The rope pump – an example of technology transfer

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The rope pump is a low-cost pump made of readily available or easily manufactured parts. It has been widely adopted in Nicaragua, where there is considerable local demand and spare parts are available, but its spread elsewhere has been slower. This article asks why.

It is now recognized that rural water supply policies should incorporate a number of aspects to make the supply socially acceptable, sustainable and have a positive impact on health. For example, if users can put their water supply to additional productive uses then they are more likely to sustain the hardware (handpumps); also, local production of hardware and its spare parts are indispensable for sustainability. Most importantly, strategies should be based on traditionally used water sources.

This article focuses on the rope handpump, its Nicaraguan background, and its application and introduction in many countries on all continents. The social acceptance of the rope pump is directly related to its income-generating capacity and use in multiple applications. Now that the hardware and services are in place, the water supply and sanitation (WSS) sector and many NGOs can give an important stimulus to rural water supply at family and community level.

Rope pump installed on a bore hole at a school near Managua

The rope hand-pump technology

The pumping elements of this technology are the pistons and the rope loop, which pull the water to the surface through the pipe made of PVC or plastic. The rotation of the wheel, moved by the handle, pulls the rope and the pistons. The pistons, produced by plastic-injection moulding, are of high precision to prevent hydraulic losses. The structure is made out of angle iron, piping and concrete steel. The pulley wheel consists of two internal rings cut out of lorry tyres. The guide box at the bottom of the well leads the rope into the pumping pipe and is made out of concrete with an internal glazed ceramic piece to minimize wear. It is a high-efficiency and low-cost technology, but includes some pieces made with high precision and quality. Rope pumps are installed in hand-dug wells and in drilled wells or boreholes. There is no need for the pumping pipe to be installed vertically, which means that rope pumps can also be installed near ponds, riverbanks or dams. This has been found to be useful in the guinea-worm endemic areas of the north of Ghana, where rope pumps are installed in rainwater ponds using horizontal pumping pipes, thus preventing all contact of infected persons with the water.

A variety of rope pumps are available for different applications, and their costs are US$50–100, depending on the model. High technical standards are required to gain acceptance in the WSS sector. Maintenance costs are minimal at $0–10 per annum, depending on the application.

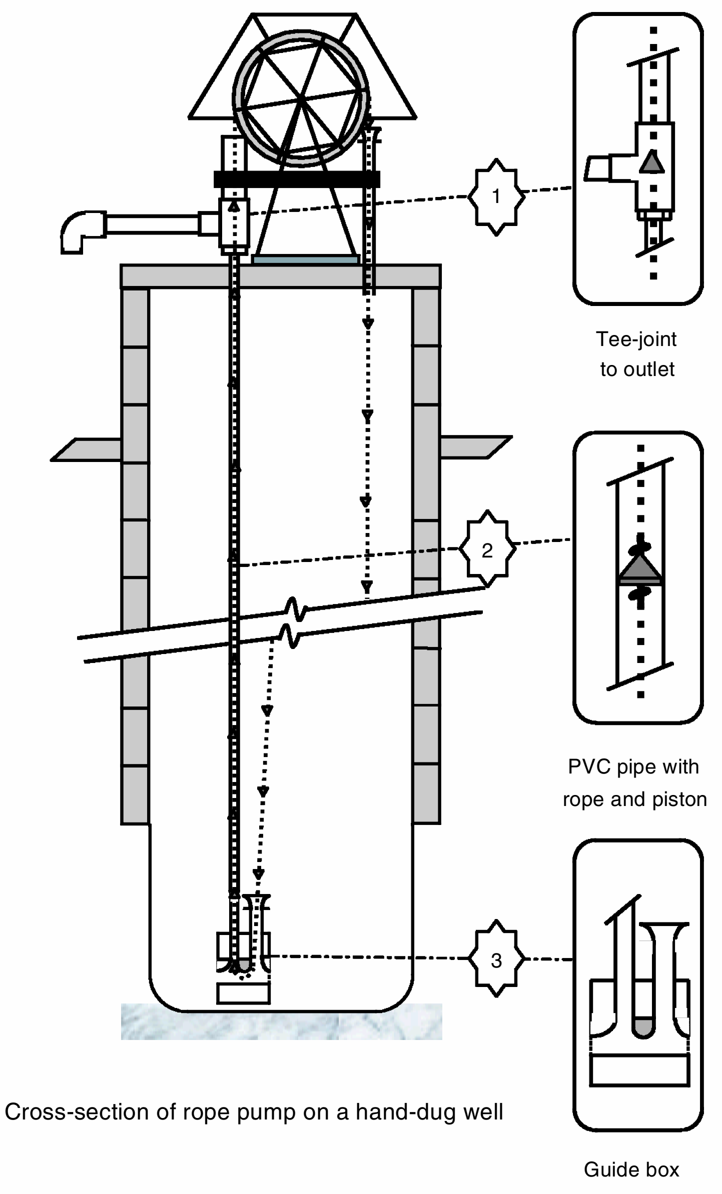
Field performance

The maximum standard depth is 40 m, which can be increased to 60 m with some adjustments and a double crank, while an 80 m installation has been reached successfully. The minimum well water depth required for a rope pump is only 10 cm. The guide box may be positioned on the bottom of the well, as sand does not affect the functioning of the rope pump. Should the water table sink significantly in a very dry season, then the rope pump will keep on working until the well is really dry. This is in contrast to the operation of traditional pumps, where the users blame the pump when the foot-valve does not reach the water any more but they still can draw water with a rope and bucket.

The 4-inch (10 cm) casing is the standard for drilled wells to install handpumps. The same diameter is used for rope pumps, though 3-inch (8 cm) and eventually 2-inch (5 cm) are also possible.

Table 1 Pumping capacity of the rope pump according to depth

Depth (m)	Adult (l/min)	Child (l/min)	Time needed for an adult to fill a 200-litre barrel (min)
10	41	19	5
20	20	10	10
30	14	6.5	15
40	10	4.8	20



Cross-section of rope pump on a hand-dug well

Figure 1 Cross section of a rope pump on a hand-dug well

Table 1 shows the pumping capacity of the rope pump, based on normal continuous operation. Even a child can easily fill a bucket thanks to the pump's high efficiency, which is another important factor in obtaining social acceptance.

Adoption in Nicaragua

In Nicaragua, rope pump technology has had an enormous impact on rural water supply. Over 30 000 rope pumps are currently installed in Nicaragua, supplying water to over 25 per cent of the rural population. The following factors have been critical:

- The technology has gained social and institutional acceptance because it is reliable, efficient and affordable.
- The rope pump is a commercial product in the hands of the private sector.
- Much time and many resources have been invested in promotion activities.
- The private sector has had an active policy towards the WSS sector, through an open relationship and active communication.

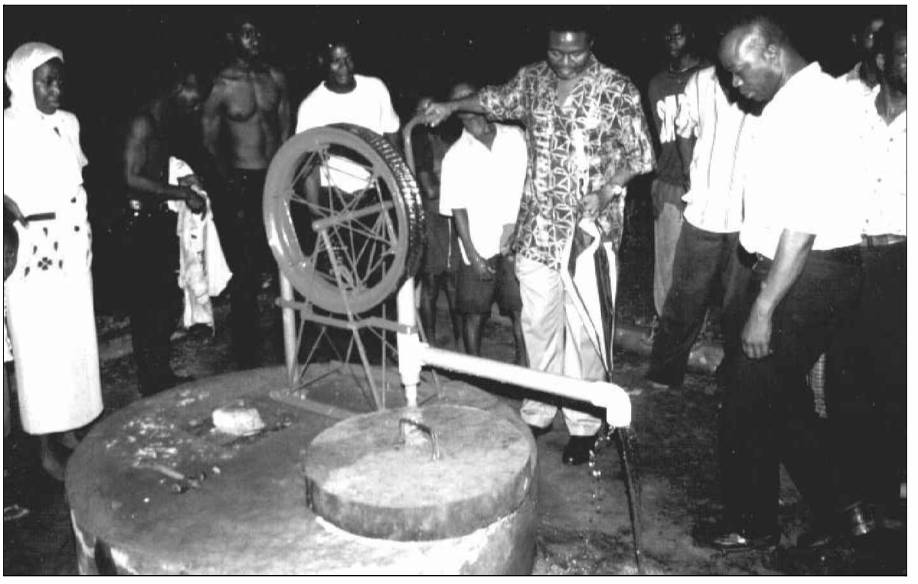
The national water utility, ENACAL, has recognized the rope pump as the national standard hand-pump technology since 1996. Interestingly, only one-third of rope pump coverage is reached through the traditional government-supervised projects where pumps serving about 100 users are installed in bore holes and hand-dug wells. About half of the coverage is reached through a wide range of organizations not traditionally closely involved in rural water supply, but which have adopted the rope pump in their programmes. Around 15 per cent of this coverage was to private-sector customers, although the number of pumps represent over one-third of the total sold, as fewer users per pump are involved.

The role of NGOs was important in the overall coverage by rope pumps reached by 2003, with over 50 per cent of rope-pump coverage resulting from their interventions. The fact that the state water and sanitation sector included the rope pump as an option for rural water supply created an important enabling environment for them. From about 1993 onwards NGOs started to include the rope pump within their programmes, partly as a response to demand from the local population, but also because of the emergence of small supply chains for the procurement of the pump and its spare parts. Thus at the start of the 1990s important decisions were already based on 'supply chains' and 'demand-responsive approaches'.

The role of NGOs in rural water supply in Nicaragua should be seen in contrast to the international situation, where NGOs have gradually been withdrawing from rural water supply provision.

International technology transfer

The development and introduction of the rope pump started in Nicaragua in 1990. Efforts to publicize this new technology[1] generated contacts from over 70 countries. Trials with rope pumps sent over from Nicaragua were conducted in Ecuador (2), Angola (3), Zambia (6), Madagascar (3), Mozambique (8) and Uganda (3). Production subsequently got underway in some of these countries, as well as in Laos and Ghana. Other countries started independent initiatives based on the documentation provided, in which the initiatives taken in Zimbabwe, Kenya and



The installation of the first rope pump to be manufactured in Ghana

Afghanistan are probably the most conspicuous.

In the mid-1990s in Nicaragua several independent workshops began producing rope pumps besides the pioneering rope-pump firm, Bombas de Mecate. The technology transfer activities of the rope pump firm were supported between 1996 and 2001 by the Swiss Agency for Development and Cooperation (COSUDE) through the documentation of the technology, resulting in a series of production manuals and the construction of a training centre.

In 2001 the 'First International Rope Pump Policy Workshop' was held in Nicaragua, attended by representatives of governments, international support agencies, NGOs, and private-sector enterprises from 23 countries. This workshop was financed by the Swiss SDC.[2] In January 2003 the International Symposium in Johannsburg 'Water, poverty, and productive uses of water at the household level' included a presentation on the rope pump, describing the relationship between the different sectors involved in rope pump adoption.[3] In March 2003 the rope pump became the joint Grand Prix Winner of the World Water Action Contest at the 3rd World Water Forum. In June 2003, as a side event of the HTN Workshop (Network for cost-effective technologies in water supply) in Durban, a half-day rope pump session was organized, with participants from over 20 countries. The HTN Workshops are traditionally supported by UNICEF and the World Bank's Water and Sanitation Programme (WSP).

Obstacles encountered

In reality, the decade starting with the first *Waterlines* publications in 1993, was a decade of contradictions with some hopeful outcomes. There has been broad international interest from organizations and private individuals in the rope pump technology. In Nicaragua rural water supply coverage has increased by roughly 3 per cent per year during this period, compared to Africa, where traditional handpumps are still the norm, and where there has been an increase in rural water supply coverage of only 3 per cent over the whole period 1990–2000.[4] Adoption may have been slowed down here for several reasons.

In several countries the following attitude has been expressed, often by well-paid consultants and embassy experts: 'This country standardized on VLOM handpumps, and that is why we can't use rope pumps.' It is more difficult to understand such an attitude coming from international NGOs and multilaterals (plus bilaterals) who, one would suppose, try to learn from their own experiences in other countries in a search for cost effectiveness. There may be two explanations here: either there is limited interchange on rural water-supply cost effectiveness between country offices, or, where rope pumps are not produced in-country, setting-up production is not within the scope of the rural water supply programme.

One obstacle has probably been that development co-operation did not know what to do with the rope pump. The Swiss SDC did its best by supporting the documentation of the technology and the 2001 rope pump workshop, but was not in a position to give further follow up. UNICEF as well as WSP have declared on several occasions that it is their policy to incorporate the rope pump as an additional option in rural water supply.

The point is, how can this be translated into action? First of all it requires top-down support and demand for action from the organization's country officials. But not less important is active participation of private sector producers and a sound focus on marketing and quality. Probably the most important bottleneck is the distance between the country or regional official and the relatively informal private sector. The introduction of the rope pump involving the local private sector is quite different from the more traditional purchase and installation contracts. Perhaps the best way forward might be to include an intermediate NGO to guide the introduction process as well as the necessary generic marketing.

Until now, it is the Nicaraguan private sector firm, Bombas de Mecate that plays the role of a development organization, providing information on the technology and introduction strategies on a regular basis. Production experience in over 20 countries is now documented and available on the website www.ropepump.com.

Whatever the reasons, it is clear that rural water supply is a multi-sectoral endeavour:

- Beneficiaries (users) have multiple needs: e.g. more water, clean water and water for productive uses.
- The private sector producer needs continuity that can be achieved by selling this product to private sector users, as donors do not offer this continuity of demand.
- The national WSS sector should focus on the effectiveness and sustainability of their interventions, promoting more water for hygiene,

taking into account the productive use of water, and fostering direct relationships between the service provider and the user.

At least according to plans and expressed intentions, after a decade, many of these obstacles have been overcome and rope pump adoption is really taking off. The production of rope pumps has started in several countries supported by national governments or by NGOs; this is sometimes still informal and without political support, but luckily even the international NGOs and multilaterals are getting more involved, as mentioned earlier.

The Millennium Development Goal to halve by 2015 the proportion of people without sustainable access to safe water is within reach. Let this be the last article on how it could be done: the next should describe how it has been done.

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software review

SANEX: Sanitation planning decision support software
$100, available from
www.decisionscape.com.au

SANEX is a computer-based decision-support software for the assessment of sanitation technologies. Its purpose is to assist identification of critical constraints affecting the suitability of sanitation systems during the early stages of sanitation planning. The software is based upon multi-criterion decision-analysis techniques and involves three main stages: screening, evaluation and finally a comparison of various technologies on the basis of their physical, social and economic feasibility. This second version of the software includes a number of important modifications since the first release in 1999, based upon practical experience and feedback from a core team of sanitation experts.

One of the inherent strengths of the software is its ability to carry out a rapid evaluation of various options under different circumstances. Provided the user is proficient in using the software, the information can be used to assist in interactive, participatory planning exercises by demonstrating how the local situation and the preferences of local stakeholders affect potential technologies, as well as the construction and recurrent costs of these options.

Amongst its many applications, the software has been used to assist in a planning process with community members for a sanitation system in Indonesia and in a workshop focusing on ecological sanitation in Nepal.

A useful feature is the ability to define different sections within the community, to account for the fact that communities are never homogeneous and there is often a need to assess these different requirements independently. Once suitable sanitation systems are identified for each section, they need to be combined to form an integrated solution for the whole community. However, this task is outside the scope of SANEX, and will require the assistance of an experienced engineer.

Another interesting feature of SANEX is the ability to include comments, which allows users to keep a record of their rationale for making specific choices during the decision-making process.

The software will run on virtually all PCs with Windows operating systems and is relatively easy to use, but users should be computer literate and will need to spend some time to familiarize themselves with the software. Users should also have a basic knowledge of sanitation technologies and planning issues, or be supervised by someone who has greater familiarity with these issues. However, to assist the user, SANEX includes a complementary compendium containing comprehensive information describing sanitation technologies; including brief descriptions, as well as schematic diagrams and details in relation to hygiene and convenience, construction, operation and maintenance for each technology.

Due to the complexities of sanitation-related problems, SANEX has its limitations, but it makes no pretences – it neither was designed to replace the human expert, nor to identify a single 'correct' solution. Although the software does not, and cannot, provide all the answers, it encourages engineers and planners to consider a wider range of potentially viable solutions. Experienced practitioners may not totally agree with all aspect of the software, but without doubt the potential uses of SANEX are many, and one of its main attributes is that it encourages users to 'think outside of the box'. SANEX may be particularly useful as a training tool, and academic institutions may be able to use the software for teaching purposes.

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