be taken to facilitate the collection, storage and sharing of borehole data?

- Collect - Quality control - Archive - Valorize - Accessible - Collect
- Data collection must be formal at every stage of the drilling process
- Ensure that data collection procedures are well defined in the technical specifications and respected by the drillers
- Hydrogeological and drilling data must be collected in a standard format and submitted to relevant authorities
- Encourage harmonization of data collection procedures and template
- Value groundwater/drilling data and ensure that drilling reports are of good quality Create a free national database accessible to all partners

6. Self-assessment and course review

Before and after the training, a questionnaire was provided to participants to self-assess their knowledge on all aspects of boreholes drilling and supervision. The objective was to assess the improvement in participants' technical knowledge for each learning objective. A value of 1 suggests very low technical knowledge in boreholes drilling and supervision, while a value of 5 indicates high-level knowledge.

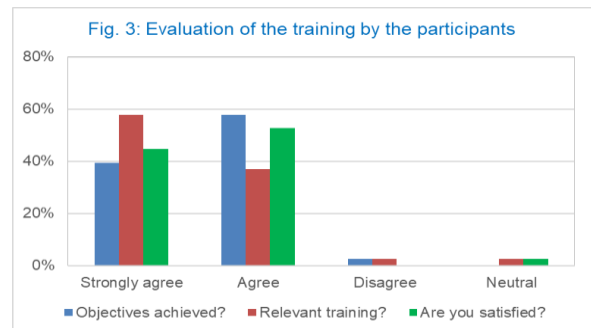
Before the training the average knowledge of all participants (level = 2.5) was lower than the "Acceptable" level (Figure 2). However, at the end of the training course, participant's technical knowledge increased to the level "Sufficient" (level = 4) for each of the five course modules. The improvement of technical knowledge demonstrates that the participants have learnt and retained many of the boreholes drilling and supervision principles presented during this course.



At the end of each three-day training sessions, participants were requested to review the entire course. To have their general perception and assess the impact of the training, the following questions were asked:

- Has the training achieved the objectives?
- Was the training relevant for your professional development?
- Were you satisfied with this training course?

Overall, participants expressed their satisfaction with the course content and the relevance of the topics that were covered (Figure 3). One participant disagreed with the course because he was expecting a field-based training.



Below are selected comments from participants:

- *"This training helped me a lot to enhance my technical knowledge in borehole drilling. I think that after this training, I will be a good player in the drilling sector in Madagascar." Participant from a drilling company.*
- *"The training allowed me to clarify gray-areas on best practices in boreholes drilling and supervisions, especially on the development of boreholes, the performing of pumping tests and the determination of boreholes' performance." Participant from a consultancy firm.*
- *"This training course was very helpful. It brought me a lot of know-how and motivated me to become more professional and integrate this technical knowledge during the supervision of drilling projects." Participant from government.*

7. Certification of participants

An evaluation test was organized on the last day of each training session to assess how much each participant had learnt. The test consisted of forty multiple choice questions spanning the five modules of the course. Out of the fifty-four participants, forty-three (83%) scored over 70% (passing mark). Fourteen of them were women. Among the participants who failed the test, some had French language barrier, while others did not attend all modules.

During the official closing ceremony on March 28th, 2018, each successful participant received a poster on cost-effective boreholes² (Annex 1), in addition to a certificate signed by the Minister of the MWSH and the representative of UNICEF Madagascar. In their closing speeches, representatives of MWSH and UNICEF congratulated participants for their commitment to contribute to the professionalization of the drilling sector in Madagascar, and encouraged them to put into practice all the technical knowledge acquired during this course.



8. Conclusion

All participants were very committed and showed great enthusiasm to learn and improve their knowledge. They actively engaged in the discussions and group activities. The training provided them an opportunity to learn from each other and to reflect on what can be improved.

9. Lessons learnt

Lessons learnt from this first training conducted for the WASH sector in Madagascar:

- Lengthen the duration of the training to promote a better assimilation of theoretical principles and review more case studies;
- Organize this training periodically for better capacity building of the drilling sector;

² The poster "Drilling and rehabilitating professionally so that wells last a lifetime" summarizes the six areas of engagement for professional drilling. It is a result of a collaboration between UNICEF, SKAT Foundation and WaterAid.

- Synthesize the RWSN³ documentation in the form of technical sheets of 2 to 3 pages that can serve as a guide during fieldwork;
- Associate the course with a field-based training to better illustrate best practices in drilling professional and sustainable boreholes;
- Update the MWSH procedure manual by incorporating UNICEF's technical notes on mapping of boreholes' salinity, the index of negative boreholes and procedures of borehole development and pumping tests.

10. Course resources

The following RWSN and UNICEF publications were shared along with exercises to be carried out by the participants for each module:

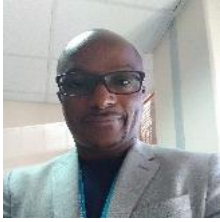
- Code of Practice for Cost Effective Boreholes, http://www.rural-water-supply.net/_ressources/documents/default/1-128-2-1344514867.pdf
- Siting of Drilled Water Wells. A Guide for Project Managers, http://www.rural-water-supply.net/_ressources/documents/default/1-187-4-1521131535.pdf
- Supervising Water Well Drilling: A guide for supervisors, http://www.rural-water-supply.net/_ressources/documents/default/1-392-34-1418981410.pdf
- Professional Water Well Drilling: A UNICEF Guidance Note, https://www.unicef.org/wash/files/Guidance_Note_005.pdf
- Mapping of Boreholes Salinity, https://www.unicef.org/madagascar/eng/WASH_Technical_Note1_-_Mapping_salinity_of_boreholes_EN.pdf
- Development of an Index of Negative Boreholes, https://www.unicef.org/madagascar/eng/Technical_note_2_WASH_ENG.pdf
- Procedures for Boreholes Development and Pumping Test, https://www.unicef.org/madagascar/eng/WASH_Technical_Note3_-_Procedures_for_boreholes_development_EN.pdf
- Videos on professional drilling of boreholes: <https://vimeo.com/channels/drilling>

Acknowledgement

This training was organized under the supervision of the Chief of WASH, Silvia Gaya and with the support of the UNICEF WASH team. We are grateful to the UNICEF Madagascar Country Office Management, the MWSH, the drilling companies and the consultancy firms for their contribution and participation in this training course. Many thanks to Daniel Ziegler and Lucy Segero from UNICEF Madagascar for reviewing this report.

³ Rural Water Supply Network

Course facilitator



Charles Serele is a hydrogeologist and works for UNICEF Madagascar as a WASH Specialist. He provides management and technical guidance on all aspects of water supply projects (mechanized/manual drillings and medium-scale systems). To help strengthen the capacity of the drilling sector, he developed innovative tools to map risks of drilling failure and set out different risk-based payment rules. Charles is also a GIS/RS expert currently working on mapping suitable groundwater areas based on satellite imagery to improve boreholes siting. Additionally, he conducts activities for the monitoring of groundwater depletion, develops a national hydrogeological database for the south of Madagascar, and delivers training to WASH specialists (government and private sector).

For additional information

UNICEF Madagascar: antananarivo@unicef.org

Annex 1: Drilling and rehabilitating professionally so that wells last a lifetime



PROFESSIONAL WATER WELL DRILLING & REHABILITATION
SO THAT BOREHOLES CAN LAST FOR A LIFETIME



Concise, easy-to-use guidelines available from RWSN in English, French & Portuguese:



Download from: www.rural-water-supply.net/en/sustainable-groundwater-management

Cost Effective Boreholes and Professionalization of the Drilling Sector is a collaboration between UNICEF and Skat Foundation, in partnership with WaterAid, as part of the RWSN Sustainable Groundwater Development theme.