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Sustainable transfer of manual well drilling technology to the private sector: A Niger case study

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This paper examines the benefits and shortcomings associated with the introduction of manual drilling in Niger over a 45-year period. Using the experience in Niger, the paper highlights the necessary and desirable conditions under which manual drilling can become integrated into the mainstream in the water sector. As such, the paper enables practitioners who are interested in promoting manual drilling in their countries to avoid some of the pitfalls and benefit from the successes. The paper is based on the authors' more than 30 year combined experience in promoting manual drilling in Niger.

Background

Niger is an arid country whose northern two-thirds lie within the Sahara Desert. Water is one of the country's most pressing needs, especially in rural areas. According to the Joint Monitoring Program (2008), 68% of Niger's rural population, more than 7.7 million people, are getting their water from unimproved sources. In many parts of the south, where the population is concentrated, there are shallow sandy aquifers with good quality ground water that for centuries have been tapped using traditional hand dug wells to supply drinking water for people, livestock and gardening. Even though these traditional wells suffer from many of the contamination problems associated with unprotected sources and often yield water that is unfit to drink, many people still get their water from them.

Technology transfer

First wave

The first recorded hand drilled wells were installed in Niger in 1963 at a Farmers' Training Centre in Maradi in response to a need for water. The installation was done by Richard Koegel based on the knowledge that he had acquired from manual drilling in Vietnam (Koegel, 2008). Two wells were drilled to supply water for the trainees and staff and two wells for irrigation. At that time, PVC well casing was not available so asbestos cement and steel pipe were used. From this single source, the idea spread and another 15-20 wells were drilled by Peace Corps Volunteers and missionaries using the tools built by Koegel. Still, it would be many years before hand dug wells would become the prevailing method for tapping into shallow aquifers.

Second wave

In the 1970s Peace Corps volunteers in Niger introduced manual drilling in Balleyara. The activity was dependent on the volunteers, who organized the work and the supply of materials, and provided the initial subsidies which were gradually eliminated over a 3 year period. One of the early well drillers, Idrissa Hamikane, continued drilling wells and worked with succeeding waves to learn new techniques and share his experience. He is still drilling wells today but complains that donors are giving away wells for irrigation through contracts with Niamey based well drillers, so his market with the farmers has dried up.

In 1977, ten years after Koegel left Niger, the Food and Agricultural Organization of the United Nations (FAO) published a manual Koegel wrote that presented a variety of manual well drilling techniques. The

manual was one of the documents subsequently used by Lutheran World Relief (LWR) to reintroduce manual drilling to Niger in 1987. LWR's goal was to develop a system that would use locally made tools and train local well drillers to install wells for farmers at one-tenth of the cost of a concrete well. This would reduce the cost of providing gardeners with water for irrigation, and establish an affordable alternative that reduced reliance on project funds for reinforced concrete wells. LWR was successful in developing locally made lightweight tools that, at less than $200 per set, were inexpensive and well adapted to Niger's sandy soils. Still, although the wells were much less expensive than the alternative, they proved to be too expensive for many farmers, who continued to rely on large open pits that barely penetrated the sandy aquifers. At the time, PVC well casing was only available in Niger either through large drilling projects or as recycled material in the local scrap markets. LWR began placing orders for well casing from Abidjan through local merchants to encourage them to maintain a stock of casing so that it would be available for the well drillers. LWR also attempted to address other constraints over the nine years (1987-1996) that it was active in the sector. A local manufacturer of well drilling equipment was trained so that tools would be available for expansion and to replace broken or lost equipment. Local workshops were also trained to manufacture bailers for lifting water from the tubewells and LWR worked with aluminium casting artisans to make the bottom valve plates for the bailers. To encourage widespread adoption of the drilling techniques, LWR demonstrated them throughout the country and trained well drillers from Balleyara, well diggers from the Tarka Valley Project and private well drillers in Magaria. Last but not least, the technical staff from the Water Ministry were trained to show them the effectiveness, ease of installation and cost savings of tubewells as compared to concrete wells, and a Hand Augered Garden Well manual, complete with technical drawings, was produced in both English and French.

The widespread adoption of manual drilling in Niger can be traced back to these efforts by LWR. One of the first well drillers trained by LWR in the Tarka Valley, Ibrahim Lawali, today has 5 teams of well drillers and is the President of the 30-member local Well Drillers' Association. According to him, the Lower Tarka Valley Project that received an initial training from LWR in the installation of hand augered wells in 1989 went on to install about 6,000 wells, during its lifetime (1988-1998). This popularized the hand drilled well in the Tarka Valley and created a demand for manually drilled wells in the region that continues today, with wells being used for irrigation and for domestic use. The project trained 6 teams of well drillers and provided tubewells and motorized pumps to gardeners on credit. The well drillers worked for the project and were paid a flat fee of about $14 per well for the team of four well drillers for their labour, while the project supplied the pipe and the drilling tools. The well casing was ordered by container load from Abidjan. A local welder in the project area was trained to make the drilling tools and the well drillers learned to make the bailers.

Third wave

In 1997, the World Bank-funded Private Irrigation Project contracted EnterpriseWorks/VITA (EWV) to promote low cost irrigation technologies, including tubewells and treadle pumps, in Niger. EWV works with the private sector to transfer technologies that the end users will be willing and able to purchase, so it examined the farmers' incomes from their gardens and the cost of the tubewells and determined that a lower cost solution was required. Since the main cost of the tubewells was the imported well casing, EWV modified the installation procedure so that the heavy wall well casing was used as a working casing and the final well was an inexpensive 110 mm waste pipe that was readily available in most urban centres. This reduced the cost of the wells to about $50 for a 10 meter deep irrigation well, without any protection around the top of the well. The irrigation products were branded and promoted through demonstrations at markets and farmers' days, and radio and television advertisements. Eleven well drilling enterprises were trained and assisted in acquiring manual drilling equipment on credit. They drilled more than 776 wells during the life of the project, with the majority of the wells purchased directly by the gardeners. In an effort to establish a database for future reference, most of these wells were tracked using GIS. Well construction was monitored after the end of the project until 2004, at which time a total of 2,226 wells had been installed, predominantly for irrigation. An important factor in the success of this intervention was the parallel introduction of a low cost treadle pump.

Following the end of the irrigation project in 2001, with funding from the AGFUND, UNICEF, the World Bank, US Department of State, and USAID, EWV implemented a series of potable water projects that resulted in more than 500 wells and improved the capacity of the well drilling enterprises to drill deeper wells in a wider variety of formations. Techniques (percussion, rota-sludge) were introduced to enable the well drilling enterprises to drill 20-40 meters deep in harder formations and, once the rope pump was

successfully tested as a water lifting device, EWV worked with rope pump manufacturers to ensure that a low cost, locally available pump would be available for the deeper wells. Other activities that were conducted to enhance the professionalism of the well drilling enterprises included training in hydro-geology and good practices for manual drilling training, business training and an international workshop that brought together manual drilling experts and local well drilling enterprises for 10 days to exchange ideas and explore improvements in manual drilling techniques.

45 years - what have we learned?

The first wave of hand drilled wells in Niger is something that has been repeated in many countries around the world. An NGO or individual with a specific goal transferred manual drilling technology as a means of reaching that goal. A few wells were drilled, and the idea was seen to be good, 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.

The second wave characterized by an outside agency, such as an NGO, developing manual drilling in order to implement a program 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 get too old 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 has been seen in Niger. Perhaps as many as 40 private sector well drillers trace their origins back to the Tarka Valley Project. While there was some private sector involvement in these cases it was not sufficient to launch manual drilling fully into the mainstream of the water sector in Niger.

The complete integration of the private sector that happened in Niger as part of the third wave is much less common in the development world. It occurs when the goal is the sustainable transfer of technology not the installation of a certain number of wells or pumps, and its success is dependent on building the private sector's capacity and professionalism by providing it with the tools (both technical and managerial) and the knowledge to respond to demand. It relies on the willingness of consumers to invest in improving their lives if they are presented with the right product at the right price. Unfortunately, it requires resources and time that many donors are unwilling to make available since it is dependent on the provision of training and follow-up over a period of years. Nonetheless, EWV has proven this to be a successful approach with a number of products and technologies ranging from treadle pumps and water filters to improved cook stoves. Many of the EWV wells in Niger were been paid for the by users, and hand drilled tubewells have become the product of choice for water supply in Niger both by individuals and by donors. Well diggers report that there is little demand for hand dug wells because the tubewells are wanted by everyone. It seems that finally hand drilling has come into the mainstream in Niger after 45 years.

Conclusions

We believe that the lessons learned in Niger can be used by other countries to mainstream manual drilling as a means of providing more people with improved water sources. By building on the experience from Niger the time needed to develop a sustainable capacity in the private sector can be significantly reduced.

From the long history in Niger we can see that there are certain conditions that are essential for the introduction of manual drilling including favourable hydro-geological conditions for manual drilling and a government that is not opposed to manual drilling. Other essential conditions include:

- The availability of suitable material for well casing;
- Knowledge of appropriate manual drilling techniques;
- A motivated and entrepreneurial private sector;
- Substantial demand for wells either by private individuals or by villages and donors;
- Support from the government for the creation of a professional manual well drilling sector;
- An adequate donor support timeframe (5 years) for the necessary technical/business training, and promotion and consumer education;
- Training capacity for well drilling enterprises in hydrogeology, well installation and well development practices, pump installation and maintenance;

Additional but perhaps not essential factors that have favoured the mainstreaming of private sector well drilling in Niger include the availability of appropriate low cost water lifting devices such as bailers, treadle pumps and rope pumps; the availability of financing for well drillers to obtain the drilling equipment; training for users in the operation and maintenance of pumps; and the production of technical manuals for well drillers, decision makers, and consumers. Practices/factors that can adversely affect small businesses include the competition from organizations that are providing wells that are highly subsidized and policies that favour large drilling companies over local manual well drilling enterprises.

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