



# PROFESSIONALIZING THE MANUAL DRILLING SECTOR IN AFRICA

A GUIDE TO BUILDING CAPACITY  
TO INCREASE ACCESS TO SAFE  
WATER IN RURAL AREAS





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# FOREWORD

## ABOUT THE TOOL KIT FOR PROFESSIONALIZING MANUAL DRILLING IN AFRICA

UNICEF, Practica and Enterprise Works/VITA, a division of Relief International, have developed a toolkit for African countries wishing to embark on the professionalization of manual drilling. This toolkit includes Technical Notes, Technical Manuals, Advocacy Materials, Mapping of suitable areas for manual drilling, Case Studies, and Implementation and Training Manuals. This initiative builds the capacity of the local private sector in order to respond to the ever increasing demand for safe water in rural areas.

This manual is a part of this larger set of tools that contribute essential information on how to professionalize manual drilling in Africa. The complete set of materials includes:

- Mapping the Potential for Manual Drilling in Africa (12 countries in Africa):
  - Chad, Madagascar, Niger, Sierra Leone, Central African Republic, Mauritania, Togo, Senegal, Benin, Ivory Coast, Liberia, Mali
- Technical Notes:
  - The Case for Manual Drilling in Africa
  - Professionalizing Manual Drilling in Africa
  - Selection of Well Construction Methods
  - Manual Drilling Techniques
  - Mapping the potential for manual drilling
- Case Studies:
  - Niger - Sustainable Transfer of Manual Well Drilling to the Private Sector in Niger
  - Chad - The Impact of Manual Drilling for the Construction of Sustainable Water Points in Chad
- Videos:
  - Advocacy for Manual Drilling in Africa – Highlights (3-min)
  - Professionalizing Manual Drilling Sector in Africa (12-min)
  - How to Professionalize the Manual Drilling Sector in Africa (16-min)

- Manuals:
  - Professionalizing the Manual Drilling Sector in Africa (this manual)
  - Understanding Groundwater and Wells in Manual Drilling
  - Desk Study: Inventory of Manual Well Drilling Techniques (Rota-sludge, Augering, Jetting and Manual Percussion)
  - Improving Skills of Manual Drilling Enterprises: Business Management
  - Financing Options for Low-Cost Well Drillers and Communities for Rural Water Supply

Successful manual drilling operations that deliver sustainable water supplies to communities and support viable local micro, small, and medium manual drilling entrepreneurs and enterprises must consider technical, management, and financing issues to be successful. The reader is therefore encouraged to review the entire range of resource materials listed above, keeping in mind that the materials have been developed as a set.

# INTRODUCTION

The purpose of this manual is to assist UNICEF Country Offices and others interested in promoting the emergence of a professional manual drilling sector in their country of operation. The manual provides a step-by-step methodology, based on experiences in Niger, Chad and Senegal, for the promotion of a local professional manual drilling sector. Drawing on these experiences and using the expertise available in the partnership, programs can be tailored to the needs and the means of different country programs.

It is critical to understand from the beginning that this document aims at defining a Capacity Building Process and does not describe a borehole drilling program. The ultimate goal is to have an alternative option for providing sustainable water points. In order to do this it is important to create a sustainable professional manual drilling sector that will be able to respond to demand from donors, communities, and individuals in the future. During the capacity building process boreholes will be installed but the priority will be on training and quality assurance. In some cases this will require that long term goals will take priority over short term goals of installing the maximum number of boreholes. Depending on the existing capacity in the country, it will take 3-5 years to develop a professional manual drilling sector that will be able to respond effectively to tenders.

Experience has shown that it is important to match the capacity of the sector to the anticipated demand while providing a means to increase the sector capacity as demand increases. It makes sense that a business that is installing 50 boreholes a year will gain experience more quickly and do a better job than an enterprise that is only installing 10 boreholes per year. Initially it is better to start with a fewer number of enterprises and then gradually increase their numbers as demand increases. Additional enterprises should be selected because there will always be businesses that either withdraw or are removed from the capacity building program, due to lack of interest or non-compliance. The idea is to have competition to ensure quality and to maintain reasonable price levels while ensuring that the enterprises are actively involved in manual drilling on a regular basis.

It is important to recognize that any private sector initiative is driven by profit and manual drilling enterprises are no exception. In order for these businesses to be sustainable and to grow to meet increasing demand they need to earn a reasonable profit. Due to much lower capital investment and lower operating costs these enterprises will be able to install wells at a sig-

nificantly lower cost than companies relying on large drilling rigs. The final product whether drilled manually or by machine is the same, so the cost savings come from lower overhead and operating costs of the manual drilling enterprises. Competition will over time result in the optimum price for boreholes, but initially the emerging businesses should be encouraged to invest in growth by ensuring that they receive adequate profit margins.

This manual provides a step-by-step guide for developing a professional manual drilling sector but it is not a cookbook. It provides an overview of the steps and it will indicate when experienced practitioners should be consulted to provide in-depth support as the program moves forward. Every country will have its unique set of conditions and challenges that will require experience to resolve and keep the program moving forward.

The goal of the program outlined in this manual is to dramatically increase the number of safe water points that are installed annually in Africa, without huge increases in investments. This manual provides a guide for realizing this dramatic increase, by building the capacity of the manual drilling sector. This is not the process to follow for the installation of a handful of wells. As mentioned earlier, this program will require a commitment for at least 3-5 years, which may exceed the planning horizon of some country programs. This is a critical issue because once the program is initiated and well drillers are equipped and given the initial training, it will be difficult to turn back, especially if there is profit to be made through drilling. Experience from other countries has shown that unregulated, inadequately trained, unprofessional well drillers have installed poor quality wells that adversely affect the environment and give a bad reputation to manual drilling in general. Once a country feels that manual drilling poses a risk to health or the environment it becomes much more difficult to convince the decision makers that professional manual drilling is a viable complement to other rural water supply options.

In addition to this manual there are other resources that are available to help country programs with training and promotion (see foreword page and annex 4).



# 1. RURAL WATER SUPPLY SECTOR ASSESSMENT

A detailed assessment of the current situation in the country is a critical step in planning a program to professionalize the manual drilling sector. The following steps are important in deciding if the conditions in a country favor the promotion of manual drilling, and if so, it then provides guidance on the steps that will be needed to develop a professional manual drilling sector.

## 1.1 Preliminary Assessment

It is assumed that a significant potential for manual drilling to improve access to safe water in rural areas has been demonstrated, either through the UNICEF Mapping of the Potential for Manual Drilling in Africa or another program.

It is critical to point out here that manual drilling is not a panacea, it is feasible under certain hydro-geological conditions, but it is not practical everywhere. Moreover, in order for a manual drilling sector to emerge there will need to be a substantial market for manual drilling in the given country. The large scale mapping should provide an indication of the potential for manual drilling based on geology and depth to the water table. This should be cross referenced with the population in the favorable zones to give an idea of the number of people that could benefit from manually drilled wells. The information can also be cross referenced with the present level of drinking water coverage in these areas in order to define priorities.

It will be important to identify the key actors in the rural water supply sector and to understand their capabilities and their limitations. In addition, it will be critical to understand how they view manual drilling and to seek ways to gain their support or counter their resistance. The following parts of the assessment should be done concurrently in order to move the process forward in a timely manner.

## 1.2 Detailed In Country Mapping

While the general mapping based on analysis of existing data will provide an indication of the potential for manual drilling it may not be detailed enough to provide a true picture. In many countries data available are not detailed enough (in terms of scale and thematic coverage) to allow an accurate assessment without in-depth field investigations. The spatial distribution of suitable manual drilling locations

may depend on the weathering of the parent material and be found in pockets of alluvial deposits located in geologically unsuitable areas.

The detailed mapping will need to use all of the local resources available including:

- Local hydrogeology experts
- Interviews and discussion with the population
- Detailed data regarding existing water points, both from existing information as well as direct field observation
- Topographical maps
- Existing well logs
- Field surveys
- Geological maps
- Satellite images
- Shuttle Radar Topography Information

The information is correlated and cross linked to provide overlays of suitable geology and static water table depth, plus other layers of information where it is considered suitable.

Geological and geomorphological information are essential to define geological suitability. Equally important is the available data regarding static water level in the wells. This data is essential to define the expected depth of the water table

In general manual drilling is considered feasible in unconsolidated alluvial formations (sand, silt and clay) with interspersed layers of soft sedimentary rock or laterite. Igneous formations such as granite and basalt are too time-consuming to penetrate using manual methods. Depending on the nature of the formations and the depth to the water table manual drilling is generally considered feasible for depths up to 40 meters but depths of 60 meters are not uncommon under favorable conditions. A rule of thumb is that if a hand dug well is feasible without the use of a jack hammer or dynamite then manual drilling will be feasible, provided that a good (sand or gravel) aquifer can be found. In cases where the aquifer is clay or silt, large diameter hand dug wells are a better option, as water inflow will be higher.

Once the areas that are feasible for manual drilling have been delineated then these maps need to be

cross referenced with the un-served population to see the potential market for manually drilled wells and the corresponding potential impact. As an initial estimate it could be assumed that there is a need for one well for every 250 people in the favorable zones. This estimate should reflect the national policy guidelines that may dictate either higher or lower levels of coverage. Using the national target for people per water point, this figure would need to be adjusted based on the spatial distribution of the population (many small dispersed

## Steps to Professionalize the Manual Drilling Sector

### Rural Water Supply Sector Assessment

- Favorable hydrogeological conditions for manual drilling
- Substantial market for manually drilled wells
- Dynamic private sector to support manual drilling enterprises
- National policy open to manual drilling



### Selection of Drilling Enterprises

- Identify experienced well drillers or well diggers
- Mechanical well drillers interested in expanding into manual drilling
- Businesses in related field



### Training of Drilling Enterprises

- Well Drilling Techniques
- Hydrogeology for manual drilling
- Business management and Tendering
- Supervised practical field experience



### Training of Supporting Businesses

- Quality control firms
- Social mobilization trainers
- Well drilling tool makers
- Pump installers and repairers



### Certification Drilling Enterprises

- Nationally recognized certification
- Branding and promotion of certified drillers
- Use of certified drillers by other organizations

communities would require more water points) and the alternative water sources (abundant alternative sources of water would reduce the demand for manually drilled wells). These adjusted estimates would provide an idea of the potential market for manually drilled wells and would give an idea of the drilling capacity needed if financing was not an issue.

In addition to the market for community wells, there will be a market for private wells that will be more difficult to assess. The size of this market will depend on variety of social and economic factors including disposable income, tradition of private water supply, tradition of using ground water, and the existing well digging or drilling capacity in the country.

Initially the capacity required will depend predominantly on the funding available to invest in manually drilled wells from UNICEF, the government and other donors.

## 1.3 National Policy

It is critical that the government is involved from the early stages and that the decision makers are on-board with the idea of using local manual drillers as one of the tools to increase access to safe water for the rural population. It should be stressed that the target is rural areas, not densely populated urban areas. Manual drilling should be presented as another tool in the fight to increase access to safe water in order to achieve the MDGs. Other techniques are better suited in certain situations, but where manual drilling is feasible it should be considered. It also needs to be stressed that the goal of professionalizing the manual well drilling sector is to ensure that the local capacity exists to provide high quality boreholes. These boreholes will be of the same standard and quality as mechanically drilled boreholes, but at a cost of 20% or less of the prevailing costs for a machine drilled well.

The reaction of the government will depend greatly on the in-country experience with manual drilling. If there is a history of poor quality wells and polluted aquifers, the need for professionalizing the sector may be evident, but the government will want reassurance that a quality control and certification mechanism will be put into place. If there is limited experience with manual drilling the government may be skeptical that it will be effective. There may also be the feeling that this is not a state-of-the-art technology and that it is somehow inferior to what is used in other countries. It is important to emphasize that the end result is the same as a machine drilled well and that it has the additional advantages of creating local employment and developing local businesses.

In addition to general impressions based on experience there is always a certain amount of inertia, which maintains the status quo. Governments are often reluctant to try something new when there is a well established procedure for the current way of doing things. It is important to show the government that there are clear advantages to manual drilling over other techniques such as machine drilled boreholes or cement lined wells. The use of promotional materials, rapid assessments on water quality and perhaps visits to countries where manual drilling has been accepted are ways to get the key decision makers on-board.

## 1.4 Technical Standards for manually drilled wells

One of the key activities that UNICEF can initiate is a dialogue on the collaborative development of a set of technical standards for manually drilled wells. Although, the standards for machine drilled boreholes in some countries are excessively strict for wells that are less than 50 meters deep and destined to be used with a hand pump, these standards should be used as the starting point for discussions. The goal is to ensure that manually drilled wells meet the same quality standards as machine drilled wells. This will go a long way toward alleviating the government's concerns relating to borehole quality.

Providing funds for key government officials to attend conferences where manually drilling is being promoted or study visits to countries where manual drilling has become part of the mainstream may help to overcome their reservations. As Ada Issoufou, Departmental Director for Water in Matamey, Niger said "At first we were reluctant to use low cost manually drilled wells but after 3 years of testing and 58 wells installed, the results are excellent. The people really appreciate this technology and I would encourage my colleagues in Africa to try it in their countries."

In Chad the government has adopted well standards for manually drilled wells and has included them as part of the national rural water supply policy.

## 1.5 Other Actors in the Rural Water Sector

The actions of other organizations working in the rural water sector can have a significant impact on the development of a professional manual well drilling sector. It will be important to sensitize the entire sector to increase the understanding of the role of manual drilling so that conflicts can be minimized. Initially some of the players may feel threatened by the introduction of a lower cost technique and there may be

established relationships that are threatened. It will be essential to identify concerns and work to find solutions so that conflicting interests can be managed. For example, one government official expressed the concern that if manual drilling becomes widely used then his district where water is only found in the bedrock would not get any assistance. It is important to ensure that everyone understands that manual drilling complements mechanized drilling and other water source development efforts.

### 1.5.1 Non-Governmental Organizations (NGOs)

It is not unusual for an NGO with a rural water supply project to become involved directly with drilling, using either manual or mechanized techniques. Depending on the size of the program they could be in direct competition with the private sector drillers. There are many examples of NGOs closing their operations in a country and taking the expertise with them when they leave. Often NGOs cite the cost of boreholes as the reason that they want to do the drilling themselves or the lack of a quality control mechanism. However, NGOs have tax advantages that private businesses do not and much of their overhead costs are not supported by the drilling. It would be hoped that as the manual drilling sector becomes more professional with quality control mechanisms in place and the costs come down, that NGOs could be encouraged to use the certified professional drillers, rather than to compete with them. This will require lobbying and education of the NGOs to convince them that the long term development goals for rural water supply are better served by a vibrant local manual drilling sector than by external projects.

It will be critical to identify the key actors in rural water supply and begin dialogue with them early, to learn of their concerns and their impressions of manual drilling. The more support for the development of a professional manual drilling sector the easier it will be to ensure consistent approaches that do not compromise the emerging enterprises.

### 1.5.2 Donors

Donors have their own criteria and standards and UNICEF will need to work with them to raise their awareness of manually drilled wells. The most important criteria for most donors will be the formalization of the manual drilling enterprises and their ability to respond to tenders. If donors wish to use manual drilling enterprises, where it is feasible, they will have to separate their tenders by zones. It is not uncommon to find tenders that specify the requirement for equipment based on the worst case scenario for the given lot of boreholes. Thus a donor might require the enterprise



Drilling Tools

to have a large mechanized rig capable of drilling to 200 meters, even when the majority of the wells will be less than 40 meters in unconsolidated soils. In some countries, although the donors have not made the distinction, the drilling companies have, and they sub-contract wells to small manual drilling enterprises in areas where it is feasible. In the cases where this occurs the donors and governments are already satisfied with the quality of manually drilled wells but they might be paying too much for them.

A significant risk that will need to be managed is that large donors may seek to contract manual drilling enterprises before they have the capacity to respond. This could not only damage the image of manual drilling, but it could also destroy the emerging enterprises if they take on more than they can handle.

As with all other actors in the rural water supply sector, maintaining open communication and dialogue will go a long way to mitigating some of these problems. UNICEF is well placed to maintain dialogue with NGOs, Donors, Governments and the Private Sector and this will be a critical role.

### 1.5.3 Machine Drillers

In some countries machine drillers are particularly aware of manual drilling enterprises and will even sub-contract drilling work to them. This may be without the knowledge of the funding agency and occurs when manually drilled wells are feasible. Currently in most countries the manual drillers remain in the informal sector and are not eligible to bid on tenders for larger drilling contracts, instead they work for individuals and farmers.

The machine drillers may view the professionalization of manual drilling as direct competition with them. Certainly a lower cost option will encourage them to reduce costs of machine drilled wells. Bringing manual well drillers into the mainstream will enable them to receive a fair return on their labor. In some cases machine drillers may wish to add manual drilling teams

to the services that they offer. Because it is easier to start-up a manual drilling business there will be more competition possible and this will help to establish a fair market price for the wells.

Machine drillers may constitute a very strong lobby that will oppose the acceptance of manual drilling, because for many years they have had a monopoly on the provision of wells. Machine drilling companies may also be well known and respected by the government and the donors, giving them considerable influence with decision makers. It will be important to understand where there is overlap between manual drilling and machine drilling because this is where conflicts over market share may arise. If manual drilling is mainly feasible in remote or inaccessible places (i.e. steep valleys with no road access) then there will be little reason for a dispute. However, if manual drilling begins to erode markets that have been traditionally the domain of machine drillers then conflict is more likely to arise.

There will always be areas where manual drilling is simply not feasible due to the depth to the water table or the nature of the overburden. These areas will require machine drilling and will remain the market for the machine drillers.

The assessment will need to identify the number of enterprises that are doing machine drilling and their capacity (types of rigs, number of wells they can drill per year, depth of wells drilled, where they are working, etc.)

### 1.5.4 Well Diggers

Manual drilling will likely be in direct conflict with well diggers who construct concrete lined wells for village water supply. In most places where a well can be dug by hand, a manually drilled borehole can be installed. There are exceptions to this, for example, where wells have been dug 70-100 meters deep by hand or where the yield is very low.

In some cases well diggers may wish to be trained to drill wells and their knowledge of the geology in their region will certainly be beneficial to their work as drillers.

Well diggers range from informal sector businesses providing a service in a small geographic area to large companies that respond to tenders from donors and operate country-wide.

The assessment will need to identify the number of enterprises that are digging wells and their capacity (number of wells they can dig per year, depth of wells dug and where they are working, etc.)

### 1.5.5 Manual Drillers

Manual drilling has been used in many countries, although there are only a few cases in Africa where it has become widely practiced. Often an NGO, a government ministry or an individual wishing to have a water point has used manual drilling as a means to that end. Perhaps only a few wells were drilled in a limited geographical area. The methods may have been effective, but no one had the time or the resources to do much promotion beyond the immediate area. Generally all traces of these interventions disappear unless there is some written record, like a published manual or report.

Perhaps an outside agency, such as an NGO, developed manual drilling in order to implement a program; this scenario has also been repeated around the world. Usually the agency is the driving force, owning the tools, employing the well drillers, selecting the sites, sourcing the materials and providing the funding. Under this scenario, the activities continue until the funding ends or until the employees, because of the physical conditions needed, are not able to drill wells by hand. Since no one relies on this activity for their livelihood, there is little incentive to expand and frequently no incentive for the beneficiary to invest in their own water supply. If the activity continues for a long enough period, there are likely to be private sector spin-offs, as have been seen in Niger, Chad and Nigeria.

This program uses an approach that has been much less common in the context of development programs and that is the complete integration of the private sector. This can occur when the goal is the sustainable transfer of technology, not the installation of a certain number of wells or pumps. Its success is dependent on building the private sector's capacity and professionalism by providing the tools (both technical and managerial) and the knowledge to respond to demand. It requires resources and time that many donors have not been willing to make available until now. The program is designed to provide the necessary training and follow-up over a period of years.

It will be important to look carefully at the history of manual drilling in the specific country and to identify areas where manual drilling was used in the past. Are there still manual drillers actively working? What techniques are they using? What will be the best way to contact others in the sector (radio, newspaper, etc.)? Are the wells used for drinking water, livestock or irrigation? It is very important at this stage is to understand the perception of manual drilling at all levels (government, consumer, etc.). It will also be important to assess the quality of the existing installations, bearing in mind the intended use.

If manual drilling businesses exist they may provide a foundation on which to build a professional manual drilling sector. The key question will be if these informal sector businesses can be transformed into formal sector professional businesses that can respond to tenders and provide professional services.

### 1.5.6 Social Mobilization Organizations

One of the keys to a successful well drilling and hand pump program is the creation of sustainable community management for the water point. While most programs pay lip service to this point, very few invest the time and money into the community level capacity building to ensure that Water User Associations (WUAs) have the skills necessary to manage their water point. This requires ongoing training beyond the 5 days generally allocated to sensitization, explanation of roles and responsibilities, record keeping, and operation and maintenance. Committees need support over time to resolve conflicts as they arise, deal with major maintenance and eventually pump replacement.

Part of the assessment will be to identify organizations with a track record of supporting community management of water points over a period of years. The idea would be to look at contracts that are performance based with payments linked to the functionality of the water point and the level of community management.

### 1.5.7 Pump Suppliers, Manufacturers and Repairers

It is futile to professionalize the manual drilling sector if the problem of getting water out of the well is not addressed at the same time. The assessment must take a careful look at the supply chains for pumps that are commonly in use. Are spare parts readily available in rural areas? Are complete pumps available locally? Are there qualified pump mechanics that can repair pumps?

In addition to the supply chain for imported pumps another consideration is the availability of locally made pumps. This will be especially important for small communities and for self-supply where investment costs must be kept low. It would not be unreasonable to consider a two-tiered system in which donor funded wells are equipped with imported pumps and self-supply wells would have the option of a locally made pump.

One consideration for UNICEF is to work with local pump suppliers to purchase pumps. This can help to reinforce the local supply chain. When local dealers are cut out of the initial purchase of pumps there is little incentive for them to stock spare parts which maybe slow moving and provide relatively little profit per unit

sold. Often the big profit is realized on the initial purchase of the pump.

### 1.5.8 Quality Control Firms

Quality control is a critical part of any tendering process. In order for manual drilling to be considered on a par with machine drilling, similar quality control practices must be used. It will be important to identify the consulting firms or other institutions that are doing quality control for mechanized drilling contracts and determine if they would be interested in providing supervision for manual drilling. Part of the capacity building to professionalize the manual drilling sector depends upon mentoring. Quality control enterprises, after specialized training, will be well placed to provide the necessary supervision and initial mentoring of the well drillers while they are upgrading their skills. From the experiences from Niger and Chad it has been seen that this is an essential component to ensure an independent professional private sector. In Niger, EWW, an NGO, provided quality control, which was effective for the wells that they supervised and for as long as they were in the country. In Chad for many years, only the manually drilled wells done under subcontracts for larger drilling companies working on large donor programs were subject to formal quality control. For the rest, there was limited supervision of the private drillers who drilled numerous wells, of variable quality.

## 1.6 Expression of Interest

Fairly early in the assessment phase, once the key factors have been identified, expressions of interest should be sought from businesses involved in manual drilling, social mobilization, and quality control. These expressions of interest should seek businesses that have a proven track record in the related areas. Examples of the expression of interest announcements are given in Appendix 2a.

## 1.7 Results of the Sector Assessment

The assessment will provide an analysis of the rural water sector and a summary of the roles of the various actors and how their interests relate to manual drilling.

The information obtained during the assessment will inform the development of social marketing instruments tailored to the different interest groups. It will be necessary to raise the awareness of the government, donors and other key players in the sector as to how they can benefit from the creation of a strong manual well drilling sector.

The assessment will also provide the data for the initial recruitment well drilling enterprises, quality control firms and social mobilization organizations. The initial lists will be used to assess the viability of the different enterprises to participate in the program.

## 2. MANUAL DRILLING ENTERPRISE SELECTION

### 2.1 Does manual drilling exist?

This is one of the first questions that would have been answered during the initial assessment. If there are few or no manually drilling enterprises in the country then the process begins in Section 2.3 below.

### 2.2 Initial Selection –Manually Drilling Exists

From the list of manual well drilling companies obtained during the assessment the most promising should be requested to submit supporting documentation including:

- Bank statements
- Company registration
- Diplomas of the owner/manager

- List of wells drilled with well logs and location, date of installation and client contact information for references

The exact criteria for selecting manual drilling enterprises will be determined by prevalence of manual drilling in the country. Ideally for a business to be included in the capacity building program they would have:

- At least 5 years experience manually drilling wells
- Formal registration as a company or the willingness to register
- Necessary drilling and well development equipment or willing to invest in the well development equipment
- Necessary support equipment including cell phone and means of transportation

- A bank account or willingness to open one
- A literate and numerate owner or manager
- Qualified well drillers with 3 or more years of experience

It is likely that in most countries it will be difficult to find businesses with all of these criteria, but if there are enough businesses with most of them, the capacity building program can be designed to fill in the gaps.

## 2.3 Initial Selection –Manually Drilling Does Not Exist

In the event that manual drilling is not common or the level of business expertise in well drilling enterprises is not sufficient, alternatives should be considered. These would include looking to businesses that are involved in activities related to rural water supply. It will be easier to teach the technical skills needed to drill a well, rather than to create an entrepreneur. Criteria to consider for these secondary choices are:

- At least 5 years in related business such as: well diggers, pump installers or repairers, machine well drillers, or pump manufacturers.
- Formal registration as a company or the willingness to register
- A bank account or willingness to open one
- A literate and numerate owner or manager

## 2.4 Final Selection

The final selection of the businesses to be included in the training program will be based on visits to the business to verify their capacity in terms of equipment and staff. As well as visits to completed installations

and interviews with former clients for references.

Business documentation including tax receipts, bank accounts, company registration and accounting records will be examined.

The number of business to be selected for the initial training will be based on the anticipated demand from UNICEF and other partners who have expressed an interest in using manual well drillers. Under average drilling conditions a drilling enterprise with one team of drillers could be expected to drill 50 to 100 drinking water wells per year. It is normal in any capacity building program for a certain percentage of participants to drop out or to be asked to withdraw due to non-compliance with the terms of the training agreement. Initial recruitment of 20% more enterprises than needed, will ensure that an adequate number of businesses will complete the training program and become certified. For example, if UNICEF and other partners anticipate adequate funding for a total of 1,000 wells per year for the next three years, then it would make sense to train between 15 and 25 well drilling enterprises.

## 2.5 Mechanized Drillers

One source of qualified businesses to train for manual drilling would be existing mechanized drillers because they would likely have both the necessary business skills and the experience. However, it would be in the best interest of the sector not to work only with existing mechanized drillers, because of the benefits of decentralizing the drilling sector. As part of a professional manual drilling sector they could strengthen it significantly and provide subcontracts to smaller operators. Including mechanized drillers in the training program will depend on their interest in adding manual drilling to their capacity and their perception of manual drilling as complementary or competitive.

# 3. TRAINING FOR DRILLING ENTERPRISES

Once the businesses have been identified a training needs assessment should be conducted to determine the gaps in their understanding. Experience has shown that generally a combination of practical training on drilling techniques combined with theoretical geo-hydrology and business training will be needed. Experienced drillers will be able to understand the applicability of the geo-hydrology training and can be offered this training before upgrading their practical drilling techniques. However for enterprises that have never drilled wells before, the first step will be to teach them to use the equipment to drill holes in the ground.

Once they are familiar with the tools and the basic drilling operation they will be better able to appreciate the theoretical training and better able to apply the lessons learned when they return to the field.

The manual for the hydro-geology training, Understanding Groundwater and Wells in Manual Drilling is available and should be used as a training guide and a reference manual for the well drillers. This manual only deals with the essential subjects which are relevant to manual drilling and well installation in practice, in simple and understandable language and is designed to be used in classroom sessions in combination with



*Drillers Training in Ziguinchor*

practical training in the field. It is an instruction and reference manual for manual drilling teams on hydrogeology for well drilling, well installation and well development. It provides the best practices for well siting, well drilling, aquifer protection (hygiene) and practical hydrogeology as they relate to manual drilling.

As part of the program to professionalize manual drilling in Africa practical training manuals are being developed for four manual drilling methods. One that describes Rota-Sludge drilling is already available and the others dealing with the three other manual drilling techniques (Augering, Manual Percussion, and Jetting) will be available by middle of 2010. These manuals are designed to be used during practical training and to provide a reference for the well drillers. They make extensive use of illustrations in order to provide a reference for semi-literate well drillers. In addition, the manuals provide technical drawings for the local fabrication of the drilling tools needed for each technique.

Although these manuals provide references for the trainers and trainees, it is strongly recommended that the initial training is conducted by an experienced

trainer. During the first training the experienced trainer can train a local trainer while training the enterprises. Ideally the second training would be conducted by the local trainer with the experienced trainer providing further instructional support.

Often entrepreneurs do not feel that they need business skills training. For this reason the training must be designed to address perceived needs that currently prevent the businesses from accessing new or larger markets. Informal sector businesses are prohibited from bidding on tenders because they are not registered. It will be important for the business training to assist the drillers to become registered and to maintain the records that they will need to respond to tenders. The tendering process is one that most small drilling enterprises have not experienced and the business training will address the tendering process. In addition, as part of the capacity building program the enterprises will have the opportunity to conduct a practice tendering exercise, that will involve preparing an actual tender application.

In most countries there are organizations that are specialized in providing training to Small and Medium Enterprises (SMEs). Ideally one of these organizations with the knowledge of the local laws and regulations would be contracted to provide training and follow-up for the businesses over a period of 6-12 months. A business training manual that has been tailored for the needs of manual drilling enterprises is available as part of this program. It was prepared as part of the series of documents to support the professionalization of manual drilling in Africa. Although the manual provides the basic business training modules, it will need to be tailored to reflect local laws and regulations.

## 4. MANUAL DRILLING SUPPORT ORGANIZATIONS

In addition to building the capacity of manual drilling enterprises, it is important to ensure that all of the supporting organizations (consulting firms, NGOs, businesses, government bodies, etc.) have the capacity to fulfill their roles. This includes trainers (business and hydro-geology), workshops to make the drilling tools, quality control firms, social mobilization organizations, social marketing/marketing companies and financial institutions. It is not a question of creating these supporting businesses, but providing them with specialized training to ensure that they have the skills needed to support the growth of the manual drilling sector.

### 4.1 Drilling Equipment Manufacturers

Depending on the level of development of the manual drilling sector in the country it may also be necessary to train workshops to make the drilling tools. Technical drawings for the tools are provided in the technical manuals for each drilling technique. Although the tools do not require specialized skills beyond those found in good welding shops, they do require a level of precision especially at the connections to ensure that the tools are interchangeable.



## TRAINING OPTIONS FOR DRILLERS



Workshops selected to be trained to make well drilling equipment should:

- Have been in business 3-5 years making good quality products
- Be able to read and understand technical drawings
- Understand of the need for precision manufacturing and the use of jigs
- Be interested in making well drilling tools
- Have an adequate capacity to make tools rapidly and well

For jetting and for rota-sludge the specialized threaded couplings require a skilled lathe operator, ideally with a CNC lathe, to make them in large quantities and to ensure that they are interchangeable. If this is not possible, the next best option is to make couplings from black steel pipe with a 5 mm wall thickness using standard pipe threads on them. With this solution the threads are finer and they are more difficult to keep clean and to use. It is not advisable to use standard pipe couplings because they are not strong enough and they are likely to fail during drilling.

Once again it is recommended that a trainer be used to train the welding shops to make the tools. Having one or two manufacturers of the tools in the country facilitates the replacement of tools that may be lost or damaged. It is important that the well drillers are able to keep drilling long after the capacity building program ends.

## 4.2 Quality Control

In countries where manual drilling has evolved there has generally not been the emergence of a parallel quality control mechanism. This is primarily due to the informal nature of the sector where the manual drillers work directly for individual clients. The results in many cases have been the installation of poor quality wells that do not perform as well or as long as they should. To ensure the development of a professional manual drilling sector a parallel quality control structure must be supported. Currently there are consulting firms that are contracted by donors to control the quality of well installation

for mechanized drilling programs. These firms should be encouraged to work with manual drillers under similar contractual arrangements. Although, the contracting arrangement will be similar, initially these firms should also play a mentoring role to support the capacity building nature of the program. These firms have educated staff members who understand the necessary procedures to ensure quality borehole installation. However, it is unlikely that they will have had any training on manual drilling. They will need to attend specific training on manual drilling techniques and their application, the 'standards' and a training on their mentoring role. Once these firms have been trained they would be able to provide training for new well drilling enterprises as the sector expands.

The government has the ultimate responsibility for ensuring quality control in the drilling sector. In order for government personnel to provide oversight they also will need to have training to understand manual drilling techniques and their application, the 'standards' and participate in a capacity building program.

It is likely that the personnel from the government and from the quality control firms will already have had training on hydro-geology for borehole installation. However, in order for them to provide mentoring sup-



Hydro-Geology Training

port to the manual drillers it will be important for them to know what has been taught to the drillers. For this reason they should attend an abbreviated hydro-geology training.

Due to the capacity building nature of this program it will be important for the government and quality control firms to assume a mentoring role as opposed to a strict regulatory role. When they observe a problem in the field they should explain what was done incorrectly, how it needs to be done and why. The goal is to create a professional manual drilling sector that installs high quality wells and understands why best practices must be followed.

### 4.3 Business Development

As mentioned earlier there are often specialized training institutes that provide training for SMEs. The initial assessment and the request for expressions of interest should identify these institutions. Their training programs should be evaluated through review of their curriculum and training methods. One key criteria should be that they spend time working with the businesses at their place of business and do not rely simply on classroom instruction.

The training institution would be contracted to provide initial screening of well drilling or related businesses to determine their capacity. Once the businesses are selected they would provide a training needs assessment. Using the Professional Manual Well Drilling Business Training Manual as a guide they would prepare a tailor-made training program to respond to the needs of the selected businesses. The manual provides modules on record keeping, registration, cost calculations, tendering, personnel management, client relations, sources of finance and marketing.

## 4.4 Social Mobilization

Social mobilization (before, during and after construction) is critical to any community managed water point. There is a current trend in the donor community to ensure that after establishing new water points the community has the capacity to manage the water point for the expected life of the infrastructure. This will require that programs pay more than lip service to capacity building at the community level.

The level of capacity building for this essential supporting sector will vary greatly from country to country. It will be necessary to identify organizations doing community social mobilization for water and sanitation including: NGOs, Community-Based Organizations (CBOs) and consultants. Once identified their track record and approach should be evaluated. It will be important to distinguish between organizations that simply provide training and those that work closely with the community to ensure that the desired outcome of a well managed water point is achieved.

Depending on the capacity of the organizations available they may need training to improve their ability to deliver the desired results. A social mobilization manual is being prepared as part of this series that will outline the procedures for:

- Initial contact and presenting options
- Community participation in decisions
- Water User Association Training
- Quality control of construction for WUAs
- Operation and Maintenance
- Conflict resolution
- Participatory planning
- Ongoing follow-up to ensure that the water points remain functional

## 4.5 Social Marketing/Marketing

Social marketing will be needed to bring about a change in prevailing practices and to encourage the addition of manual drilling to the methods used for rural water supply. In promoting manual drilling there will be a need to use a mix of social marketing and product marketing tools. Social marketing uses several successful techniques from commercial marketing, including price, product, place, promotion and positioning to bring about voluntary behavior change that can have meaningful benefits, both for individuals and for society as a whole.

Social marketing is audience driven, whereas commercial marketing is product driven. The hybrid that combines the two will use a different mix of messages depending on the audience. Segmenting a larger audience into smaller groups with common interests or backgrounds is an essential part of the commercial marketing and social marketing processes. Marketing campaigns use marketing research techniques and practices to better understand the target audience. For example, donors and governments may get a message that will explain how manual drilling can be effective in increasing rural water supply coverage for the same level of investment, making the realization of the MDGS more feasible. Individuals and communities may get a more product-based message presenting the branded wells, installed by certified well drillers, as a solution to their water supply needs.

It will be critical to use marketing and branding to promote the professional certified well drillers and to make a distinction between them and those who have not been trained. It will be important for donors and consumers to be aware that certified well drillers have received supplemental training to enable them to provide high quality wells. It is also important to ensure that the donors and consumers will know and realize the value of high quality wells, such as less pollution (better water quality). The certified well drillers will have to provide a quality product to ensure that the brand that is created will have a value.

Effective social marketing/marketing messages must capture the attention of the target audience, be meaningful to their daily lives and must be short, simple and singular. It will be important for any marketing campaign to identify a local marketing company that can prepare the promotional materials for the local market.

It is uncommon to find organizations with experience in social marketing because of its complexity. However, if local organizations can be identified with experience in developing educational messages and using local theater to present these ideas, they would benefit from training in social marketing. In addition, as part of this series, two social marketing manuals have been developed: a basic overview and a more comprehensive manual. While these manuals provide a wealth of information they would need to be supplemented by training from an experienced practitioner.

In selecting a marketing company the following criteria should be used:

- Have they done marketing campaigns with a behavior change component?
- What type of promotional materials do they use?

- What brands have they been involved in developing?
- Are their advertising campaigns well known and well appreciated in the local context?

The roles of the social marketing organization are many and include:

- Research to understand how the target audience sees manual drilling;
- Develop and test messages to see if they resonate with the target audience;
- Determine the mediums for transmitting the message;
- Contracts with the providers from the selected media to convey the message;
- Follow-up with clients to determine if the desired change has been achieved;
- Modify and reinforce the message based on audience feedback.



*Drilling Tool Manufacture*

## 4.6 Pump Suppliers

Local pump suppliers or manufactures should be used during this program. It is an important part of building the local supply chain that pumps are purchased on the local market. One of the serious failings in the rural water supply sector can be traced to the lack of local suppliers for pumps. If programs import pumps directly there is very little incentive for local dealers to stock spare parts.

For smaller communities and individuals locally made pumps should be considered because when a pump is made locally the spare parts will be available locally as well.



Rope Pump Training

Pump suppliers should train well drillers to install the pumps correctly to ensure that they reach their useful service life. Alternatively, the well drillers may subcontract the pump installation to the suppliers or to their trained agents.

## 4.7 Well Driller's Association

Once manual drilling enterprises begin to function there may be benefits to them of forming an association. This should not be something that is externally required, but facilitation and training could be provided. There must be perceived benefits that members will receive from the association. It is important to recognize that an association will only work as long as the members see tangible benefits from associating such as: promoting their industry, obtaining better prices on materials and supplies, protecting themselves from untrained operators, and lobbying with the government.

An association could also endorse certified well drillers and report non-certified drillers who are doing substandard work to the authorities. An association could order a higher quantity of PVC pipes and other materials than individual members could, which brings the price of materials down. Often the larger machine drillers control the supplies of materials and individual small orders tend to be very expensive. Implementation Guide

# 5. IMPLEMENTATION GUIDE

The details of a country specific program will vary based on the initial assessment. Part of the contract with the consultants doing the assessment should be to provide an implementation guide that is tailored to the local conditions.

## 5.1 Assessment

The assessment has been described in detail already and the timeline and resources required are presented in the table below.

## 5.2 Implementation

Representative timelines and the resources needed are presented in the tables below. The results of the assessment will determine the starting point for the implementation based on the local manual drilling experience and capacity.

### 5.2.1 Scenario 1

Scenario 1 presented on the right would be followed if the assessment indicated that there was no capacity in the country for manual drilling.

Under Scenario 1 the capacity building would have to start from the very basics and would include training local workshops to make the drilling equipment.

The training for the well drillers begins with a training contract with the enterprises in which they agree to respect quality norms and to reimburse the cost of tools. Well drillers would first be trained to use the tools to drill simple holes using the best technique for the prevailing geology. Then they would progress to drilling wells 10-20 wells in a 6-9 month period under supervision of the trainer(s) and/or of the quality control mechanism previously identified and under contract for do that supervision.

Ideally organizations that have been training water users would have been identified and they would conduct the initial meetings with the villages and ensure that the village was willing to participate physically and financially during the construction and to assume the management of the water point. The key principles of organizing communities will be part of the Community Participation document.

The lack of experience under this scenario would cause all of the activities to develop more slowly. It might be necessary to repeat some of the training before moving on to Scenario 2. In general it is likely that it will take longer to develop a professional manual drilling sector in the country. Scenario 1 feeds into Scenario 2.

ASSESSMENT		Year 1		Year 2		Year 3		Year 4		Year 5			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Activity and Resources Required	Identify favorable areas for manual drilling and potential impact on water supply coverage												
	Identify key actors and their roles in rural water supply												
	Evaluate the capacity of manual drilling sector												
	Prepare implementation plan												
Resources required													
<b>UNICEF - 1 WASH Officer 10% of time for 6 months, Logistical Support – Vehicle or funds to rent vehicle</b>													
<b>EXTERNAL CONSULTANTS - Expat 1-2 months over 3-6 month period. Local consultant 3-6 month period</b>													
<b>SCENARIO 1</b>													
<b>No Local Manual Drilling Capacity</b>													
Activity and Resources Required	Identify and train workshop to make tools and provide procurement contract under specifications in drillers' contract												
	Identify, make a training agreement and train selected enterprises in basic drilling techniques 10-20 wells each												
	Contract with selected organization to do social mobilization for training water users												
	Contract with pump supplier to provide and install pumps												
Resources required													
<b>UNICEF - 1 WASH Officer 30% of time for 9 months Logistical Support – Vehicle or funds to rent vehicle</b>													
<b>EXTERNAL CONSULTANTS - Expat full-time for 9 month period, Local technical assistance 18 person-months for 9 month period ( 1 technical, 1 social), Local technical trainer/field supervisor full time 9 months, Additional quality controllers as needed (12 person months)</b>													

Table 1: Assessment and Scenario 1

SCENARIO 2 and SCENARIO 3 Local Manual Drilling Capacity and Self Supply																				
Activity and Resources Required	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Work with government to develop standards for manual drilling																				
These activities are representative and may be repeated in waves depending on the extent of the program and the size of the country. (8 enterprises per wave not more than 2 waves in the training program at a time for 18-24 months)																				
Identify and train workshops to make tools for improved drilling techniques																				
Identify contract and train selected enterprises and government technical staff in hydro-geology for manual drilling																				
Identify, contract and train quality control enterprises in manual drilling techniques																				
Train selected enterprises in advanced drilling techniques																				
Contract for social mobilization for training - provide capacity building as necessary																				
Contract with pump supplier to provide pumps and to train well drillers to install pumps																				
Initial Certification of Well Drillers																				
From this point forward the sector has the capacity to respond to tenders and scale-up is possible																				
Well Drillers, Quality Controllers and Community Organizers, respond to tenders for the installation of wells and pumps and related activities																				
Refresher training for well drilling enterprises, quality controllers and community organizers as needed																				
Resources required	<b>UNICEF</b> - 1 WASH Officer 100% of time for 3-4 years, 30% WASH assistant (contracts) <b>EXTERNAL CONSULTANTS</b> - Expat full-time for 24 months, perhaps reduced to 75% time for the next 12 months and 50% time for the final 12 months, Local technical assistance full time for 3-4 years ( 1 technical, 1 social), Local technical trainer/field supervisor (number dependent on level of activity), Logistical and support personnel (Chauffeurs, Accountant)																			

Table 2: Scenario 2 and 3

## 5.2.2 Scenario 2

If the manual drilling sector is performing adequately then Scenario 1 is skipped and upgrading of the local drillers begins immediately following the assessment. If the manual drilling sector exists but is too weak to support the anticipated demand the plan would be to start with Scenario 2 (see table 2) and combine it with additional training from Scenario 1. If there are too few qualified drilling enterprises then the local capacity could be increased by encouraging the existing enterprises to take on apprentices to increase the capacity of the sector.

In Scenario 2 capacity building addresses the weakness in all parts of the manual drilling sector including: drilling, pump supply, quality control, government oversight, and social mobilization.

UNICEF will work with an external consultant and the government to develop national standards for manual well drilling. These standards can be based on existing national standards for machine drilled wells (see Annex 4 for Chad National Standards). In some countries, the standards for machine drilled wells are too restrictive and the opportunity to develop standards for manually drilled wells may be used to encourage the adoption of the principles for cost effective boreholes. In addition, there may be variations in the standards for household wells as compared to community wells.

As in Scenario 1 all drilling enterprises would have a training contract before starting the training. In addition to the conditions in Scenario 1, the enterprises would also agree to participate in business improvement training, open a bank account and register their businesses.

Following a training needs assessment the well drillers may receive technical training on specific techniques for the prevailing drilling conditions based on the skills they already have and the skills that are critical for them to gain. They will also receive training on hydrogeology and quality standards/control for manual drilling. The first and most important quality control is vested in the well drillers. This is important because they will not only drill wells for projects where quality controllers will be contracted but also for individuals where external quality control is likely to be absent.

In parallel with the hydro-geology training and the practical training the businesses will receive business training. The training will be tailored to the well drilling enterprises and will cover: basic accounting, business management, business planning, access to finance, and preparation of tenders.



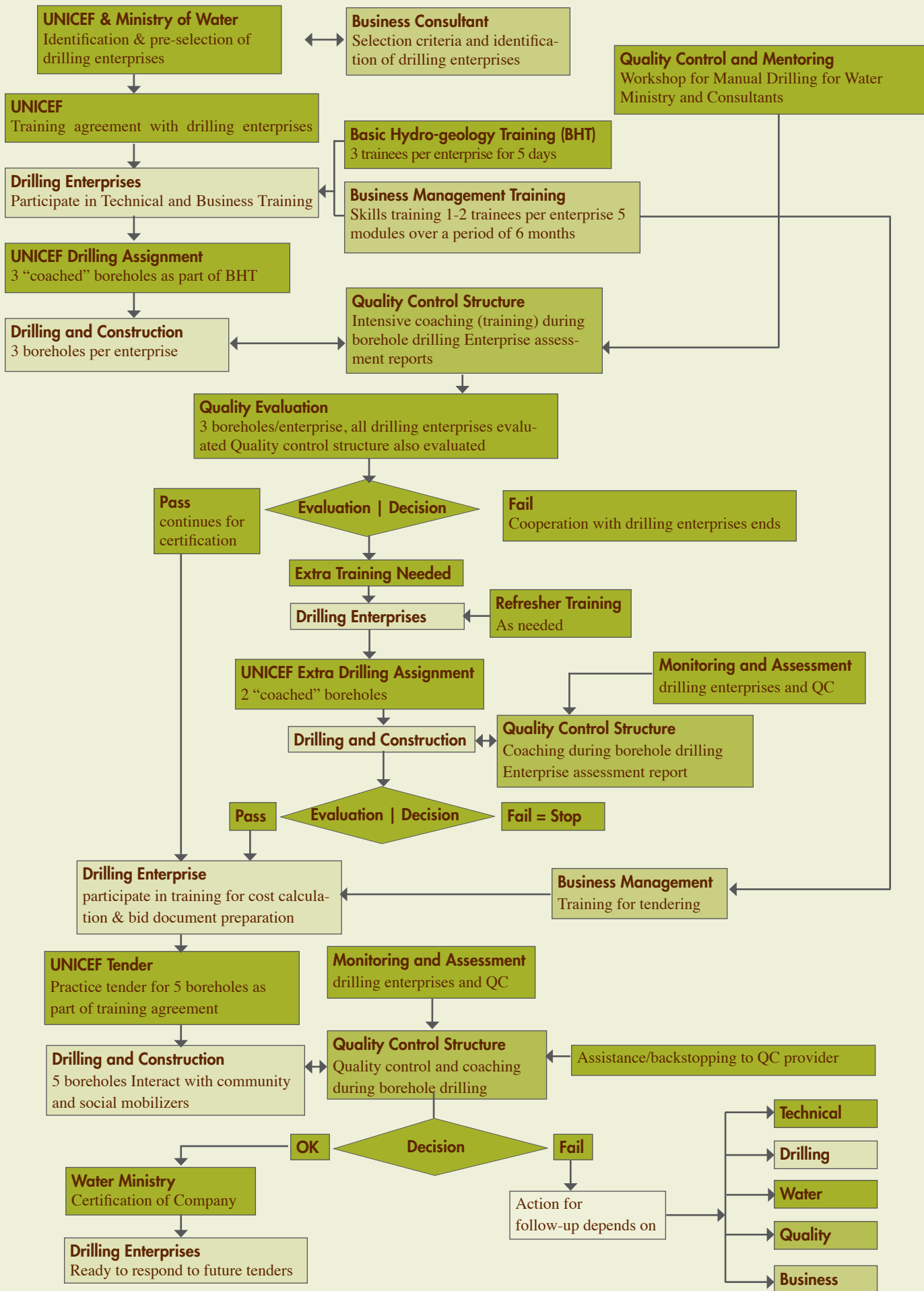
*Rope Pump on Hand drilled Well*

The well drillers and the quality control firms will work together under close supervision by an experienced trainer, during a coaching period. Generally the quality control firms will have personnel with more theoretical training and the well drillers will have more practical knowledge. The goal is to create a situation where each group learns from each other and the sector as a whole becomes stronger. The training will involve the drilling of a series of wells to ensure that the norms are understood and followed. There may be the need for retraining along the way. Once the trainers are satisfied that the enterprises have mastered the techniques and the quality standards they will be asked to participate in a practice tender, where their bids will be evaluated and critiqued openly. They will all have the opportunity to drill 10 wells under the supervision of the quality controllers, who will note deficiencies in practice. Following this exercise their performance will be evaluated either they will become certified or they will be sent for further training.

A training process flow chart presented in Figure 2 gives an indication of the steps in the training process and the feedback loops necessary to ensure that certified drillers have the skills that they need. This flow chart presents the training process for the well drillers and the quality control firms.

The needs for improvements in social mobilization, pump supply chain development and social marketing have already been discussed in the sections on required supporting businesses and institutions. These needs are not unique to manual drilling but are important considerations that have been neglected in the rural water supply sector as a whole.

# Well Drilling Enterprise Training





### 5.2.3 Scenario 3

Scenario 3 runs in parallel with Scenario 2 and will promote investment from communities and individuals to solve their own water needs. It will emphasize marketing to encourage direct investment by better off community members and individuals. This will require a strong marketing campaign using market research to identify target clients including: Individuals, communities, wealthy community members, and overseas workers sending remittances. The market research will identify the best ways to target each group and the unique selling points to attract their investment. These might include: low cost, ease of installation, job creation and promotion of an easy way to help their ancestral community. The marketing campaign would need to develop and use appropriate promotional materials to create interest and then to turn that interest into demand for wells.

Marketing is expensive but the return on investment can be huge, which is why industry invests so much annually on promoting their products. An important part of the marketing will be brand creation and the promotion of certified manual drillers. Creating a well drillers association will help certified drillers to protect their brand and to ensure that their work is of the highest quality. The marketing campaign would develop a meaningful local brand and promotional materials that would be appro-

priate for the indentified markets. These materials would be presented where they would have the most impact on the target market.

Another important part of self-supply is the access to finance. One of the additional documents in the current series is a manual on financing options for rural water supply. It provides an overview of where communities and individuals can look for finance for manually drilled wells. There are sources of funding including micro-finance institutions, rural banks, commercial banks and donors but each one has their own set of criteria for lending. It may be necessary if self-supply is to be promoted widely that a credit specialist works with local financial institutions to help them to develop appropriate lending instruments for community and individual wells. If people are paying for water, given the lower cost of manually drilled wells they should be able to pay off a loan and to cover maintenance and pump replacement costs.

### 5.2.4 Check list for Planning

Annex 2 contains a checklist which will help to guide the implementation of a manual drilling program. It will need to be tailored for each country and should not replace technical assistance for experts who have implemented similar programs in other countries.





# ANNEX 1

## FREQUENTLY ASKED QUESTIONS ABOUT MANUAL DRILLING

### HYDROGEOLOGY

#### **How do you know if manually drilling will work in a specific area?**

In general manual drilling will work in formations (soils) that are stone free, that is to say, without large stones that would prevent even the percussion drill from working. If the soil is suitable for hand dug wells and can be dug with hand tools all the way to the aquifer, manual drilling will be possible. Manual drilling cannot change the nature of the aquifer in terms of contaminants or make it more productive. Clay soils often do not have sufficient pore space to allow water to flow freely into the wells and therefore do not make suitable aquifers.

#### **Which types of soils are favorable and not favorable for manual drilling?**

Alluvial soils or highly weathered soils are generally suitable for manual drilling that is sand, clay, silt and fine to medium gravel. Drilling is possible in softer sedimentary rock, mud stone, schists and laterite but the progress will be slower. While drilling is possible using the percussion method even in harder rock the drilling rate and effort needed will discourage most drillers and the cost will likely approach the cost for a machine drilled well under these conditions.

#### **How do you know which technique to use for the drilling of the borehole?**

Experience is the most important factor in selecting the correct tools. Often a combination of techniques will work best because in a given borehole the conditions will change as the drilling goes through different layers (refer to the Desk Study of Manual Drilling Techniques).

#### **To what depths can manually drilled boreholes be drilled?**

On average most wells are drilled in the range of 15-50 meter depths. However, the depth depends on the technique used and the soil conditions. Hand drilled wells of 60 meter depths are

not uncommon and there are examples of wells drilled by hand that were much deeper. However, many of these deeper wells were drilled before large rigs were available. The question that should be considered is: "Is it more economical to drill a particular well by hand or with a machine?"

#### **Will a small diameter borehole produce enough water to supply a village?**

This depends on the quality of the aquifer. If the aquifer volume is large and consists of coarse sand then the well can be equipped with high capacity pump and supply water for a large village. However, if the aquifer is not good, especially, clay or silt, then a large diameter well that can accumulate water in the well overnight would be a better choice.

#### **How many days does it take to manually drill one borehole?**

Once again this depends on many factors including the depth and the types of strata but wells can be drilled in from as little as a couple of hours to several weeks. If the drilling takes more than 10 days perhaps the conditions are simply not favorable.

### WATER QUALITY

#### **Will manually drilled boreholes capture water from the first layer of groundwater which is typically more likely to be polluted by latrines?**

Ideally manually drilled wells will be able to reach a second aquifer but this is not always feasible. The wells will be able to penetrate much deeper into the first aquifer than a hand dug well. The further that fecal coliforms and other pathogens must travel within the soil profile the fewer that will survive. This is why it is important to select the drilling location carefully and to drill deeply into the aquifer.

#### **Will manually drilled boreholes be tapping into non-renewable ground water supplies?**

Generally manually drilled boreholes do not reach the depths need to tap into "fossil" water. They

generally reach aquifers that are recharged annually by rainfall.

### **Is there a risk for manually drilled boreholes to be contaminated by polluted surface water and latrines?**

There is a risk for all wells to be contaminated by surface water and seepage from latrines. It is for this reason that there is a need for professional well drillers, who have been trained to mitigate these risks through proper installation and protection methods. We also need to educate communities about the activities that can lead to ground water pollution including latrine construction, excess application of agricultural chemicals and fertilizers and pollution from industrial activities (used engine oil, tanneries, etc.).

## **COST OF BOREHOLES**

### **How much does a manually drilled borehole cost per meter?**

This is variable but we can list the factors that make up the cost:

Mobilization costs- getting the drillers to the site

Drilling costs – this is mainly labor cost so is directly related to the time needed to drill the well

Casing costs- the cost of the PVC casing used to line the well (same as the cost for a machine drilled well)

Well development costs – the cost of creating a clean and permeable area around the well by removing drill fluids and settlement of the gravel pack (similar to the cost for a machine drilled well)

Well protection – (sanitary seals and apron) same as machine drilled well

Pump – same as machine drilled well

Training for Water User's –same as machine drilled well

Quality Control – same as for a machine drilled well

Depreciation of equipment – low because the investment cost in equipment is low

Profit for the enterprise – generally a percentage of the costs

Demobilization costs – getting the drillers back to their base

### **How does this cost compare with a hand dug well or machine drilled borehole?**

The cost is generally more than an unlined traditional hand dug well but much less than a concrete lined well. The cost is 7-10 times less expensive than the prevailing costs of machine drilled wells in Africa.

### **What are the on-going costs of maintaining the borehole?**

Generally the borehole if drilled properly and developed correctly, it will have a 25-50 year life with perhaps the need for redevelopment every 10-15 years. The recurring cost for maintenance will be for the pump.

## **TOOLS FOR MANUAL DRILLING**

### **Where can you buy the tools and equipment for manually drilling?**

Manual drilling tools are generally made by trained welding shops in the country where the drilling is being done. This ensures that the drillers can get replacements for lost or damaged tools. After training the tools are not difficult to make and use materials that are generally available.

### **How much does it cost to buy the tools and equipment for manually drilling?**

A complete set of tools for 4 different techniques that would cover the range of soil conditions including a motorized pump for jetting and a generator and submersible pump for developing the well would cost less than \$3000 if made locally. However, if only one technique is needed the cost could be considerably lower.

### **If the transportation network in the country is very limited how will it be possible to provide spare parts of tools or pumps?**

In places with limited transportation infrastructure it will be important to manufacture tools and pumps as close to where they are being used as possible. If the raw materials for making the tools or pumps are also not available then manual drilling may not be possible until the infrastructure becomes more developed.

## **PRIVATE SECTOR DEVELOPMENT**

### **Why target the development of small private enterprises when there are already NGOs and Government agencies implementing water sector projects?**

In order to ensure sustainability it is important to train people who are earning their livelihood through the drilling activity. Past experience has shown that both NGOs and government programs only work while there is funding for the activity.

Private sector on the other hand, will actively seek markets for their products and services. In general the cost of wells drilled by small private sector companies will be less expensive when all of the costs are considered such as overheads staff salaries, logistical support, etc. In addition, small private sector companies with lightweight tools can respond quickly in the event of an emergency situation such as internally displaced people or natural disasters such as floods or cholera outbreaks.

**If a limited number of enterprises are being trained, how do you prevent these private entrepreneurs from setting elevated prices for the boreholes?**

Fortunately the cost of entry into manual drilling is relatively low, especially if the tools are available locally, so that if the profit is too high others will seek to enter the field. The goal of a capacity building project is to arrive at a balance between competition and over-supply. This will provide the environment where healthy businesses will be able to grow while providing quality products at affordable prices.

**What if there is no local private sector capacity?**

If there is no private sector drilling capacity then there will be the need for extensive training but the techniques are not complicated, they do however require a lot of physical effort. If people are not accustomed to hard physical labor they will not last as well drillers. If there are no small workshops to make the tools then there is a serious problem and it is unlikely that manual drilling will be possible. Building a manual drilling sector from nothing can be long process in Chad, Niger, Nigeria and Senegal manual drilling has been practiced for more than 30 years.

## QUALITY CONTROL

**Is a manually drilled borehole inferior quality to a machine drilled borehole?**

A manually drilled borehole drilled in the same place to the same depth and equipped with the same casing is identical to a machine drilled well. Once the well has been installed there is no way to differentiate them.

**Are there different specifications for a manually drilled well than a machine drilled well?**

There can be different specifications depending of the use of the well. Manually drilled wells for irrigation often use inexpensive pipe for the well casing and are drilled to shallow depths. Wells that are drilled for a single family may use a medium quality casing while wells drilled for villages

would have similar specifications as those for machine drilled wells. Quality and price go hand in hand. An irrigation well may be as cheap as \$ 100, while a village well may cost as much as \$ 2500 (depending on depth, water quality, casing material used, diameter, etc).

**If private enterprises are constructing the wells, who will control the quality of their work?**

The first line of quality control is the well drillers themselves who must be convinced during their training that maintaining a reputation for high quality wells is important for their business. As with other types of wells when they are financed by donors an independent quality control service should be used. These quality controllers will supervise the installation, for a fee, and ensure that the quality norms and specifications are followed.

## WATER PUMPS

**Once the borehole is installed, are there low cost methods for lifting the water out?**

There are a wide variety of methods for getting water out of well and their suitability depends on the number of users. These methods range from the simple Blair Bucket Pump, which is simply a bailer and a windlass, through rope pumps, India MKII, Afridev and other hand pumps to electric submersible pumps.

**Can motorized pumps be used in a manually drilled borehole?**

Yes they can as long as the casing diameter is large enough to accommodate them and the well is placed in a good aquifer.

**Is the rope pump robust enough for village use and not only for family usage?**

There are robust community models of the rope pumps that have been used in villages with 250 people getting their water from these pumps. They work well and are easy for the village to maintain. Local manufacture keeps the costs low and it would be good if the manufacturers considered providing a reconditioning service every 3 years

**What depth can the rope pump be used?**

The rope pump can be used effectively to depths of 25 meters, beyond this while it is possible, the level of effort is high and the discharge is low.

**If you have further questions please refer to the Additional Resources listed in Annex 4 and included on the CD-ROM version of this manual.**

## ANNEX 2

### IMPLEMENTATION CHECKLIST

#### IMPLEMENTATION CHECKLIST

This check list is presented here as a representative guide of the steps needed to develop a professional manual drilling sector. Each country will be different and it will be important to make use of experts who have implemented similar programs elsewhere, especially in the early planning stages.

STEPS TO PROFESSIONALIZE MANUAL DRILLING SECTOR	YES	NO
<b>Mapping of the potential for manual drilling Assessm sector</b>		
<i>Recruit international &amp; national experts</i>		
<i>Collect available hydro-geological data</i>		
<i>Report based on depth to water and geology</i>		
<b>Assess the capacity to support manual drilling</b>		
<i>Government support</i>		
<i>Local drilling sector (machine and manual)</i>		
<i>Quality control organizations</i>		
<i>Workshops to make tools</i>		
<i>Community organizers to train WUAs</i>		
<i>SME business training</i>		
<b>Plan program to promote manual drilling</b>		
<i>Recruit international manual drilling expert</i>		
<i>Evaluate capacity building needs for sector</i>		
<i>Identify local competencies to provide capacity building</i>		
<i>Plan to supplement local competencies with international expertise</i>		
<b>Stakeholders Workshop</b>		
<i>Presentation of implementation plan by manual drilling expert to Government, UNICEF, well drillers, business trainers, quality controllers, community organizers, community representatives</i>		
<i>Discuss capacity building plan</i>		
<i>Modification of the implementation plan to reflect stakeholder inputs</i>		
<b>Implementation of Capacity Building Plan</b>		
<i>Recruit international manual drilling experts (long term contract)</i>		
<i>Identify workshops to make drilling tools</i>		
<i>Recruit trainer to train tool makers</i>		

STEPS TO PROFESSIONALIZE MANUAL DRILLING SECTOR	YES	NO
<p><i>Identify and recruit business trainers</i></p> <p><i>Contracts with tool makers for training and production of tools</i></p> <p><i>Establish criteria for selection of well drilling enterprises</i></p> <p><b><i>First set of well drilling enterprises (repeat process as necessary to obtain the desired capacity to match the anticipated demand)</i></b></p> <p><i>Purchase drilling tools for first set of well drilling enterprises</i></p> <p><i>Identify and recruit first set of eight (8) well drilling enterprises</i></p> <p><i>Training contracts with well drilling enterprises</i></p> <p><i>Identify and recruit first set of quality controllers</i></p> <p><i>Training contracts with quality controllers</i></p> <p><i>Identify source of hand pumps and well casing</i></p> <p><i>Order pumps and casing for practice wells for well drillers</i></p> <p><i>Contract expert for Hydro-geology training</i></p>		
<p><i>Training in Hydro-geology for well drillers and quality controllers</i></p> <p><i>Contracts with well drillers and quality controllers for training wells</i></p> <p><i>Contracts with organizations to do social mobilization for practice wells for well drillers</i></p> <p><i>Installation of practice wells for well drillers</i></p> <p><i>Evaluation of well installation quality</i></p> <p><i>Refresher training for well drillers and quality controllers</i></p> <p><i>Prepare tender documents for tender exercise for well drillers, quality controllers and community organizers</i></p> <p><i>Obtain submissions for tenders</i></p> <p><i>Contracts with well drilling enterprise, quality controllers and community organizers</i></p> <p><i>Evaluate results</i></p> <p><i>Provide certification of completion of the training program</i></p> <p><b><i>Repeat process above for addition sets of well drilling enterprises, but only after first set is trained</i></b></p>		
<b>SCALING-UP OF WELL DRILLING</b>		
<p><i>Prepare tender documents for well drillers, quality controllers and community organizers</i></p> <p><i>Obtain submissions for tenders</i></p> <p><i>Contracts with well drilling enterprise, quality controllers and community organizers</i></p>		



# ANNEX 3

## TERMS OF REFERENCES

### ANNEX 3a - Initial Identification of Well Drilling Enterprises

#### Request for Expressions of Interest

**XXX** is seeking expressions of interest from qualified businesses with experience in manual well drilling of water wells. **XXX** will be pre-selecting enterprises to participate in program to increase the capacity to drill wells by hand in **COUNTRY**.

#### Criteria for Pre-Selection

1. Experience in drilling wells by hand (or by machine);
2. Have legal registration to operate as a business or be willing to register
3. Have at least three years of experience in the field;
4. Have a bank account or be willing to open one;
5. Maintain accounting records;
6. Willing to undergo an evaluation by **XXX**.

#### Documents to Provide

7. Photocopies of all documents authorizing the business to operate (licenses, tax certification, registration with the chamber of commerce, etc.);
8. Photocopy of letter from the bank attesting certifying that that the account is in good standing;
9. References from clients for completed wells.

The documents must be delivered by **DATE** to the address provided below:

NAME \_\_\_\_\_

Address \_\_\_\_\_

City, State \_\_\_\_\_

Country \_\_\_\_\_

Telephone \_\_\_\_\_

### Annex 3b – Contract for Participation in Manual Well Drilling Training

#### Contract for Participation in Manual Well Drilling Training

Between **UNICEF**

And

\_\_\_\_\_ hereafter referred to as the well drilling enterprise.

#### ARTICLE I - INTRODUCTION

As part of the UNICEF funded program to professionalize the local manual drilling sector in **COUNTRY**, this contract provides the terms and conditions for providing training to the well drilling enterprise in order to assist them to become certified so that they can respond to tenders for the installation of manually drilled wells.

#### ARTICLE II – RESPONSIBILITIES OF THE WELL DRILLING ENTERPRISE

One of the objectives of the training program is to move businesses into the formal sector as part of this process the well drilling enterprise agrees to:

Open a bank account for the business before starting the training program;

Complete formal business registration within 3 months of signing this contract;

Repay the cost of tools that are provided under this contract through deductions from the fees paid for wells drilled during the training, with the balance to be paid following an approved payment schedule;

Participate in training programs at their own cost in manual drilling techniques, business management and tendering, and a basic hydro-geology and hygiene training to better understand groundwater and wells for manual drilling, and;

Follow approved norms for the installation of manually drilled wells and pumps and follow in-

structions from coaches to improve installation techniques.

### ARTICLE III - RESPONSIBILITIES OF UNICEF

UNICEF will provide training over a period of 18-24 months to the selected well drilling enterprises that comply with the above conditions. The training is designed to result in certified professional manual drilling enterprises. UNICEF will provide the following:

Training in manual well drilling techniques that are appropriate to the prevailing conditions found in the regions of operation. These may include some or all of the following techniques: rota-sludge, hand augering, jetting or manual percussion;

Training in a basic hydro-geology and hygiene to better understand groundwater and wells for manual drilling;

Manuals to serve as references for all of the training courses;

Coaching support during the installation of practice wells as an integral part of the practical training;

Contracts for the installation of XX practice wells in support of the practical training which will be paid for at the agreed upon price for manually drilled wells as calculated in conjunction with the well drilling enterprises;

Business management training that may cover some or all of the following topics: cost calculations, personnel management, business registration, business financing, and tendering;

Contracts for practice tendering that will simulate an actual response to a tender that the well drilling enterprise will respond to with coaching.

### ARTICLE IV – TOOLS AND EQUIPMENT

The well drilling enterprise is responsible for all tools and equipment provided under this contract and agrees to maintain them in good condition. The tools remain the property of UNICEF until the completion of the training program. In the event that the well drilling enterprise fails to successfully complete the training program and become certified the equipment will be returned to UNICEF.

### ARTICLE V - REMOVAL FROM THE PROGRAM

If the well drilling enterprise fails to comply with the conditions stated in ARTICLE II they will be notified in writing of the failure and will be requested to comply within a stated time period. If they are unwilling or

unable to comply then they will be removed from the program. In the event of removal from the program the well drilling enterprise will return to UNICEF or their designated agent:

- a) All tools and equipment provided by UNICEF. Any payments made toward the purchase of the equipment will be deemed to be rental for the period in question and there will be no refunds: and,
- b) Any materials including training manuals, signs, brochures, etc that were provided under this contract.

Upon removal from the program the well drilling enterprise will not be entitled to participate in future UNICEF tenders requiring certified manual well drillers.

### ARTICLE VI - INSURANCE

The well drilling enterprise is responsible for insuring its personnel and vehicles and will comply with all of the applicable labor laws in COUNTRY. UNICEF assumes no responsibility for claims resulting from this contract or the failure of the well drilling enterprise to comply with applicable statutes.

### ARTICLE VII - PROMOTION OF MANUAL WELL DRILLING

The well drilling enterprise will participate in promotional events to promote manual well drilling to the extent possible and will make use of promotional materials provided by UNICEF to increase the public awareness of manual drilling as a feasible option for potable water supply.

### ARTICLE VII - CERTIFICATION

Successful completion of the training program will entitle the well drilling enterprise to receive a certificate from UNICEF that will attest to their successful completion of the professional manual well drilling program. This certificate will allow them to participate in calls for tenders from UNICEF. Periodic recertification may be required.

### ARTICLE VIII – POST-CERTIFICATION

The well drilling enterprise agrees to maintain high quality standards for well installation and to maintain records of all wells drilled including drilling logs and locations and to provide these records to UNICEF and other competent authorities. The maintenance of good records will be one of the criteria for recertification.

# ANNEX 4

## ADDITIONAL RESOURCES



### Additional Resources

#### • Technical Notes

- The Case for Manual Drilling in Africa
- Professionalizing Manual Drilling in Africa
- Selection of Well Construction Methods
- Manual Drilling Techniques
- Mapping the potential for manual drilling

#### • Manuals

- Understanding Groundwater & Wells in Manual Drilling
- Improving Skills of Manual Drilling Enterprises: Business Management Training
- Financing options for low-cost well drillers and communities for rural water supply
- Desk Study: Inventory of Manual Well Drilling Techniques
- Technical manuals on the drilling methods:
  - Rota sludge drilling
  - Hand Augering
  - Manual Percussion
  - Jetting

#### • Videos

- Advocacy for Manual Drilling in Africa – Short Promotional Video (3 minutes)
- Professionalizing the Manual Drilling Sector in Africa – A Promotional Video (12 minutes)
- How to Professionalize the Manual Drilling Sector in Africa – A Training Video (16 minutes)

#### • Mapping of the Potential for Manual Drilling (12 Countries)

- Chad, Madagascar, Niger, Sierra Leone, Central African Republic, Mauritania, Togo, Senegal, Benin, Ivory Coast, Liberia, Mali

#### • Case Studies

- Chad - The Impact of Manual Drilling for the Construction of Sustainable Water Points in Chad
- Niger - Sustainable Transfer of Manual Well Drilling to the Private Sector in Niger

#### ***These materials are available on the following sites:***

- UNICEF: [www.unicef.org/wash/index\\_watersecurity.html](http://www.unicef.org/wash/index_watersecurity.html)
- Practica Foundation: [www.practicafoundation.nl](http://www.practicafoundation.nl)
- Relief International/EWV: [www.enterpriseworks.org](http://www.enterpriseworks.org)

## PARTNERS

### **PRACTICA Foundation**

Oosteind 47  
356 AB Papendrecht  
Netherlands  
arjen.vanderwal@practicafoundation.nl

### **UNICEF**

3 UN Plaza  
New York, NY 10024  
USA  
sgaya@unicef.org

### **RELIEF INTERNATIONAL/EWV**

1100 H Street NW, Suite 1200  
Washington, DC 20005  
USA  
nauglej@enterpriseworks.org

## Other Organizations

The RWSN hand drilling cluster group, see the website [www.rwsn.ch](http://www.rwsn.ch)



*Concrete Apron and Hand Drilled Well*



