
Striving for Professionalism
in
Cost Effective Boreholes Angola

Professional Borehole Drilling Management Training Course
Understanding groundwater, cost-effective boreholes,
procurement,
contract management and costing and pricing of boreholes
Angola, 20 – 24 November 2017



Final Workshop Report

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Frontispiece: Group photograph of the workshop participants on 22nd November, 2017

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Abbreviations

DPEA	Provincial Directorate for Energy and Water
DNA	National Directorate for Water
INRH	National Institute for Water Resources
MINEA	Ministry of Energy and Water
PCA	Project Collaboration Agreement
RWSN	Rural Water Supply Network
SPICE	Striving for Professionalising in Cost Effective Boreholes
ToR	Terms of Reference

Summary

As part of the cooperation agreement between UNICEF and Skat Foundation on Professional Borehole Drilling Management, a five day training workshop on '*Understanding groundwater, cost effective boreholes, procurement, contract management and costing and pricing of boreholes*' was conducted by Skat Foundation on behalf of the Ministry of Energy and Water, Angola, between the 20th and 24th November, 2017. The workshop was delivered at the Instituto Superior Politenico, Tundavala, Lubango, Angola by Miguel Angelo Gonzalez Alonso, Belis Matabire and Dotun Adekile with remote support from Kerstin Danert and Jose Gesti Canuto on behalf of Skat Foundation and UNICEF Programme Division, New York. Tomas Lopez de Bufala and Edson Monterio of UNICEF Angola provided both logistical and technical support during the workshop. Apart from the facilitators, 28 participants took part in the workshop. The following report gives an account of the proceedings and outcomes of the workshop.

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

- Understand the Principles of Cost Effective Boreholes
- Have some knowledge of groundwater occurrence in Angola
- Understand the procurement process in borehole construction
- Appreciate why transparency in procurement is essential for sustainable water supplies
- Understand how to cost and price boreholes in drilling projects
- Be able to prepare engineer's estimates for borehole drilling projects
- Evaluate tender documents for siting and drilling of boreholes
- Effectively manage borehole drilling projects from site selection through to completion

The delivery of the course was by lectures with PowerPoint point presentations, interactive discussion, group work, drama sketches and film shows. Participants were presented with copies of the Portuguese versions of the following RWSN publications:

- Code of Practice for Cost Effective Boreholes.
- Costing and Pricing; A guide for Water Well Drilling Enterprises
- Procurement and Contract Management of Drilled Well Construction
- Supervising Water Well Drilling, A Guide for Supervisors

They were also each presented with a flash drive containing all the slides of the Power Point presentations and other relevant resources materials.

The discussion throughout the workshop was very lively and informative. The participants arrived promptly every day of the course and stayed throughout. All the participants contributed to the group exercises and were attentive to the presentations. The drama sketches and debates were taken seriously and the participants readily identified the messages of the sketches and the logic in the debates.

By the end of the course the participants had grasped the principles of cost effective boreholes and were able to use it to identify the challenges of the sector in Angola. Some the challenges identified are:

- Drillers and groundwater consultants are not registered or licenced.
- The high level of corruption in borehole procurement
- Government should identify the reasons for the high and variable prices of boreholes in Angola and how it can be reduced and standardized so that the water supply coverage can increase
- There are few individuals available to professionally procure and supervise borehole drilling
- The low rural water supply coverage at 22% despite the huge investment in the sector
- There are no technical guidelines or regulations on borehole siting, drilling, development and pumping test
- There are no mechanisms for post construction monitoring
- There is no central database for borehole records
- There is lack of communication and coordination between the central government and the provincial governments in rural water supply
- Lack of information sharing, i.e., stakeholders are not aware of the water law/policy and other WASH guidelines/policy

It was an intensive five day course which should be spread over a longer period but the participants were provided with several resource materials for reference and further study and use in their work.

The report of the Preliminary Study of the Drilling Sector in Angola¹ was presented at the workshop by the consultant. The report succinctly identifies the challenges in the drilling sector in Angola. It corroborates the outcome of the discussion at the workshop. The findings of the study need to be made known to a wider audience of stakeholders to develop an action plan to address the issues. Before developing the action plan a more detailed study is required. The study should unravel the history of drilling in Angola since colonial times to be able to understand the evolution of the present situation and determine the way forward. The study should also assess the drilling capacity in the country, the number of drilling companies, the state of their equipment and experience and skills of the personnel. The study should look at the factors that affect the pricing of boreholes, why the price is so high and so variable and the current procurement procedure.

The study should then lead to an action plan involving the development of statutory instruments for the regulation of groundwater abstraction in the country and a strategy to increase the rural water supply coverage.

¹ Pinto Fiel (2017) *Preliminary Assessment of Water Well Drilling Sector in Angola*, UNICEF Angola

1 Introduction

A training course on Professional Borehole Drilling Management: Understanding groundwater, cost-effective boreholes, procurement, contract management and costing and pricing of boreholes was organised by a collaboration of UNICEF New York and Skat Foundation on the one hand and UNICEF Angola on the other hand, as support to the National Water Directorate (DNA) in the Ministry Water and Energy Angola (MINEA). The workshop was held at the Instituto Superior Politécnico, Tundavala, Lubango, Angola between the 20th and the 24th November 2017.

Participants

A total of twenty eight participants and three facilitators and two UNICEF Angola staff took part in the course. The participants were drawn from government departments, private drilling companies, the NGO and the academia. Eleven of the participants (39%) were female. The list of participants is provided in Annex 1.

The concept and content of the training course was developed and agreed with UNICEF Angola and MINEA by José Gesti Canuto of UNICEF New York and Kerstin Danert of Skat Foundation. It drew on experience from previous courses in Sierra Leone, Nigeria and Zambia. The workshop was facilitated by two trainers, Miguel Angelo Gonzalez Alonso, an experienced hydrogeologist based in Lubango, Angola and Bélis Matabire, a seasoned trainer and geologist from Mozambique. Dotun Adekile, a hydrogeologist, based in Nigeria, who had been involved in the development of the Cost Effective Borehole theme and had delivered the course in the three other countries (above) acted as the support trainer to the two main facilitators. Prior to the workshop the three facilitators had gone over the entire course material so that there was common understanding about the delivery of the courses. Tomas Lopez de Bufala, Chief of WASH UNICEF Angola and Edson Monterio, WASH Program Officer provided both technical and logistical support during the course.

2 Background to the Training Course

The course was declared open by Tomas Lopez de Bufala. He welcomed all the participants. He provided the background to the training workshop. The collaboration between UNICEF Programme Division (New York) and Skat Foundation, **Striving for Professionalising in Cost Effective Boreholes (SPICE)** identifies problems that undermine borehole cost-effectiveness such as low quality, high failure rates and high cost of construction and installation. To tackle this, the collaboration aims at improving country capacity to professionalise the practice of both manual and machine drilling and improve construction quality. This is done by trying to embed the Principles of Cost Effective Boreholes in country practice in a number of African countries.

Following discussion between UNICEF Angola, UNICEF Programme Division and Skat Foundation in early 2016, a concept note proposed three courses to support the development of a professional drilling sector in Angola. The National Directorate for Water (DNA) in the Ministry of Energy and Water Angola (MINEA) expressed keen interest in the courses. It was therefore agreed that the Skat/UNICEF Project Cooperation would focus on the development and running of the first three modules of the six module course in Angola. This led to the development of the Terms of Reference (ToR) between UNICEF Angola and Skat Foundation. The specific outputs of the consultancy were

- Delivery of a five day short course to 35 participants in Angola on drilling procurement, costing & pricing and contract management
- A review of the Consultant's report of the Preliminary Assessment of the Water Well Drilling Sector in Angola

Tomas Lopez de Bufala reiterated UNICEF's support to the government of Angola to increase water supply coverage in the rural areas of the country. He narrated the activities of the Rural Water Supply Network (RWSN) in the development of the Code of Practice for Cost Effective Boreholes. He urged the participants to avail themselves fully of the opportunities provided by the workshop.

This report gives an account of the proceedings and outcomes of the course and a review of the consultant's report on the Preliminary Assessment of the Water Well Drilling Sector in Angola (See footnote 1).

Learning objectives

The learning objectives of the 5-day short course were that by the end of the course, the participants would:

- Understand the Principles of Cost Effective Boreholes
- Have some knowledge of groundwater occurrence in Angola
- Understand the procurement process in borehole construction
- Appreciate why transparency in procurement is essential for sustainable water supplies
- Understand how to cost and price boreholes in drilling projects
- Be able to prepare engineer's estimates for borehole drilling projects
- Evaluate tender documents for siting and drilling of boreholes
- Effectively manage borehole drilling projects from site selection through to completion

Course Structure and Activities

The course was delivered in three modules as follows:

- Module 1: Introduction: Understanding groundwater without jargon
- Module 2: Introduction to Cost Effective Boreholes – what does it mean for Angola?
- Module 3: Procurement, contract management and costing and pricing of boreholes

The programme of activities of each day of the short course is summarised in Annex 2. The overall approach to the delivery of the course recognised that some of the participants had little or no knowledge of groundwater, procurement and contract management and had to be introduced to the topics in a simplified manner. The approach used was a mixture of training and teaching methods and group exercises to enhance the knowledge of the individual participants and enable experiences to be shared and an exchange of ideas and opinions.

The courses were delivered by lectures using PowerPoint presentations, interactive discussion, group work, drama sketches and film shows. Participants were encouraged to ask questions for clarification regularly during each presentation or activity. Seating places were changed part way through the course and four different groups were formed to allow each participant to work with everyone else and to get to know each other. Each morning began with an icebreaker and there was an energiser after the lunch break. Throughout the course the participants were encouraged to think

critically about the state of groundwater development in Angola. Issues of concern in the sector identified by the participants during the course were noted by the facilitators and are presented in the section on Day 4 of this report. The highlights of each day's activities are summarised below.



Picture 1 The facilitators preparing for the workshop in the UNICEF Office Lubango - from left Dotun Adekile, Bélis Matabire, Miguel Angel Gonzalez Alonso

Day 1: Opening; Introduction; Understanding groundwater without jargon

Understanding groundwater without jargon

Following the opening by Tomas Lopez de Bufala, Bélis Matabire and Miguel Angel Gonzalez Alfonso delivered a lecture on *Understanding groundwater without jargon*. The lecture provided participants without a technical background in hydrogeology with a basic understanding of groundwater occurrence and development. It used a simple language, and was intended to enable the participants to subsequently carry out their duties in procurement and management of borehole projects in an informed manner. The lecture explained the importance of water and groundwater usage, its occurrence in different rock types, methods used in prospecting for groundwater, borehole design and borehole construction and the groundwater resources of Angola.

Introduction to cost effective boreholes- What does it mean for Angola?

Miguel Angel Gonzalez Alonso introduced the participants to the RWSN nine principles of cost effective boreholes and asked them to discuss the principles in relation to the drilling environment in Angola. The outcome of the discussion is resented in table 1 below. It shows that there are several challenges facing the sector and that very few of the principles, based on global good practices, are yet to be taken on board in the country.

Table 1 The RWSN Principles of Cost Effective Boreholes and the Angola Situation

RWSN Principle	The Angola situation
Principle 1 - Drilling is by professional enterprises and consultants under national standards	There is no licensing or registering of drillers or groundwater consultants in the country. There is no self-regulation in the form of an association of drillers or groundwater consultants.
Principle 2 - Appropriate siting practices are utilised and scientifically carried out	There are no technical guidelines on borehole siting. Most times there is no hydrogeologist to direct the siting.
Principle 3 – Construction method is economical and drilling technology matches borehole design	There is a great variety of drilling rigs. In the last few years the supply has increased, generally medium to large duty rigs, with capacity to drill depths exceeding 100m, in diameters up to 250mm. Manual drilling is being carried out to some extent in the country.
Principle 4 – Procurement: Contracts are awarded to experienced and qualified contractors and consultants	There is a law of public contracts, revised in 2016 which guides all public procurements. The extent of compliance is unknown. Corruption is widespread.
Principle 5 – The design is cost effective, to last 20-50 years based on minimum specification	There is a water law but with no specific clause on water quality.
Principle 6 – Arrangements are in place for proper contract management, supervision and payment	DNA has a standard format of reporting for its projects but not used by other institutions. There are few competent personnel for supervision so there is very little supervision of drilling. DNA has only one hydrogeologist. Consultants are hired particularly when the project is considered big e.g. the Tundavala wellfield for supplementary water supply to Lubango, visited by the participants.
Principle 7 – High quality hydrogeological data for each borehole is collected in a standard format and submitted to the relevant government authority	DNA compiles data from the holes drilled by government but there is no protocol or defined criteria for the numbering and registration of boreholes. Borehole data are scattered. There is no report of negative boreholes.
Principle 8 – Storage of hydrogeological data is undertaken by a central government institution with records updated, information made freely available and used in preparing subsequent drilling specification	There is no central database
Principle 9 – Monitoring: Regular visits to water users with completed boreholes are made to monitor functionality in the medium as well as long-term, with the findings published	There is some initiative for monitoring but there has been no funding so no monitoring is being done

Film show

The animated film on borehole siting; *Drilling, the importance of good borehole siting* was shown to the participants. Afterwards, the messages of the film were discussed. The film was in English but the narration was translated to Portuguese by Bélis Matabire.

Drama sketches

Each of the four groups was presented with thematic drama sketches. They were asked to rehearse, modify, if they wish and perform the sketches on subsequent days of the course. They were informed that there would be an award for the best female actor (who may be a man playing a female role), best male actor (who may be a woman playing a male role) and the best drama group. A voluntary committee was established to develop a system of selecting the award winners.

Publications

The four RWSN Publications in Portuguese had been printed along with the exercises to be carried out by the participants on each of the modules and presented in folders to each participant. The publications were:

- Code of Practice for Cost Effective Boreholes
- Costing and Pricing; A guide for Water Well Drilling Enterprises
- Procurement and Contract Management of Drilled Well Construction
- Supervising Water Well Drilling, A Guide for Supervisors

They were also each presented with a flash drive containing all the prepared course materials and other relevant publications and documents.



Picture 2 Tomas Lopez de Bufala opening the workshop on Day 1

Day 2: Procurement

Ice breaker

Day 2 started with an icebreaker. The participants stood in a circle and each recalled one new lesson learnt or knowledge acquired from the previous day's sessions. This was repeated by the next person whilst adding his/her own new item of learning; and was repeated by the next person.

Procurement of Borehole Projects

Miguel Angel Alonso Gonzalez delivered a lecture on *Procurement of Borehole Projects* giving the definition of public procurement and its objective of ensuring maximum benefits to the public by transparently obtaining goods and services following laid down government guidelines and regulations. He discussed the highlights of the Law of Public Contracts in Angola and identified the different stages in public procurement as procurement planning, contract award, contract management and monitoring and evaluation.

Contract Award

Bélis later took the participants through the Contract Award process starting with prequalification of bidders. Participants were asked within their groups to develop the requirements and criteria for the evaluation of prequalification applications for a planned borehole project. The outcome of the group work was presented by each group and compared with the requirements and criteria previously prepared by the facilitator. There was a close correlation between the two.

Bélis went on to discuss the need for multiple borehole contract packaging, technical specifications that fit the purpose, realistic bills of quantities, the importance of a pre-bid meeting, the bid opening and award procedure.

Drama sketch

A drama sketch, *“The importance of transparency in procurement or OK you can have the contract”* was presented by Group 1. The moral of the play was discussed by the participants.



Picture 3 Performance of *The importance of transparency in procurement* with Pinto Fiel on the right as Thandi and Jose Coimbra Gaspar on the left as the minister

SWOT Analysis

Participants were asked to carry out a SWOT analysis of the procurement of boreholes, platforms/soakaways, pumps and siting and supervision consultancy in Angola. The outcome is presented in Table 2.

Table 2 SWOT Analysis of Borehole Procurement in Angola

Strengths	Weaknesses
<ul style="list-style-type: none"> • Abundant groundwater resources • National financial resources • Laws that regulate the procurement process • Competent indigenous drilling companies 	<ul style="list-style-type: none"> • Non-compliance with the law on public procurement • Lack of sector-specific legislation and standards • High price of boreholes • Lack of qualified professional staff • Lack of professional ethics • Poor supervision • Lack of market for the purchase of parts for maintenance
Opportunities	Threats
<ul style="list-style-type: none"> • Support and collaboration with NGOs • Need to train professionals in the sector • Need to improve the quality of the life of the population • Need to guarantee access to drinking water for every citizen in quantity and quality • Need for job creation 	<ul style="list-style-type: none"> • Corruption in the sector • Contamination of the aquifer • Breach of contract by the client • Vandalization of drilled boreholes • Poor quality of works • Natural disasters – droughts, floods, climate change • Economic dependence on oil



Picture 4 Participants starting the day with the ice breaker on Day 2 – from left Jorge, Leonel, Fabio, Carlos, Gift, Paula, Adelina, Olga, Alfonsina, Cleomara

Day 3: Contract Management (including an introduction to drilling supervision)

Contract Management

The lecture on Contract Management was delivered in two parts. The first part by Bélis, defined contract management and discussed the need for effective arrangements for logistics, meetings, quality assurance and data management. The second part by Miguel discussed the need for effective

supervision to achieve cost effective boreholes, the roles and responsibilities of the supervisor and the different types of supervision. It also discussed the need for timely payment, analysing the risk of dry boreholes and the client sharing the risks with the contractor, monitoring of borehole functionality and reporting.

Drama sketches

Two drama sketches were presented; *‘Where is the data on the borehole drilled last year? Or information is not monkey business ‘* and *‘Payment for dry borehole or but this is the third borehole we have drilled that is dry’* The messages of the plays were discussed by the participants.

Presentation of the Preliminary Study of the State of Water well drilling in Angola

The consultant who carried out the Preliminary Assessment of the Water Well Drilling in Angola, Pinto Fiel, made a presentation of the outcome of the study. It was followed by a lively discussion in which the participants corroborated most of the findings. This is further discussed in the review of the summary findings in Annex 3.

The Fishbowl – should the local government, the national government or UNICEF pay for dry borehole

In the fishbowl, two participants sitting in the middle of a U shaped sitting arrangement volunteered to support or oppose the motion that dry boreholes should be paid for. Whilst engaged in the discussion, other participants came in to sit in the two available chairs in the U shape to make their contributions either for or against. The discussion was very interesting, participants got very excited, not shifting their ground such that instead of the 15 minutes allowed for the exercise it extended to 45 minutes with no winner. The general trend was that the participants from the university felt there should be no payment whilst the participants from the private sector, drillers, felt there should be some remuneration for the work done and cost incurred, if not the entire sum in the contract.

Monitoring and reporting

The four groups were each asked to develop a post-construction monitoring checklist and report format from one of 4 different perspectives:

- Minister of the Ministry of Energy and Water
- UNICEF WASH office
- Provincial government – technical department
- Citizens

The result is shown in table3. The responses showed a weakness in the knowledge of post construction monitoring which they confused with supervision.



Picture 5 Participant in the Fishbowl: From left, Enyaline, Carmen, Carlos and Miguel

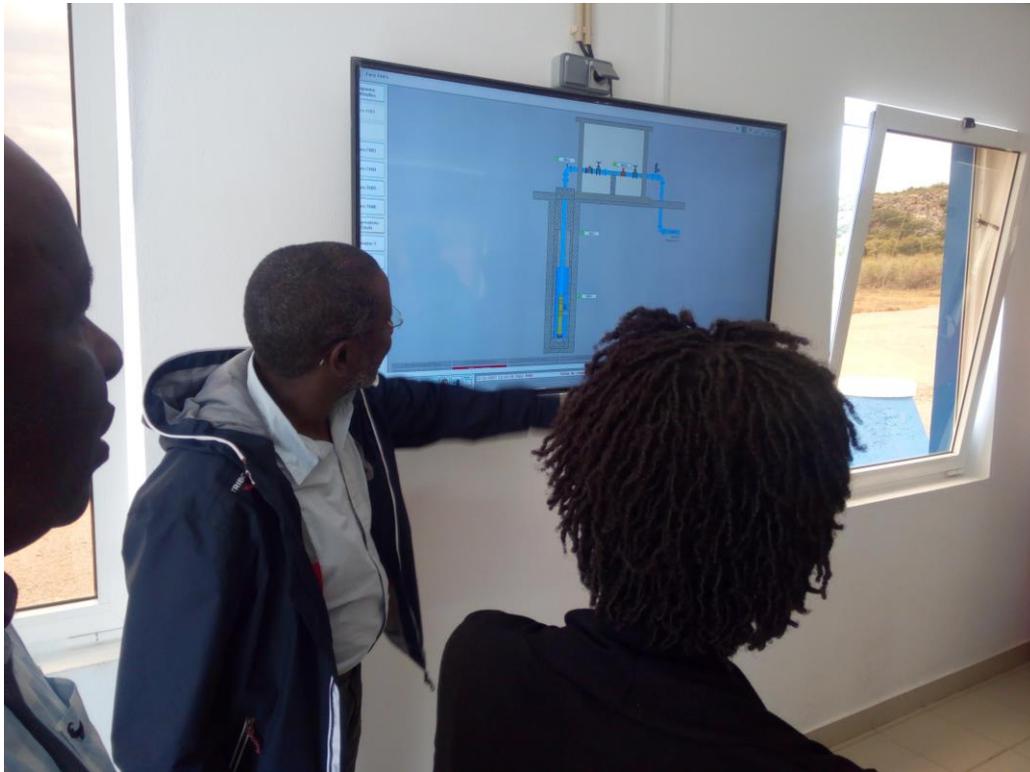
Table 3 Monitoring and reporting perspectives - Post construction checklists

Group 1 MNIEA	Group 2 UNICEF	Group 3 Community/Citizens	Group 4 Provincial Government
Name of the community	Name of the community	Community involved in the design and construction	Mobilise the community
Identity of the contractor	Identity of the contractor	Community involved in site selection	Supervise borehole location
Duration of the survey	Commencement date	Community monitored the drilling	Disseminate information on hydrogeology of the area
Report on geophysics/hydrogeology	Completion date	Site fenced by the community	Data sheets are in accordance with work materials
Type of system built	Technical report	Community established the rule of use	Check that all the parameters of the hole construction have been done
Type of materials used	Quality of work	Community monitor the functionality of the system	Collect water quality data
Duration of the construction	Type of equipment used		Collect the final information on the borehole
Type of pump installed	Borehole depth		
Technical specification of the contract	Yield		
Data sheet of the materials used	Water quality		

Group 1 MNIEA	Group 2 UNICEF	Group 3 Community/Citizens	Group 4 Provincial Government
Submit inspection report	Benefit to the community		
	Comment on success		
	Budget map		
	Interveners in the process		

Visit to the Tundavala Wellfield

In the course of discussion, it was discovered that some of the participants had never seen a borehole. As the training venue was only a walking distance to the recently completed Tundavala wellfield, an excursion was made to the wellfield. The hydrogeology of the location was explained by Miguel who conducted the participants around the deep boreholes and the control room.



Picture 6 Edson explaining a borehole section to participants at the Tundavala wellfield control room



Picture 7 Participants in group work

Day 4: Costing and Pricing

Day 4 started with an icebreaker with each participant asked to complete the statement, *if there was one thing I could change or do to improve drilling cost effectiveness in Angola it will be...* The responses are presented in Box 1. The responses by the participants showed that by Day 4 they were already coming to understand the issues affecting the sector.

Definition of terms

Miguel led an exercise on definition of common terms in costing and pricing of boreholes and the difference between the *cost* and the *price* of a borehole. The terms were written on coloured cards and participants were asked to discuss them in their groups to come to a common understanding of each of them. As was the case when the course was run in Zambia, it generated a rather heated debate among the participants but was eventually resolved.

Box 1 What can be done to improve borehole cost effectiveness in Angola?

- Provide professional training in siting, borehole procurement, drilling, and supervision.
- Provide independent and competent supervision during the construction of boreholes
- Involve the community in project execution.
- Define and standardize drilling construction methodology.
- Allow a budget that can meet the cost of the specific materials to be used.
- Carry out preliminary groundwater study.
- Creation of water and sanitation group to monitor completed projects.
- Develop a program of periodic maintenance of boreholes.
- Determine the best siting techniques.
- Develop a plan of operation and maintenance for boreholes.

- **Develop an economic and environmental social sustainability plan.**
- **Monitor borehole water quality.**
- **Monitoring of drilled holes.**
- **Implementation of programs to monitor and maintain the holes made.**
- **Creation of a database with hydrogeological information of the holes executed.**
- **Evaluate technical and financial proposals in more detail.**
- **Creation of a regulation for companies in the sector.**
- **On-time payment for proper execution of the works.**
- **Creation of a market for the sale of spare parts.**
- **Creation of a drillers association in Angola.**

Steps in Borehole Costing and Pricing

The participants were taken through the steps in borehole costing and pricing and then carried out two exercises in:

- calculating interest and loan repayment
- calculation of depreciation

Participants were led in identifying the six common components of boreholes and identifying the items of cost in each component. This led to calculating the cost of a 50m deep borehole lined with 110 PVC casing and screening and discussion on how to arrive at the price.

Drama sketch

The last drama sketch was presented: *The importance of realistic engineer's estimate Or what does a borehole really cost.* The lessons learnt were discussed afterwards.

Development of an Engineer's Estimate

The participants were asked to carry out a group exercise to develop an engineer's estimate for a 10 borehole project in four different locations with different types of geology. Miguel first led the participants on how to determine the geology of a particular area using the hydrogeological map of Angola and how to download several useful maps.

All the groups made a spirited effort at the exercise. Although the time proved to be inadequate to complete the exercise fully, the participants realised the importance of carefully identifying all the cost components in arriving at the estimate.

Issues of concern in the sector identified by the participants

As the workshop progressed and discussion continued, issues of concern in the sector were identified. The issues are as follows.

- Drillers and groundwater consultants should be registered and licensed
- The high level of corruption in borehole procurement should be addressed
- Government should identify the reasons for the high and variable cost of drilling in Angola and how it can be reduced and standardized
- Very few individuals available to professionally procure and supervise borehole drilling
- Low rural water supply coverage at 22% despite the huge investment in the sector

- There are no technical guidelines or regulations on borehole siting, drilling development and pumping test
- There are no mechanisms for post construction monitoring
- There is no central database for borehole records
- Lack of communication and coordination between the central government and the provincial governments in rural water supply
- Lack of information sharing, i.e., stakeholders are not aware of the water law/policy and other WASH guidelines/policy

Day 5: Course Review, Awards, Certificates and Closing

Course Review

The entire course was reviewed on the final day. Participants were each asked to state what they were taking away from the course, one particular thing they learnt and their general perception of the course. A video recording of this session was made and their entire comments have been transcribed and presented in Annex 4. Select comments about what they learnt are as follows:

- Procurement, project/contract management, supervision, borehole siting and budgeting
- Requirements for borehole construction, water law, and staff management
- The importance of water and the need for proper borehole siting
- Deep borehole does not mean high yield
- How to prepare a borehole contract, and the need for transparency in procurement
- Need of capable staff for policy and project implementation
- Importance of supervision during borehole drilling, cost estimation of boreholes

Select general perception of the course are as follows:

“The course was very useful. Thank you UNICEF for selecting the facilitators. They are real professionals with a lot of experience. They managed to respond to most of the questions raised by the participants. It would be good for the private sector to be more involved for practical experience in the drilling process. In future, the organizers should provide transport for the participants.”

‘Because there was no opportunity for practice it is necessary to have more videos in Portuguese about what was learned. In future I will like to proceed to MSc in hydrogeology. I am able to assist my relatives and friends on how to construct boreholes in Huila Province’;

“The course was very helpful. Before the course I did not know anything about hydrogeology. However after two days I got a lot of information and better understanding about the subject”

“I learned a lot in terms of water quality. Personally I suffer a lot from consuming unsafe water. I am interested in working in the WASH Sector. The methodology used by the facilitators was very useful. Drama and videos were very useful to better understand the subjects. The course was very interesting.”

Professional borehole drilling: what next for Angola?

Each group was asked to discuss how they could improve borehole procurement and contract management in Angola. The result of their discussion is summarised in Box 2.

Box 2 Professional borehole drilling: what next for Angola?

- Regulation and dissemination of laws governing the sector
- Improve the training of practitioners in the sector
- Identify and register professional groundwater consultants
- Certification of companies to ensure that they are suitable for carrying out the work
- Improve professional ethics in the tender process
- Creation of independent entities to evaluate the tenders
- Creation of internal project managers
- Improve monitoring and inspection of projects
- Creation of mobilization teams
- Improve system management and maintenance
- Creation of a reliable database
- Seek sustainability of facilities
- Improve transparency in hiring of contractors and consultants
- Require contractors to provide drilling data
- Create national database
- Eliminate corruption
- Improve water quality analysis laboratories
- Rationalize the bureaucracy.
- Improve the supervision of projects
- Payment according to the physical evolution of the contract

Quiz

A quiz was conducted as a revision exercise for the course and to evaluate how much the participants had learnt and retained. The quiz consisted of ten questions spanning the entire course content. 92% of the participants scored over 70%. One person scored below 50%. This person spent most of the course outside the venue on the phone.



Picture 8 Participants answering the quiz

Course evaluation

Participants were asked to evaluate, using a form, the presentation, delivery and organisation of the course to improve on the design of future courses. The form and a summary of the response to the questions are shown in table 4. From the summary and discussions, it can be inferred that the participants were highly satisfied with the conduct and organisation of the course. Specific comments and recommendation for improvement to the course are summarised in Table 5.

Table 4 Summary of course evaluation

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	The training met my expectation	11	13	2		
2	I think that I will be able to apply the knowledge acquired	12	15			
3	The training objectives for each unit were identified and followed	18	8			
4	The content was organised and easy to follow	13	12	1		
5	The material distributed were pertinent and useful	19	7			
6	The instructors were knowledgeable	23	4			
7	The quality of instruction was good	19	8			
8	The instructors responded well to questions	20	5			
9	Trainees participation and interaction were encouraged	19	6			
10	Adequate time was provided for questions and discussion	11	11	3		

Table 5 Comments and recommendations by Course Participants

General comments
<ul style="list-style-type: none"> • Grateful to UNICEF and congratulations for a successful workshop • It is very satisfying to see that there are people like Dotun, Bélis, Edson and Miquel who have so much pleasure in teaching and above all patience and humility to pass to us so much ethics as future professionals • It was good to mix with professionals and students
How could the format be improved?
<ul style="list-style-type: none"> • Participants should be informed of other courses in the future by email • More videos in Portuguese to illustrate the topics • More images of drilling machines
Venue
<ul style="list-style-type: none"> • The venue was good, the food was excellent • Transport should be provided for participants or the venue located closer to the city
Specific improvements to the course to be considered for incorporation in this or other courses in the future
<ul style="list-style-type: none"> • More time should be allocated to the training • The course should be part of the curricula at ISPTundavala. If possible the next training should take place at IPS Metropolitano in Luanda • More practical should be incorporated into the course • Include proposal writing

Presentation of drama awards

A three-person committee defined the modalities of for the selection of the best actors and the best drama. The award for the best female actor went to a man, Pinto Fiel. The best male actor went to a woman, Dezia Brodrega. The best drama was by group 4.

Certificates and Closing

Certificates of attendance were awarded to all the participants and the workshop was brought to a close with remarks by Edson Monteiro and Dotun Adekile who thanked all the participants for their cooperation.

3 Observations and Conclusion

The discussion throughout the workshop was very lively. All the participants contributed to the group exercise and were attentive to the presentations. The drama sketches and debates were taken seriously and the participants readily identified the messages of the sketches and the logic in the debates.

By the end of the course the participants had grasped the principles of cost effective boreholes and were able to use it to identify the challenges of the sector in Angola. It is always an intensive five day course which ideally should be spread over a longer period but the participants were provided with several resource materials for reference and further study and use in their work.

The report of the Preliminary Study of the Drilling Sector in Angola succinctly identifies some of the challenges in the drilling sector in Angola. It corroborates the outcome of the discussion at the workshop. The findings of the study need to be made known to a wider audience of stakeholders to develop an action plan to address the issues. Before developing the action plan a more detailed study is required. The study should unravel the history of drilling in Angola since colonial times to be able to understand the evolution of the present situation and determine the way forward. The study should also assess the drilling capacity in the country, the number of drilling companies, the state of their equipment and experience and skills of the personnel. The study should look at the factors that affect the pricing of boreholes, why the price is so high and so variable.

The study should then lead to an action plan involving the development of statutory instruments for the regulation of groundwater abstraction and a strategy to increase the rural water supply coverage.

ANNEXES

Annex 1 List of Participants and Facilitators

Nº	Nome	Gender	Instituição
PARTICIPANTS			
01	Adelina Artur Liunda	F	ISPT – Instituto Tundavala
02	Alberto Songo Venâncio	M	DPEA Huila
03	Alfonsina Quiimbo Panzo	F	ISPT – Instituto Tundavala
04	Jose Antonio Augusto Luis	M	DPEA Huila
05	Carlos Victor Kandimba	M	Sela Grup Lda
06	Carmen Larissa de Oliveira Barros	F	ISPT – Instituto Tundavala
07	Cleomara da conceição Cahete	F	ISPT – Instituto Tundavala
08	Diana da Assuncena Francisco Cardoso	F	ISPT – Instituto Tundavala
09	Enyaline Corte Real	F	ISPT – Instituto Tundavala
10	Evandro Adilson Andre	M	Sela Grup Lda
11	Fábio Ivan Teixeira Rocha Santos	M	Sela Grup Lda
12	João António Celestina	M	ISPT – Instituto Tundavala
13	Joao Domingos Pedro	M	Ministério do Ensino Superior
14	Jorge Fierro Albizu	M	NGO People in Need
15	Jose Coimbra Gaspar	M	Governo Provincial de Malanje
16	Juvenália Vanessa Contreiras	F	ISPT – Instituto Tundavala
17	Leonel Mauro Ferreira Nóbrega	M	Sela Grup Lda
18	Olga Claudia Paulino	F	ISPT – Instituto Tundavala
19	Oscar Lopes Canhique	M	DPEA Huila
20	Paula Juelma Martins	F	ISPT – Instituto Tundavala
21	Paulino Jose Gomes	M	NGO People in Need
22	Pedro João da Silva	M	Direcção Nacional das Aguas
23	Sabina Helena Bartolomeu	F	ISPT – Instituto Tundavala
24	Samir Santos	M	ISPT – Instituto Tundavala
25	Zuze Gift	M	NGO People in Need
26	Pinto Fiel	M	Consultor
27	Desia Nóbrega	F	ISPT – Instituto Tundavala
28	Mario Raul Correia Armando	M	Driller
TRAINERS AND FACILITATORS			
	Dotun Adekile	M	
	Tomás Lopez de Bufalá	M	
	Belis Matabire	M	
	Edson Monteiro	M	
	Miguel Angel Gonzalez Alonso	M	

Annex 2 Detailed Training Programme

DAY 1	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD
8:30 – 9:00	Welcome & register			Edson/Tomas
Sitting Arrangements: Horseshoe behind tables				
9:00 – 10:15	Introduction	<p>Introductions (20 min) – get the participants to stand in a circle inside the tables. Each participant provides a name and an adjective that describes oneself with the same letter (example – Beautiful Belis)</p> <p>Course rules - open flip chart and consult and write rules (5 min)</p> <p>PPT Presentation (20 min)</p> <ul style="list-style-type: none"> - D1_1_Introducao.pptx (20 min) - Slide 14 “Learning Objectives” – Ask participants to write down any additional expectations that they may have on cards – facilitator pins on the pin board 	<p>Overhead projector</p> <p>Flipchart at front to write down rules</p> <p>Cards & markers for the participants.</p> <p>Pin board.</p>	Edson/Tomas
10:15 – 10:45	<i>Tea break</i>			
10:45 – 12:30	<u>Module 1 (part I)</u> Understanding groundwater without the jargon	<p>Start by asking students to draw the F-diagram. Keep dialogue with the students throughout the session.</p> <p>PPT presentation</p> <ul style="list-style-type: none"> - D1_2_Entender_agua_subterranea_Module 1.pptx interspersed with questions & answers. 	Overhead projector	Belis
12:30 - 13:30	<i>Lunch</i>			

DAY 1	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD
13:30 – 15:15 1 h 45 mins	Module 2: Cost-effective Boreholes – what does this mean for Angola?	<p>PPT presentation (30 min)</p> <ul style="list-style-type: none"> ➤ D1_3_Furos_de_agua_rentaveis_Module 2.pptx ➤ Tell the participants that the Código de Boas Práticas is in their folder <p>Discussion (40 min)</p> <ul style="list-style-type: none"> ➤ What (if anything) could be improved in Angola? – write these onto cards. <p>If time is available, consider showing the films (in French) Siting and Supervision & discuss (30 min)</p> <ul style="list-style-type: none"> ○ What is the main message? ○ Do you agree? ○ What are your experiences in these areas? – Take notes 	<p>Overhead projector, films and speakers.</p> <p>Memory sticks</p> <p>RWSN Code of Practice (35 copies)</p> <p>Cards & markers</p>	<p>Miguel</p> <p>Belis</p>
15:15 - 15:30	<i>Health break</i>			
15:30 – 17:00	Module 1 (part II): Understanding groundwater without the jargon	<p>PPT presentation</p> <ul style="list-style-type: none"> ➤ D1_2_Entender_agua_subterranea_Module 1.pptx, interspersed with questions & answers 	<p>Overhead projector</p>	<p>Miguel</p>

DAY 1	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD
17:00 – 17:30	Introduce drama sketches and closure	<p>Explain: Four drama sketches will enable key issues in relation to cost-effective boreholes to be considered and discussed. Each sketch will be presented a group of participants (put into groups at random). The scripts of the sketches are for guidance only. “You don’t have to memorise the lines. You are free to embellish, improvise, add characters and add fun to it as you like so long as the message is not lost”.</p> <p>Get the participants to count ONE – TWO – THREE – FOUR out loud in order to form the groups. Hand out the sketches. Explain (with a flip chart when the sketches will be held).</p> <ul style="list-style-type: none"> • Sketch 1 - Tuesday - The importance of transparency in procurement • Sketch 2- Wednesday - early morning - Where is the data on the boreholes drilled last year?! • Sketch 3 - Wednesday– late morning or afternoon - Payment for dry boreholes • Sketch 4 Thursday - The importance of a realistic engineer’s estimate <p>Inform the group that a team will be tasked to establish process to nominate:</p> <ul style="list-style-type: none"> - the best performing actress (who could be a man playing a female role) - the best performing actor (who could be a woman playing a male role) - the best performing group <p>Ask for volunteers for a committee to run the Oscars for the plays. The team is tasked with running the Oscars. The committee will determine and un a process on Friday to determine: the best performing actress (who could be a man playing a female role)</p> <ul style="list-style-type: none"> - the best performing actor (who could be a woman playing a male role) - the best performing group 	Drama script handouts (4 sets x 10 copies each)	Belis

DAY 1	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD
17:30	End of the day	Homework		Dotun

DAY 2	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD FACILITATOR
8:30 – 9:00	Ice-breaker & register	Revision from yesterday: Standing in a circle –pass the ball what was the key thing that you learned yesterday – as a game where you repeat what the person before said.		Belis
9:00 – 9:50	Introduction	PPT presentation , followed by questions & answers ➤ <i>D2_Adjudicacao.pptx</i> Discussion based on the Angolan Public Procurement Act Participants are presented with <i>RWSN Procurement and Contract Management of Drilled Well Construction</i>	Overhead projector RWSN Proc & CM Publication	Miguel
9:50 – 10:00	Contract management film	➤ Four Steps to Better Drilling Contracts (English)		Miguel
10:00-10:30	Stage 1 Procurement Planning	Lecture PPT presentation (continued from above) ➤ <i>D2_Adjudicacao.pptx</i>		Miguel
10:30 – 11:00	Tea Break			

DAY 2	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD FACILITATOR
11:00 – 12:30	Stage 2 Contract Award (part I)	<p>Lecture PPT presentation</p> <ul style="list-style-type: none"> ➤ D2_Adjudicacao.pptx <p>Exercise</p> <ul style="list-style-type: none"> ➤ Exercicio 2.1_Adjudicação e Gestão .docx <p>Development of prequalification requirements and criteria for a planned borehole project. Presentation of group exercise, discussion and summary</p> <p>Lecture PPT presentation (finish slides for Stage 2)</p> <ul style="list-style-type: none"> ➤ D2_Adjudicacao.pptx 	Exercise 2.1 in folder	Belis
12:30-13:30	<i>Lunch</i>			
13:30 – 14:00	Drama Sketch 1 The importance of transparency in procurement	Drama Group 1 set up and present their sketch, followed by a short discussion	“Stage”	Miguel
14:00-15:15	Stage 2 Contract Award (part II)	<p>Lecture - PPT presentation on Contract packaging, Technical specification, Pre-bid meeting, Bid opening and Award</p> <ul style="list-style-type: none"> ➤ D2_Adjudicacao.pptx 	Overhead projector	Belis
15:15 - 15:45	<i>Health Break</i>			
Seating arrangements: seats inside the U				

DAY 2	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD FACILITATOR
15:45 – 17:00	Procurement in Angola	SWOT Analysis (strengths, weaknesses, opportunities and threats) of procurement of boreholes, platforms/soakaways, installed pumps and siting and supervision consultancy in Angola.	SWOT Table on wall, 80 cards, pins, 40 markers & and bid board to pin cards	Miguel
17:00-17:30	Round-up	Pass the ball and state the main take-away message from the day.		Belis
	Dinner			

DAY 3	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD FACILITATOR
8:30 – 9:00	Ice-breaker & register	Communications game (Chinese whispers/telephone)		Miguel
9:00 – 10:00	Stage 3 Contract management (pt I) (definition, logistics, meetings and QC, data management)	Lecture/PPT presentation: ➤ D3_Gestão de Contratos.pptx	PPT & overheads	Belis
10:00-10:30	Drama Sketch 2 Where is the data on the boreholes drilled last year?	Drama Group 2 set up and present their sketch, followed by a short discussion	“Stage”	Belis
10:30 – 11:00	<i>Tea Break</i>			
11:00 – 12:30	Stage 3 Contract management (pt II) (supervision, payments & completion)	Lecture- PPT presentation , followed by questions and answers ➤ D3_Gestão de Contratos.pptx	PPT & overheads	Miguel
12:00-12:30	Drama Sketch 3 Payment for dry boreholes	Drama Group 3 set up and present their sketch, followed by a short discussion	“Stage”	Miguel
12:30 - 13:30	<i>Lunch</i>			
13:30 – 14:15	Payment for dry boreholes	Fishbowl – Should the local government, the national government or UNICEF pay for dry boreholes? (15 min) ➤ See: Trainer Notes_FISHBOWL.pdf	Four chairs in the middle of the room.	Miguel

DAY 3	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD FACILITATOR
14:15-15:30	Stage 3 Contract management (pt III)	<p>Short lecture PPT presentation, followed by questions and answers:</p> <ul style="list-style-type: none"> ➤ D3_Gestão de Contratos.pptx <p>Point out RWSN Supervision Guidance in folder.</p>		Belis
15:30 - 15-45	<i>Health Break</i>			
15:45– 16:45	<p>Stage 4 Monitoring and reporting</p> <p>Theory and practice!</p>	<p>Short lecture PPT presentation, followed by questions and answers</p> <ul style="list-style-type: none"> ➤ D3_Gestão de Contratos.pptx 	PPT & overheads	Miguel
16:00-17:00	Monitoring and reporting	Exercise 3.1 – In four groups		Belis
17:00-17:30	Round-up	<p>Facilitated discussion on theory & what could be put into practice on procurement & contract management</p> <p>-</p>		Miguel

DAY 4	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD FACILITATOR
8:30 – 8:45	Icebreaker & register	“If there was one thing that I could change or improve drilling cost-effectiveness in Angola it would be.		Belis Miguel to take notes
8:45 – 9:15	Unit objectives & outline Introduction – define cost and price	<p>Opening – PPT presentation:</p> <ul style="list-style-type: none"> ➤ D4_Custos_e_Precos.pptx ➤ Exercise 4.1: entendimento_comum.docx <ul style="list-style-type: none"> ▪ Define cost and price - Make four groups - participants discuss and define the key terminologies of the topic, written on coloured cards. Randomly ask group members to stand up and explain at the end. 	Overhead projector Exercise in folder	Miguel
9:15 – 10:30	Steps in Borehole Costing: Step 1: Basic cost of running the business	<p>Lecture – PPT presentation</p> <ul style="list-style-type: none"> ➤ D4_Custos_e_Precos.pptx <ul style="list-style-type: none"> ▪ Understanding basic cost of running a drilling business and overheads, followed by exercises. ➤ Exercise 4.2: Loan Repayment.docx <ul style="list-style-type: none"> ▪ Calculation of interest and loan repayment ➤ Exercise 4.3: Depreciacao.docx <ul style="list-style-type: none"> ▪ Calculation of depreciation cost per day and per hour for various categories of equipment <p>Point out the publication <i>Cálculo de Custos e Preço: Guião para Empresas de Furos de Água/ Costing and Pricing A Guide for Water Well drilling enterprises</i></p>	Overhead projector Exercise in folder	Miguel
10:30 – 11:00	Tea break			

DAY 4	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD FACILITATOR
11:00 – 12:30	Step 2: Analyse the tender documents	Lecture – PPT presentation <ul style="list-style-type: none"> ➤ D4_Custos_e_Precos.pptx <ul style="list-style-type: none"> ▪ Basic issues to be considered in tender analysis followed by discussion 	Overhead projector	Miguel
	Step 3: The six cost components of drilling	<ul style="list-style-type: none"> • Exercise 4.4 Elementos de Custo da Perfuracao.docx <ul style="list-style-type: none"> ▪ Cost components of drilling. Participants set out the main stages of borehole drilling on a flip chart and identify the cost components within each stage. 	Four flip chart stands	Belis
	Step 4: Calculating Costs Step 5: Determining the Price	<p>Exercise with direction by trainer</p> <ul style="list-style-type: none"> ➤ Excercise 4.5 mobilizacao_e_desmobilizacao.docx <ul style="list-style-type: none"> ▪ Calculation of mobilisation and demobilisation cost. The facilitator leads participants in the calculation of mobilisation/demobilisation cost using the table below. The participants will fill in the answers into the empty cells in the Amount column ➤ Excercise 4.6 Furos_de_Agua.docx <ul style="list-style-type: none"> ▪ Calculation of Drilling Cost. The facilitator will lead the participants in the calculation of drilling cost using the table below. The participants will fill in the answers into the empty cells in the Amount column. <p>PPT presentation</p> <ul style="list-style-type: none"> ➤ D4_Custos_e_Precos.pptx <ul style="list-style-type: none"> ▪ Other cost components and arriving at the price, followed by discussion 	Notes	Belis
12:15-13:30	<i>Lunch break</i>			

DAY 4	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD FACILITATOR
13:30 – 14:00	Drama Sketch 4 The importance of a realistic engineer's estimate	Drama Group 4 set up and present their sketch, followed by a short discussion		Belis
14:00-15:30	Engineers Estimate	<p>Exercise 4.7 Estimativa.docx</p> <ul style="list-style-type: none"> Four groups to be formed. Each group will prepare an engineer's estimate and a bill of quantities for the drilling of a 10 borehole project in XXXX complete with pump platform but no pump using the following steps: <ul style="list-style-type: none"> a) Determine the geology of XXXX b) Determine possible drilling depth c) Determine the cost components <p>Groups have one hour for the exercise and 5 mins each to present, followed by discussion. Monitor progress to see if they require more time.</p>	Notes	Miguel
15:15 - 15-30	Health break			
15:30 – 16:30	Clarifications	Questions and answers with respect to costing and pricing. This also allows for spill over from the engineers estimate		Belis/Miguel
16:30 – 17:00	Other issues for consideration	➤ D4_Custos_e_Precos.pptx		Belis/Miguel
17:00 – 17:30	Round-up			Belis

DAY 5	TOPIC	TECHNIQUE	EQUIPMENT & MATERIALS	LEAD TRAINER/FACILITATOR
8:30 – 8:45	Icebreaker	Groups on various aspects, smallest to tallest, pass the orange or wink murder or something else appropriate depending on the group		Miguel
8:45 – 9:45	What next for Angola?	Group exercise - flip chart presentation: Re-divide the groups and get them to each present how they could improve borehole procurement and contract management in Angola. Formation of drillers association		Miguel
9:45 – 10:30	Drama Award	The committee are asked to run the nomination and award process for the drama. <ul style="list-style-type: none"> - the best performing actress (who could be a man playing a female role) - the best performing actor (who could be a woman playing a male role) - the best performing group 		Belis
10:30 – 11:00	<i>Tea break</i>			
11:00 – 12:00	Quiz	Quiz sheet handed to all participants, who fill it in, followed by a self-assessment and discussion of the results.		Belis
12:00-12:30	Review of the course	Review of the objectives set by the course, and by the participants themselves. What have you learned?		Miguel
12:30 – 13:00	Course evaluation by participants	Participants fill in evaluation forms		Belis
13:30 – 14:00	Award of certificates and closing speeches			DNA/MINEA
14:00	<i>Late lunch and departure</i>			

Annex 3 Review of the summary report of the preliminary assessment of water well drilling sector in Angola

Introduction

UNICEF commissioned an independent consultant, Pinto Fiel, to carry out a preliminary assessment of the water well drilling sector in Angola. The summary of the report was shared with the facilitators of the workshop and were asked to review and comment on it. The following section provides the review.

Terms of reference

The guiding frame work of the assessment was the RWSN Principles of Cost Effective Boreholes. Specifically the consultancy was to consider the following topics:

- Borehole drilling history: what have been the main borehole drilling programs in Angola in the past 20 years?
- Hydrogeology: what is the potential of the hydrogeology of Angola for domestic water supply; what are the main threats from productive use; agriculture, pollution?
- Functionality: to what extent does borehole drilling quality affect functionality?
- Large drilling Programme: what are the ongoing large drilling programmes in Angola?
- Small Drilling Projects: To what extent are the other funding organizations, institutions, businesses and, individuals investing in boreholes?
- Drilling capacity: who currently drills in Angola? Is there a drillers association
- Design specifications and standards: document the specifications and standards in use
- Program practices: What are the experiences of program practices and what need to be improved
- Driller's experiences: what are the experiences of drilling from drillers perspectives and what needs to be improved?
- Consultants experience: what are the drilling experience from the consultant's perspectives and what needs to be improved?

Methodology

The works was carried by interviews of personnel at the DNA, provincial directorates for water supply (DPEA) in three provinces, Coordinator of the project "Water for all", the National water Resources Institutes (INRH) private sector driller, geology students

Findings

Key findings of the study are as follows:

Institutional Issues

- The National Directorate for Water (DNA) is responsible for developing policies and strategies for water supply and sanitation in urban areas.
- Provincial Directorates for Energy and Water (DPEAs) do not have technical and procedural autonomy
- There is no clear differentiation of mandates between DNA and the National Water Resources Institutes(INRH)

- There is no database of drilling companies or any regulation requiring the certification of drilling company
- There is no association of drillers

Standards and guidelines

- There are no technical guidelines or defined or national standards for drilling. In most cases, the projects are not preceded by hydrogeological or geophysical studies
- The criteria for negative boreholes are not defined. In some cases the contractor gets paid 50% of the overall bill or compensates for the negative hole by making a second or third hole
- On projects executed by DNA, the requirement to carry out water quality analysis is not enforced as in the terms of reference and the Water Law
- There is no guarantee that drilling is according to the borehole design in the contract
- There is no central hydrogeological database
- There is no mechanism for monitoring of water facility functionality

Technical Capacity

- DNA has only one hydrogeologist
- DPEAs have very few specialists as a result ,there is very little supervision of drilling
- Almost all the drilling companies do not have geologist or hydrogeologists on their staff
- The average age of a driller is 50 Years. There is no infusion of fresh entrants into the profession
- Hydrogeological studies were not incorporated into the ‘Water for all’ project involving the drilling of 3000 boreholes. Neither DNA nor the universities were consulted in the planning or implementation of the project. No plan was made for post construction monitoring of the boreholes.

Comments

As a preliminary assessment the summary report has succinctly identified some of the challenges in the drilling sector in Angola. It corroborates the outcome of the discussion at the workshop. It does not discuss the hydrogeology of the country and borehole functionality as in the TOR and the history of drilling is rather scanty. These may be contained in the main report (currently available in Portuguese only).

The findings of the study need to be made known to a wider audience of stakeholders to develop an action plan to address the issues. Before developing the action plan a more detailed study is required. The study should unravel the history of drilling in Angola since colonial times to be able to understand the evolution of the present situation and determine the way forward. The study should also assess the drilling capacity in the country, the number of drilling companies, the state of their equipment and experience and skills of the personnel. The study should look at the factors that affect the pricing of boreholes, why the price is so high and so variable.

The study should then lead to an action plan involving the development of statutory instruments for the regulation of groundwater abstraction and a strategy to increase the rural water supply coverage.

Annex 4 Comments by the participants on the course

1. *"The course was very useful. Thank you UNICEF for selecting the Facilitators - they are really professionals with a lot of experience. They managed to respond to most of questions raised by the participants. It would be good that private sector was more involved for practice particularly in the drilling process. In the future in such kind of events the organizers should provide transport for the participants. The food was good."*;
2. *"Facilitators knew about the subjects presented and discussed along the week; there is a need for more practice – next training should include the same participants and the same facilitators, food was good;*
3. *More practice during the course"*;
4. *"As a student the course was good – the course was very informative". I am encouraged to work in WASH Sector in near future"*;
5. *"The level of discussion of participants increased day by day specially for the students; there is a need to strengthen the network starting with the participants of the training - the course was an initial platform to strengthen the network among the participants. The students integration during the course was encouraging. Facilitators from different countries helped a lot to better understand what is happening in terms of hydrogeology, how to drill boreholes and other subjects in Angola, Mozambique, Nigeria, Spain and other countries. DPAs (Provincial Department of Water) should continue with this kind of courses involving more students.;"*
6. *"The course was very helpful – before the course I did know anything about hydrogeology, however after 2 days I got a lot of information and better understanding about the subject*
7. *"I am very happy for the opportunity to attend the course. Everything I learned is so useful – I will use it for my thesis. Food was good. It is needed to allocate transport for the participants"*;
8. *"I learned too much from the facilitators on how to drill a borehole – I will share what I learned"*
9. *"I will share and replicate what I learned during the course. I learned a lot – now I know the differences between a borehole and well. I understood about the importance of transparency and procurement process in WASH Sector"*;
10. *"I gained lot of experience in terms hydrogeology, procurement and how to drill boreholes"*;
11. *"Because there was no opportunity for practice it is necessary to have more videos in Portuguese about what was learned. In future I would like to proceed to MSc in hydrogeology. I am able to assist my relatives and friends on how to construct boreholes in Huila Province"*;
12. *"As a driller I learned that it is a big responsibility to drill boreholes because water is life"*;
13. *"For me after a lot of practices in my work station the theory provided during the course was very helpful"*
14. *I learned a lot in terms of water quality – personally I suffered a lot for consuming unsafe water. I am interested to work in WASH Sector. Methodology used by the facilitators was very useful. Drama and videos were very useful to better understand the subjects. The course was very interesting.*
15. *"Course was very helpful. Teaching methodologies used by the facilitators were very dynamic and interactive;*
16. *"Thank you Unicef for organizing the course – it was very interactive – facilitators were able to interact with participants. In future it is needed to emphasize on proposal writing. This is the area were the private sector faces more difficulties.*
17. *I learned a lot during the course however I will need more practice;*
18. *"Course was very helpful – I did not know about drilling. People from different countries brought together several experiences and context;"*

19. *"I learned a lot with facilitators and other participants – the time allocated for the course was short. I gained more interest in WASH Sector".*
20. *"I am able to supervise the construction of boreholes"*
21. *"The course is complementing what we learned during our studies – the course was a good refreshment and it opened door for new opportunities"*
22. *I learned a lot during the course. I would like to join WASH Sector to apply what I learned;*
23. *"What I learned was so useful – I used to write contracts without any knowledge, but now I gained a lot of materials. The facilitators were very professional – the participants in 2-3 days were able to better understand WASH issues;*
24. *"I learned a lot – drama was very important. The course was dynamic with dram... The topics were linked to sanitation – I will use the knowledge to work on my thesis that is related to sanitation and infant development. It was a great opportunity to interact with WASH professionals;*
25. *"I like the course. I learned a lot about WASH. It was good to bring facilitators from outside of Angola. It was an opportunity to interact with WASH Professionals;*
26. *"The training helped to fill gaps regarding WASH that even WASH Professionals faced. Contract management was very helpful.*
27. *"Course was good – very dynamic and interactive. It's need more practice. In future "Cela Group" (drilling company) is available to support in terms of practice with equipment available.*