Rapid assessment of the long-term impact of the SMART approach:

The case of the rope pump in Nicaragua

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Cover photos (clockwise from top left: (1) Rope pump on borehole well in the village of Matapalo, Municipality of Villanueva, Chinandega; (2) rope pump manufactured by Bomba de Mecate, S.A., the original rope pump factory located in Los Cedros, Municipality of Villa El Carmen (3) new rope pump manufactured in Ocotal at Taller Articulos Metalicos; (4) recently manufactured rope pumps at the AMEC (Aerobomba de Mecate) factory in Managua; (5) Luis Roman Rivera, owner manager since 1990 of rope pump manufacturer AMEC demonstrating how to install and use the bare bones "kit" version of the rope pump on display at the Nicaragua WASH Smart Centre hand pump demonstration field (Chilamatillo, Municipality of Tipitapa).

Executive Summary

The rope pump was introduced in Nicaragua starting in 1983 as an alternative technology for improving water supply particularly in rural communities. After almost a decade of improvements more than 1,500 pumps had been installed by 1991 and by 1995 accepted by the government's rural water division[1] as one of the standard hand pumps for rural water supply. The recently revised Potable Water Supply System Design Standards[2] continue to include manual rope pumps in a section of borehole wells up to 50 meters deep and a productivity no less than 0.30 litres per second[3].

Initially developed under the auspices of the government run alternative technology investigation centre (CITA) which formed part of the Ministry of Development and Agricultural reform (CITA-INRA), starting in 1988 the government's rural water and sanitation division (DAR) started to experiment with and improved the rope pump. During the period from 1988 to 1998, SNV, SDC, and ICCO (formerly *Dienst Over de Grenzen* or DOG) provided substantial funding for salaries of three expats who were active in technical improvements, training local artisans, the manufacturing capacity and promotion of the rope pump.

During the period from 1990 to 1995, the newly formed small enterprise Bombas de Mecate, S.A. (BOMESA) received substantial funding and technical assistance from SDC and the World Bank to develop manufacturing capacity, promote and transfer the technology to local artisans in Nicaragua and other countries, including Ghana. In 1995 the rope pump was evaluated (IRC 1995) and in 2003 the rope pump (presented by BOMESA) won a shared first prize at the World Water Forum in Japan.

The rope pump should be considered to an emblematic SMARTech: **Simple, Market-based, Affordable, Repairable Technology**. Moreover, the process of its introduction, development/scaling up, and evolution in the Nicaraguan context established the conceptual basis for the SMART approach motivated the future development of SMART Centres to implement this approach, first in eight African countries and since 2017 in Nicaragua. The SMART approach combines the concept of SMARTechs with a focus on building supply and value chains and accelerating self-supply. The assessment over time of the reach and impact of the rope pump in Nicaragua, is thus highly informative for other efforts to accelerate self-supply and the cost-effective sustainable universalization of access to WASH.

Based on the research conducted as part of this assessment the author estimates that there are as many as 50,000 rope pumps currently in use in Nicaragua. Of these:

- 3,119 are installed on communal hand dug and also borehole wells with manual rope pumps and thus are registered in the rural WASH information system (SIASAR); these communal pumps in general were and are subsidized either by government or non-governmental organisations
- As many as 48,000 are being used on household wells by 6.3% of the total rural population or 14% of the households currently considered to be without access to water supply as per the rural WASH information system (SIASAR) registry and an online survey conducted by municipal WASH officers in the 152 municipalities of Nicaragua, to which 124 (82%) responded and for which 87 municipalities (70%) reported the presence of rope pumps while 37 municipalities (30%) reported that rope pumps are not

[1] The Rural Water Division - *Direccion de Acueductos Rurales (DAR)* - formed part of the Nicaraguan Institution of Water Supply and Sewerage – *Instituto Nicaraguense de Acueductos y Alcantarillados (INAA).*
[2] The NTON 09 007-19 Diseno de sistemas de abastecimiento. Agua potable were published in the La Gaceta on November 11, 2021.
[3] Section 6.6.1.2. Pozo perforado con Bomba Manual de Mecate (PPBM). The rope pump with one handle is capable of pumping up to 35m; with two handles it can reach up to 50m. Productivity of 0.3 lps is for wells in the order of 20m deep.

used. There is no single registry of private wells and whether or not these are equipped with pumps and if so whether these are rope pumps or other alternatives. The numbers are based on the estimate conducted municipality by municipality with the municipal WASH units and compared with data from an agricultural census conducted in 2011 which registered 60,810 hand dug wells and 9,158 artesian borehole wells on farming plots nationally. Sometimes organisations subsidized a pump if a family invested in the well but most pumps were paid for by families themselves so should be considered self-supply.

- A conservative estimate of almost 3,000 rope pumps in use in nine urban townships of the low-lying Caribbean Autonomous regions where municipal water supply systems have been highly deficient. In this case the estimate is based on the author's in-depth knowledge of the region to assume that at least 5% (1 in 20) households do obtain their water from hand dug household wells equipped with locally obtained (self-supply) rope pumps.

A previous estimate provided by Henk Holtslag in 2005 was that there had been approximately 70,000 rope pumps installed over the initial 15 years from 1990 to 2005, 20,000 of which were being used for communal wells in general subsidized by government or NGOs, while the remaining 50,000 were being used for individual family / farm wells. This estimate was based on the testimony of the rope pump manufacturers operating at the time.

All rope pumps in Nicaragua have been made locally with locally available materials like galvanized pipes, used car tires, PVC pipe and rope. Self-made model rope pumps were initially promoted in 1983 but did not take off. The rope pump really started to scale up when an "off the shelf model" was developed by SNV and others and the pump production and sales became a commercial activity rather than an activity of an NGO. The company who started this around 1990 was Bombas de Mecate, S.A. (BOMESA) located an hour outside the capital city of Managua. At around the same time two other manufacturers of rope pumps were established in Managua: Taller Electromecanico and Aerobombas de Mecate (AMEC). Besides a galvanized version of the hand powered rope pump, AMEC also developed and produced rope pumps powered by pedals, engines, horses and wind. BOMESA was provided with funds by SDC to train artisans, conduct technology-transfer activities to as many as 8 or 10 artisan workshops located around the country and to other countries in the region and globally.

It should be expected that there has been a decline in demand for rope pumps for communal systems since 2005 given both the steady increase in coverage of rural electrification from 47% in 2001 to 96.7% in 2019[4] and the decline in external support for the promotion and commercialization of rope pumps. There has also been a decline in the promotion of family level services by implementing NGOs, preferring to prioritize deep borehole wells and communal distribution systems in areas of more concentrated populations.

A case study was conducted of a project implemented in 2009 where 50 shallow[5] manually drilled borehole wells were constructed. About 10% of the 39 wells visited were out of service, 20% of the functioning wells were still equipped with rope pumps while the remaining 80% had been replaced by small electric centrifugal pumps obtained through pure self-supply. Rural electrification and convenience were identified as the motivations for switching to electric pumps.

Despite the apparent reduction in demand for the rope pump since 2005, a residual opportunity for new sales, technical support and spare parts would seem to exist given the continued presence of rope pumps in at least 86 municipalities and all 17 departments and/or autonomous regions[6].

[4] These figures originate from government publications regarding rural electrification; the rural WASH information system currently reports rural electrification having reached 74% of the rural population nationally.
[5] 8 – 18 meters deep
[6] Only the departments of Masaya and Carazo report limited presence of rope pumps.

Conclusions

The conclusions drawn by this rapid assessment are as follows:

1. Forty years after being introduced to Nicaragua, the rope pump continues to play a significant role in affordably improving access to water in rural and peri urban areas, particularly for dispersed settlements and rural farming families where the rapid expansion of rural electrification has yet to reach. Family wells with self-supplied rope pumps on premise may account for as many as 50,000 households (14%) of the 356,655 households currently considered to be without access to communal water supply based on the SIASAR information system. The SIASAR information system reports 3,119 registered communal wells equipped with rope pumps of which 85% are functional.

2. The effect of the introduction of this low-cost technology and the long-term technical assistance (coaching) in production, quality control and marketing resulted in the fact that an estimated 450,000 people in Nicaragua have access to a basic water supply with a rope pump.

3. The history of the introduction, development and scaling up of the rope pump in Nicaragua is an example of the positive cost-benefit ratio and potential impact of applying the SMART approach to introduce innovative technology solutions. The total donor investment between 1983 and 2005 is estimated to be around $2 million USD in technical assistance. The initial investment led to lasting capacity and conditions in both the private and public sectors to provide an affordable water pumping option for both households and rural communities, and so the per capita costs of that investment have reduced year by year as client numbers have grown.

4. The rope pump in Nicaragua can also be seen as an example of not only the social but also the economic impact that technical assistance in SMARTechs can have. Assuming that replacing a rope and bucket on household wells by a pump increases yearly incomes of rural families on average with US$225[7], the total increased incomes in the past 16 years of the 50,000 rural families who had or still have a rope pump on their own well could be in the order of $180 million USD. This economic impact is a direct result of the donor investment of $2 million USD in technical assistance.

5. Different from what is often assumed, subsidizing rope pumps for (targeted) families did not distort the market but stimulated the sales to families who knew they would not get a subsidized pump.

6. The history of the introduction, development and scaling up of the rope pump in Nicaragua also highlights the following challenges:

[7] This was the conclusion of a survey of more than 4,000 farming families conducted in Nicaragua in 2001 (*The Impact of Farm Water Supply on Smallholder Income and Poverty Alleviation along the Pacific Coast of Nicaragua, J.J. van der Zee, A. Fajardo Reina, H. Holtslag, 2002).* This is the only study of its kind comparing the income of families with wells without pumps and wells with pumps. Although income estimates are difficult to verify and the causality of the pump versus the causality of higher income being a factor in acquiring a pump should be further investigated. The positive economic impact of a pump on a well can be attributed to: (1) a reduction in the recontamination of water in open hand dug wells and thus a reduced health related cost of water borne diseases; (2) time saving due to the ease of extraction of water, and (3) more water readily available for both personal hygiene and productive uses given the ease of lifting water as long as the well produces sufficient water.

- Long-term investment is required for technical assistance to iron out technical details, build local capacity to manufacture and build up the market, despite the apparent simplicity of the technology
- The importance of a successful and adaptive marketing strategy, taking into account changing contexts
- The competition with low-cost options[8] from an initial capital investment perspective; over 3 years the cost of a rope pump is roughly US$120 in initial capital investment and $10 per year in maintenance for a total cost of US$150, while a low-cost electrical pump is roughly US$50 in initial capital investment and $60 per year in electricity for a total life-cycle cost in the order of US$230 and a replacement cost of US$ 50. The life-cycle cost of the rope pump over 5 – 10 years is ca $150 USD.
- The need for the decentralization of skills and the local availability of spare parts to ensure timely repair and/or replacement
- The need for government support for the technology

7. The introduction and scaling up of the rope pump in Nicaragua also highlight the key role that context plays, taking into account:
   - The initial trend during the 1980s towards self-sufficiency and rural land reform and development following the 1979 Sandinista revolution, a move towards socialism and a trade embargo (or blockade) from Nicaragua's primary trading partner (USA)
   - The expansion of the agricultural frontier in the post-war years of the 1990s,
   - Advances with rural electrification and communal water supply systems in the 2000s
   - The recurrence of hurricanes causing disaster situations for highly vulnerable populations – particularly, but by no means exclusively, on the Caribbean Coast – which trigger humanitarian responses, in this case the rehabilitation of hand dug wells with a "new" low cost hand pump. This stimulated interest, further development and scaling of this technology. A similar story is true for the Nicaraguan ceramic pot filter which now is produced in Nicaragua and in more than 30 other countries. The response tends to focus on the rehabilitation of existing hand dug wells primarily on communal and institutional wells (for schools and health posts).

   The role of the rope pump as a family-scale self-supply technology, although accepted as a national standard pump for rural water supply, is still not widely recognized in the sector as contributing to the goal of universal water access (SDG 6.1) and water related SDGs for food and income. As such it is not explicitly considered in the national register of waterpoints, their conditions and functionality.

8. Renewed efforts at marketing the rope pump and expanding its supply/distribution chain, in all of its applications, particularly in regions with limited levels of rural electrification and shallow groundwater, could generate an interesting market opportunity if combined with other SMART solutions (water filters, solar-powered pumps, rainwater catchment, etc.); in this sense the rope pump is not an end point but a valuable step leading to a natural progression of improved access.

[8] A commercial electrically powered centrifugal pumps with capacity of 1HP has an initial cost in the order of $50 USD in Nicaragua. The user does not generally consider the monthly electricity consumption that the pump generates, and which is in the order of $5 USD per month. Nor does the user consider the need for replacement every 2 – 3 years which is equivalent to a life-cycle cost of $230 USD based on 3 years of use compensating this with the ease of availability and low initial investment.

Recommendations

This assessment has also generated a few recommendations aimed at sustaining and expanding the success and positive impact achieved by introducing the rope pump to Nicaragua using the SMART approach:

1. Encourage the WASH sector (Nuevo FISE, municipal technical WASH units) to incorporate a register of private/family water points in the SIASAR information system for rural WASH, including hand dug wells, low cost manually drilled wells, rooftop rainwater catchment systems, and spring catchments

2. Conduct a market study to determine where the existing and potential demand is for technologies fit for **self-supply** like the rope pump other low cost pumping alternatives[9] and WASH technologies and products in general, and the relative access of these to local distributors. Also the opportunity to increase sales through a communications campaign and the establishment of local producers and/or distributors.

3. Use the example of the positive impact and the lessons learnt from the introduction and scaling-up of the rope pump to inform and motivate other efforts to accelerate self-supply and reach Sustainable Development Goal 6 for sustainable and equitable universal access to WASH and water related SDGs for food and income through the SMART approach

[9] The Nicaragua SMART Centre offers a low cost solar pumping system for combined elevations or heads up to 20m, including well depth and the height of elevated water storage tanks.

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Introduction

This rapid assessment was jointly commissioned by the SMART Centre Foundation[10] (Holland) and the Skat Foundation (Switzerland).

This assessment's investigator and author (Joshua Briemberg) is an independent consultant, who is also currently Director and Chief Advisor of the Nicaragua SMART Centre (*Centro de Tecnologías SMART de Agua, Saneamiento e Higiene, S.A.*). The Nicaragua SMART Centre was launched in 2017 under Joshua's leadership and guidance[11], initially while Nicaragua Country Director for WaterAid's first Country Program in Latin America and President of the Executive Committee of Nicaragua WASH Network (RASNIC) and then as Regional Director for Latin America and the Caribbean (LAC) starting in April 2018. Starting in 2021, WaterAid ended its involvement in the SMART Centre and the initiative became an independent social enterprise. The Nicaragua SMART Centre is an active member of the RASNIC and Nicaragua's Interinstitutional and Sectoral WASH Commission (COMISASH), as well as a series of global WASH networks (SMART Centre Group, SuSanA, HWTS Network, and others).

Significant support for this assessment were provided by the Government of Nicaragua by means of the national Interinstitutional and Sectoral WASH Commission (COMISASH) and two national government institutions:

- Nuevo FISE – provided information and analysis based on the rural water and sanitation information system (SIASAR) which it manages
- INIFOM – facilitated coordination with the 152 local municipal government WASH units (UMAS)

Disclaimer:
Neither the author (Joshua Briemberg) nor the Nicaragua SMART Centre had any direct involvement in the introduction and development of the rope pump in Nicaragua which took place starting in the early 1980s and continued through the year 2000. The Nicaragua SMART Centre does promote the rope pump as one of numerous SMART solutions and views this assessment of the evolution and current

[10] Stichting SMART Centre (www.stichtingsmartcentre.nl / henkholtslag49@gmail.com)
[11] The Nicaragua SMART Centre initiative was initially conceived and proposed by Henk Holtslag and Luis Roman Rivera during the 2015 edition of the annual NicaraguaSan Forum (Managua, Nicaragua).

status of the rope pump as an important opportunity for insight to learn more and continue to improve the SMART approach framework.

The SMART approach framework for this assessment refers to a process of introducing and scaling-up **S**imple, **M**arket-based, **A**ffordable, **R**epairable **T**echnologies, as promoted by the SMART Centre Group and which involves:

- Introducing SMARTech solutions and determining their applicability in the local context
- Generating demand through promotion and trials with end users
- Training of a local private sector to supply and service SMART technologies; training includes both technical skills and business development skills
- Supporting supply and value chains to sustainably provide SMART technologies, installation, spare parts and servicing at a local level
- Supporting efforts to certify and regulate use of SMART technologies by government regulators
- Marketing SMART technologies
- Establishing financing mechanisms (microcredit, subsidies) to improve the accessibility of SMART technologies to all

The final goal of the SMART approach is the creation of an eco-system that accelerates self-supply whereby the end user makes the ultimate decision to acquire, use and maintain the technology.

This rapid assessment consisted in:

- **A literature review:**
  This consisted in publications of the experience of introducing and scaling up of the rope pump in Nicaragua
- **A review of the national rural WASH information system (SIASAR) and other official surveys:**
  This consisted in three working sessions with Nuevo FISE[12], which is the government agency responsible for the rural WASH subsector, to analyze the data registered in the national rural WASH information system (SIASAR). It was confirmed that the SIASAR monitoring process limits itself (with only minor exceptions) to registering community-scale projects and thus excludes private family wells. Reference was thus made to a national agriculture survey (CENAGRO) to identify the number of private family wells.
- **A national survey of the municipal government WASH units:**
  This consisted of an online survey focused on the presence of rope pumps, local manufacturers and/or sellers, and a critical estimate of what percentage of families without access to community water supply systems have private wells and what percentage of these have rope pumps installed. The survey was completed by 123 (81%) of the 152 municipalities in Nicaragua.
- **Interviews with rope pump manufacturers:**
  This consisted in the three historically prominent and centrally located rope pump manufacturers at a national level, as well as two smaller local rope pump manufacturers; these interviews included visits to all but one of the five small/micro enterprises.

[12] FISE was initially established in 1990 as the Emergency Social Investment Fund by major bilateral and multilateral funders with the primary objective of creating private sector employment in the construction sector linked to rural infrastructure (schools, health facilities, water and sanitation infrastructure). By Presidential Decree 109-2004 in 2004, FISE was given the responsibility for implementing programs to provide access to water and sanitation in the rural and peri-urban (marginal) sectors.

- **A survey of implementing NGOs:**
  This consisted in an online questionnaire circulated among implementing organizations (international and national NGOs) that are active members of the Nicaragua WASH Network (RASNIC). Five (5) NGOs completed the survey.
- **A case study of accelerated self-supply:**
  This consisted in a field survey in three rural communities that were subject to a project carried out in 2009 by rope pump manufacturer Aerobomba de Mecate (AMEC) with Rotary Club funding. The project consisted in the manual drilling of 50 shallow wells equipped with rope pumps and was accompanied by the distribution of ceramic pot water filters. The evaluation included the inspection of 39 of the 50 wells and in-depth interviews with 12 of the homeowners.
- **An assessment of the evolution and current status of the rope pump market, supply and value chains in Nicaragua:**
  This consisted in an independent evaluation based on a combination of the different sources of information referenced including the market study published in 2008, information from manufacturers, the national survey of municipal government WASH units, and the history of sales since 2017 of the Nicaragua SMART Centre.
- **A reflection on the comparative sustainability of the rope pump communal and individual family use in rural and peri-urban settings:**
  This consisted in a reflection by the author, based on the findings of five case studies as presented in one of the documents on this subject that formed part of the literature review, combined with personal experience and informal observation.

Background

The rope pump was introduced in Nicaragua starting in the early 1980s as an alternative technology for improving water supply particularly in rural communities.

In 1995, IRC conducted an evaluation of the Nicaragua experience with the rope pump.[13] The primary conclusion was that: “The rope pump has a great potential to be introduced in other countries as an option to the range of groundwater lifting technologies since it can be locally manufactured, marketed, and installed by the private sector; operation and maintenance requirements are low; and the relatively low level of investment makes the technology accessible for individual households and farmers (except for the poorer sections of society).” The report recommends international promotion of this technology as well as the development of pump selection criteria, standardized designs, manufacturing processes and quality control procedures for the rope pump.

Based on data provided by local manufacturers it was calculated that there were approximately 70.000 rope pumps installed in Nicaragua by 2005. Of these it was estimated that 20,000 were being used for communal wells in general subsidized by government or NGOs , while the remaining 50,000 were being used for individual family / farm wells.

[13] https://www.ircwash.org/sites/default/files/irc-1995-evaluation.pdf

The total investment of donor aid to establish local capacity to manufacture the rope pump was estimated to be in the order of US$ 2 million.[14] This investment was mainly for Dutch expats who supported in making technical improvements in the pump, develop jigs for production, train and long term coaching of local producers, get it accepted as a national standard, demonstration and marketing the pump, the transfer of the technology to countries like Ghana and production of the book 'The Rope Pump'.[15]

NGOs like World Vision, CARE and others sometimes donated rope pumps to targeted families on the condition that the family invested in the well, so subsidized self-supply. Many peri urban and rural families bought pumps for their (often open) hand dug wells themselves so full self-supply. Based on the cost of 140 USD per pump, the total investment of these two groups is estimated to be around $7 million USD.

As such the introduction, training and support during the evolution of the rope pump in Nicaragua can be seen as a starter of the SMART approach with actions like:

1. Selection, introduction and improvements of an affordable technology
2. Local production, training and coaching of local private sector
3. Stimulation of 100% self-supply (many families paid for the pump themselves)
4. Stimulation of subsidized or accelerated self-supply: NGOs donating pumps to families that constructed their own well
5. Focus on productive use of water (cattle, patio, garden irrigation)

Objectives

The primary objectives of this rapid assessment are to:

1. Estimate the number of pumps produced since rope pump manufacturing was taken to scale in the early 1990s and identify trends in production and use since then.
2. Analyze the actual situation (in 2022) of the rope pump in Nicaragua, and its current status as a viable solution for rural water supply for both small communities and families and its continued evolution and/impact 20 years after the external support mechanisms were removed. The assessment will attempt to gather and analyze information on the number of pumps manufactured and installed and the number of rope pumps currently in use for communal systems and for private wells.
3. Assess the impact of rural electrification on the replacement of rope pumps by another technology further up the ladder.
4. The assessment will also try to compare the difference of pump functionality between community managed rope pumps and household/family-managed rope pumps.

[14]This investment amount is based on a combined involvement of 35 person years of 6 technical assistants (Jan Heamhouts, Bernard van Hemert, Henk Alberts, Jaap van der Zee, Henk Holtslag, Niek Bosma) at a total annual cost of approximately $60,000 per person year including salary and operational costs.
[15] https://www.ircwash.org/resources/rope-pump-challenge-popular-technology

Literature review

A literature review was conducted focusing on two previous evaluations of the experience introducing the rope pump in Nicaragua and its impact, the first in 1995 and the second in 2003, and an analysis of the market for rope pumps conducted in 2008:

- La bomba de mecate: El desafío de la tecnología popular (INAA-dar Region V, Bernard van Hemert, Osmundo Solis Orozco, Jan Haemhouts, Orlando Amador Galiz, 1990)
- Informe de Evaluacion de las Experiencias Nicaragüenses con la Bomba de Mecate (IRC, 1995)
- Cobertura comunal con bombas de mecate familiares evaluación, Nynke Caroline Post Uiterweer, Wageningen University, Technology Transfer Division Bombas de Mecate, S.A. 1999/2000
- The Impact of Farm Water Supply on Smallholder Income and Poverty Alleviation along the Pacific Coast of Nicaragua, J.J. van der Zee, A. Fajardo Reina, H. Holtslag, 2002.
- A Multi-sectoral Approach to Sustainable Water Supply: The Role of the Rope Handpump in Nicaragua, J.H. Alberts and J.J. van der Zee (International Symposium on Water, Poverty and Productive Uses of Water at the Household Level, Muldersdrift, South Africa, Jan. 2003)
- El Mercado de las Bombas de Mecate (World Bank WSP – DFID – SDC - RASNIC, 2008)
- A Randomized Trial of the Impact of Rope Pumps on Water Quality, A.C.Gorter, J.H.Alberts, J.F.Gago, P.Sandiford, Journal of Tropical Medicine and Hygiene, 1995; 98:247-255

The first publication documents the first ten years of development of the rope pump in Nicaragua, including technical, socio-economic and methodological aspects for the adoption, development, construction and maintenance of the rope pump.

An extensive evaluation was conducted in 1995 by IRC and covered technical, institutional, social, and financial issues in relation to the wide scale application of the rope pump in Nicaragua. The evaluation highlighted:

1. The potential of the rope pump as a valuable addition to the range of appropriate groundwater lifting technologies.
2. The feasibility of local manufacturing, marketing and installation by a local private sector comprising small local mechanical workshops
3. The accessible investment cost (approximately US$ 80 for a pump at the time of the evaluation) for individual households and farmers; this is the cost of the rope pump and does not include the cost of the well or installation
4. The feasibility for users to carry out the simple operation and maintenance requirements of the rope pump with minimal support from the local private sector for spare parts

The evaluation concluded the following:

- The rope pump can potentially form a valuable addition to the range of appropriate groundwater lifting technologies in other countries.
- For many countries the rope pump has the potential to be locally manufactured, marketed and installed by the private sector, including smaller local mechanical workshops. Operation and maintenance requirements are relatively low and simple, and therefore with some minimal support from the local private sector (e.g. through some repairs, spare parts support), O&M can

be done by the users themselves. This is particularly attributable to the absence of piston, foot and piston valves, pump rods etc. However, there is a need for constant attention to simple but regular maintenance requirements. The rope pump is, for many conditions, a sustainable technology.

Other conclusions were that the success of the rope pump in Nicaragua is the result of:

- the initial interest of the individual families to install the pump for farm activities (cattle watering; small-scale irrigation) and also for domestic water uses, and
- the interest of national technical institutions and the private companies (small workshops) to experiment with design and to improve the parts of the pump.

It was also deemed that the pump still needed technical improvements and that there was a lack of standardized designs and prescribed manufacturing processes given that the individual workshops differed in their designs and product quality. For instance, BOMESA used construction steel for the pump structure whereas the two other main producers used galvanized pipes for the pump structure.

By the time of the IRC evaluation in 1995, the rope pump technology had become an integral part of rural water programmes implemented by NGOs and government agencies in Nicaragua with significant funding provided by SNV, SDC and UNICEF.

The paper presented by J.H. Alberts and J.J. van der Zee in 2003 highlighted the impact of the rope pump in Nicaragua in:

1. Increasing rural water supply coverage by 23.6% between 1995 and 2002, accounting for 85% of the total increase in coverage from 27.5% to 54.8% during this period
2. Generating an additional annual household income of US$225 based on a comparative study of farm income, representing an average increase of up to 50% of the total income for lower income farm families[16]

In 2008, the Water and Sanitation Programme (WSP) of the World Bank commissioned a study focusing on the supply and demand of the small entrepreneurs dedicated to the market for the rope pump in Nicaragua. The study concluded that:

1. Nicaragua had 50,000 rope pumps installed by 2008, that there were approximately 250,000 wells without pump. This was deemed to represent a market of US$ 125,000 monthly during a 5-year period.
2. The market for the rope pump in Nicaragua was in decline.
3. The five factors that influenced the demand for the rope pump were:
    i. Price
    ii. Consumer income

[16] This finding was presented in the paper *A Multi-sectoral Approach to Sustainable Water Supply: The Role of the Rope Handpump in Nicaragua,* written by J.H. Alberts and J.J. van der Zee and presented at the International Symposium on Water, Poverty and Productive Uses of Water at the Household Level, Muldersdrift, South Africa, Jan. 2003). It is based on the application of a FAO methodology known as Land Evaluation for Agricultural Development to 1,469 non-rented farms of less than 21 ha in 8 municipalities of the Pacific Coast region of Nicaragua.

iii. User preferences
iv. Expectation in relation to the rope pump
v. Product complementarity

The market study made a series of strategic recommendations aimed at improving the sales of the rope pump. Its recommendations were loosely organized based on the 4 Ps of marketing (product, price, place and promotion) and presented as follows regarding:

1. the product itself;
2. the manufacturers,
3. the marketing process and promotion, and
4. training of end-users.

The study's strategic recommendations for **the product** itself consisted in:

a. Standardization
b. Brand design and registration
c. Product labelling and a new commercial name
d. Development of kits of replacement parts
e. Preparation of a manual for installation, operation and maintenance
f. Emission of a quality certificate
g. Environmental certification

The study's strategic recommendations for **the manufacturers of the rope pump** consisted in:

a. The creation of an association of manufacturers
b. The adoption of quality standards and specifications
c. The reduction of production costs
d. The promotion of financing mechanisms and policies
e. Training programs for manufacturers

The study provided strategic recommendations for **the marketing process** based on a generic strategy taking into account the limited budget given the reduced size of the rope pump market, and consisted in:

a. Changing the perception of the rope pump as an inferior product that necessarily is provided by a donor to being a market product with an economic value and market price
b. Expanding the possibilities of acquiring a rope pump for users through efficient distribution networks, financing and after-sales servicing

The study provided a final strategic recommendation to provide adequate training about the rope pump at the local level, to ensure that **end users and/or rural communities** have the necessary skills to correctly install, operate and maintain rope pumps. To the knowledge of this evaluation's author, the only efforts to take up the specific recommendations of the study to date are those of the Nicaragua SMART Centre, starting in 2017. Only a minimal part of the recommendations were realized, mainly due to the lack of funds, organisations, and people who could take them into practice.

A 1995 study published in the Journal of Tropical Medicine and Hygiene concluded that replacing a rope and bucket on an open well by a rope pump drastically reduces water borne diseases.

It is noted that the publications reviewed broadly cover the first 20 - 25 years of the history of the rope pump in Nicaragua. This assessment thus represents an update of the evolution and current status of the rope pump in Nicaragua, 40 years after its initial introduction as an alternative technology and roughly applying what can now be referred to as the **SMART approach** to sustainably scale the rope pump in the Nicaraguan WASH sector as a solution for access to water for both communities and individual families.

The national information system of rural WASH services (SIASAR) database (and supplementary sources)

An analysis was conducted using available sources and consulting with the municipal WASH units in each municipality in order to reach the conclusion that there are as many as 50,000 rope pumps currently in use in Nicaragua.

The initial source of information assessed was SIASAR. Starting in 2010, the rural water and sanitation information system (SIASAR) was introduced to Nicaragua as part of a World Bank supported effort in multiple countries, first in Central America and now globally.

This system has been widely implemented in Nicaragua achieving data collection in 100% of the communities and municipalities. In most cases however, data collection has been limited to community-level systems and/or water points and generally does not include the registry of family-level systems and/or water points even if used communally.

The existing registry[17] of communal hand dug and borehole wells in Nicaragua – almost all of which can be expected to be equipped with a rope pump – accounts for 3,119 wells with representation in each of the country's 17 departments and autonomous regions with the sole exception of Masaya. At the level of municipality, a total of 98 municipalities out of the total of 152 (64.5%) register the existence of at least one communal hand dug well with the maximum number of wells registered being 203 in the municipality of Leon.

Department	Hand dug Well	% HDW	Borehole Well	% BHW	Total	% of Total
Boaco	57	21%	220	79%	277	9%
Carazo	7	28%	18	72%	25	1%
Chinandega	15	12%	107	88%	122	4%
Chontales	35	9%	337	91%	372	12%
Estelí	49	34%	94	66%	143	5%
Granada	5	71%	2	29%	7	0%
Jinotega	37	32%	77	68%	114	4%
León	136	30%	322	70%	458	15%
Madriz	135	24%	422	76%	557	18%
Managua	7	21%	26	79%	33	1%
Matagalpa	85	24%	273	76%	358	11%
Nueva Segovia	145	60%	98	40%	243	8%
RACCN	202	87%	29	13%	231	7%
RACCS	19	90%	2	10%	21	1%
Río San Juan	17	46%	20	54%	37	1%
Rivas	3	3%	92	97%	95	3%
Unidentified	14	54%	12	46%	26	1%
Total general	968	31%	2151	69%	3119	100%

[17] The SIASAR registry is updated continuously.

The functionality of 2,416 (77%) of these wells has been evaluated and shows that 85% are functional with 50% in good condition and 35% in regular condition.

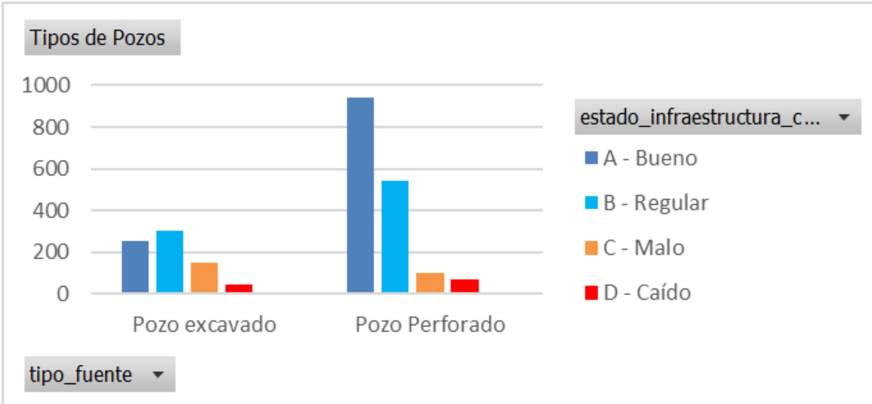


Figure 1: Reported functionality of wells by type (pozo excavado = hand-dug well, pozo perforado = borehole well; A – good condition, B – regular condition, C – bad condition, D – abandoned)

Faced with the limitations of SIASAR with respect to its omission of private family wells, an assessment was conducted combining multiple sources of information and aimed at approximating the number of private wells and the number of those likely to be equipped with the rope pump.

The methodology used was as follows:

- The SIASAR data registry was used to determine the population without access to water from a registered communal water point; this data is considered to be updated continuously
- A survey of Municipal WASH Units[18] was conducted as part of this assessment to estimate the percentage of those households without access to water from a registered communal water point or communal water supply system that is likely to obtain water from a private hand dug well and of those how many are likely to be fitted with a rope pump
- The results of the most recent agricultural census (CENAGRO)[19] were cross-referenced with respect to the total number of private hand dug and borehole wells reported

With the collaboration of INIFOM[20], an online survey was conducted with the municipal WASH units across the 15 departments and 2 autonomous regions that comprise Nicaragua. With information collected from 124 (82%) of the total of 152 municipalities it can be estimated that there may be as many as 47,500 rope pumps currently in use on private wells in Nicaragua. The estimate ranges from a conservative number of 15,087 to a maximum of 47,653 based on the rough assessment by municipal WASH officers of the percentage of families without access to communal systems that have private wells and of those wells the percentage equipped with rope pumps. To simplify the survey municipal WASH

[18] The Municipal WASH Units *(UMAS/H: Unidades Municipales de Agua, Saneamiento/ e Higiene)* are part of the municipal government's technical teams in Nicaragua. Although they lack any formal legal framework these units (usually comprising a single person in each municipality) are in charge in fact for access to WASH in the rural sector.
[19] IV Censo Nacional Agropecuario (CENAGRO) was carried out between May 15 and June 16, 2011 by the Nicaraguan Institute for development Information (INIDE) in coordination with the Ministry of Agriculture and Forestry (MAGFOR).
[20] *Instituto Nicaragüense de Fomento Municipal (INIFOM)*: The Institute for the Promotion of Municipalism.

officers were asked to select between 4 options of ranges: (1) less than 25% (2) between 25% and 50% (3) between 50% and 75% (4) greater than 75%.

In the case of the municipal survey, a total of 87 municipalities reported the existence of rope pumps on private family wells while 37 municipalities claim that the rope pump is not used on such wells. This reflects the presence of rope pumps in 70% of all municipalities that responded to the survey. Of the 28 municipalities that have not responded to the survey, 26 are known by the evaluator to have wells with rope pumps which would mean that families in a total of 112 municipalities (74% of the total of 152 municipalities) are using the rope pump.

This is in addition to the 3,119 rope pumps likely to be in use on communal wells as per the official SIASAR data and likely in addition to unreported hand dug wells equipped with rope pumps in the majority of peri urban towns on the Caribbean Coast that are classified as urban and therefore not registered neither by SIASAR nor by CENAGRO.[21]

The 2011 CENAGRO survey reports a total of 69,968 private wells – 60,810 were hand dug wells[22] and 9,158 were borehole wells - associated with an equal number of farming areas of a total of 262,546 farms ranging from 0.35ha to more than 350ha. Farms with wells represent 26.6% of the total; 53,550 (20.4%) are connected to public distribution networks; 36.5% obtain water from rivers, streams, lagoons, lakes, water holes, rainwater, dams, and estuaries; the remaining 16.5% report not having any source of water. The CENAGRO survey does not specify whether or not wells are equipped with hand pumps, nor the type of hand pump used.

Comparing the results of the CENAGRO survey which reflects a total of 69,968 private household wells (60,810 hand dug wells and 9,158 artesian borehole wells) with the estimates obtained municipality by municipality on the basis of the SIASAR, this assessment adopts the estimate of 47,653 hand dug wells currently equipped with rope pumps, plus an additional 3,119 rope pumps associated with communal wells and an additional 2,814 wells with rope pumps conservatively estimated in peri-urban areas or towns on the Caribbean Coast of Nicaragua. The total consolidated estimate of wells equipped with functioning rope pumps in Nicaragua could reach 53,586.

[21] Hand dug wells with rope pumps are common in the cities/towns of Siuna, Rosita, Alamikambang, Waspam and Puerto Cabezas in the North Caribbean Coast Autonomous Region and also in Pearl Lagoon, La Cruz del Rio Grande, Tortuguero, Kukra Hill in the South Caribbean Coast Autonomous Region.

[22] *Pozo perforacion manual.*

CUADRO N° 11

NÚMERO DE EXPLOTACIONES AGROPECUARIAS QUE CUENTAN CON UNA O MÁS FUENTES DE AGUA DENTRO DE LA EA, POR FUENTE DE AGUA, SEGÚN TAMAÑO DE LAS EXPLOTACIONES AGROPECUARIAS

Tamaño de las EA	Total de EA	Total de EA que Cuentan con una o más Fuentes de Agua	Fuentes de Agua									
			Río/ Quebradas	Laguna o Lago	Manantial/ Ojo de Agua	Recolección de Agua de LLuvia	Represa	Pozo, Perforación Manual	Pozo Artesiano	Esteros	Red Pública	No Tiene Fuente de Agua
El País	**262 546**	**219 083**	**91 206**	**5 335**	**75 127**	**7 356**	**2 627**	**60 810**	**9 158**	**794**	**53 550**	**43 463**
De 0.5 Manzana a Menos	31 804	23 855	2 027	194	987	811	35	6 421	960	31	14 860	7 949
De 0.51 a 1 Manzanas	16 676	11 994	2 143	162	1 341	530	39	3 420	506	20	5 661	4 682
De 1.01 a 2.5 Manzanas	38 215	27 714	7 001	395	4 530	1 373	143	7 899	1 389	54	10 291	10 501
De 2.51 a 5 Manzanas	35 672	27 428	8 907	409	6 730	1 095	198	7 823	1 207	55	7 995	8 244
De 5.01 a 10 Manzanas	33 686	28 229	11 294	505	9 734	874	301	7 859	1 174	72	6 034	5 457
De 10.01 a 20 Manzanas	29 881	26 680	12 866	592	11 589	646	352	7 322	949	72	3 714	3 201
De 20.01 a 50 Manzanas	37 440	35 135	20 507	1 011	17 972	807	547	9 453	1 168	148	2 956	2 305
De 50.01 a 100 Manzanas	21 238	20 490	13 649	805	11 717	563	428	5 428	734	142	1 143	748
De 100.01 a 200 Manzanas	10 911	10 680	7 642	588	6 418	368	277	3 004	510	90	545	231
De 200.01 a 500 Manzanas	5 469	5 360	4 000	466	3 248	206	205	1 629	366	70	262	109
De 500.01 a más Manzanas	1 554	1 518	1 170	208	861	83	102	552	195	40	89	36
Departamentos												
Nueva Segovia	17 739	14 617	7 685	196	5 894	287	178	1 889	486	22	2 712	3 122
Jinotega	30 330	25 137	12 481	507	13 110	544	711	2 181	455	96	5 281	5 193
Madriz	13 744	12 358	4 005	186	3 128	768	142	4 271	1 543	8	2 422	1 386
Esteli	10 951	10 168	4 123	154	3 000	325	410	3 442	412	14	3 308	783
Chinandega	15 368	12 674	3 089	76	1 446	194	75	8 670	494	85	2 502	2 694
León	18 274	15 226	2 623	66	2 013	235	63	9 598	580	39	3 916	3 048
Matagalpa	29 041	21 688	10 128	788	9 641	679	413	3 443	910	37	5 493	7 353
Boaco	12 487	9 642	4 394	382	3 993	290	109	3 117	618	67	1 412	2 845
Managua	13 131	9 274	2 011	127	483	604	78	3 374	414	35	3 939	3 857
Masaya	14 905	12 727	73	25	60	1 117	7	573	387	10	11 445	2 178
Chontales	8 366	7 612	4 320	301	3 621	271	106	2 221	662	210	330	754
Granada	5 616	4 342	478	153	128	79	15	1 150	365	14	2 608	1 274
Carazo	7 959	6 623	1 279	8	371	327	11	1 301	195	14	4 460	1 336
Rivas	12 242	8 764	2 053	491	492	138	98	5 554	393	18	2 028	3 478
Río San Juan	9 138	8 396	4 746	370	3 895	127	31	2 847	135	51	257	742
RAAN	20 541	18 106	12 184	719	9 271	729	102	3 018	695	11	449	2 435
RAAS	22 714	21 729	15 534	786	14 581	642	78	4 161	414	63	988	985

Figure 2: Cenagro survey data, 2011.

Municipal Centre	population (2005 census)	households	households with wells with rope pumps
RACCN			5%
Siuna	64,092	12,819	641
Rosita	22,723	4,545	227
Alamikambang	16,105	3,221	161
Waspam	47,231	9,447	472
Puerto Cabezas	66,169	13,234	662
RACCS			
Pearl Lagoon	10,676	2,136	107
La Cruz de Rio Grande	23,284	4,657	233
Tortuguero	22,324	4,465	223
Kukra Hill	8,789	1,758	88
TOTAL ESTIMATED ROPE PUMPS			2,814

Figure 3: Estimate of wells with rope pumps in urban/municipal administrative centres in 9 municipalities of the North and South Caribbean Autonomous Regions.

Rope pump manufacturers

Manufacturers

There are currently three centrally located and widely known (relatively speaking) manufacturers of rope pumps that have been actively producing and selling rope pumps to clients nationally since 1990.

No.	Manufacturer	Contact Person	Location	Website or Social Network link
1	Bomba de Mecate, S.A.	Ricardo Guzman	Los Cedros	http://www.ropepump.com/
2	Aerobombas de Mecate o AMEC	Luis Roman Rivera	Managua	https://www.facebook.com/amecnicaragua/
3	Taller Electromecánico	Reinhard Erlach	Managua	https://www.tallerelectromecanico.net/services/equipo-y-perforacion-de-pozos/

Testimony from each of these rope pump manufacturers supports the claim that collectively these three small companies had produced a total of more than 70,000 pumps between 1990 and 2021 (30 years) [23] with BOMESA calculated to have produced and sold as many as 38,600 pumps, AMEC 14,962 pumps and Taller Electromecanico 20,110 pumps.

It is calculated that as many as 19 more locally-based manufacturers have produced a combined total of approximately 13,850 additional rope pumps. This makes for a total calculated production of approximately 87,715 rope pumps which indicates that perhaps 43% of rope pumps have been replaced since 1990 by electric pumps.

No.	Manufacturer	Location	Start	Pumps Sold
1	BOMESA	Los Cedros, Mateare	1988	38600
2	Taller Electromecanico	Managua	1991	20110
3	AMEC	Managua	1991	14955
4	INRA-CITA	Managua	1983	200
5	Taller Metalico (Nelson Morazan)	Ocotal	2000	1040
6	Juan Carlos Gil	Ocotal	1991	890
7	Taller Rafael Castilla Castro	Juigalpa	1989	5000
8	Silvio Melendez	Juigalpa		365
9	Bernardo Vivas Gonzalez	El Sauce	n.d.	365
10	Victor Montoya	Morrito	n.d.	365
11	Yasser Maradiaga	Esteli	n.d.	365
12	Roger Jose Picado Herrera	Esteli	n.d.	365
13	Taller Parales	Esteli	n.d.	365
14	Carlos Vidal Tenorio Corea	San Juan de Limay	n.d.	365
15	Bernardo Polema Falcon	San Juan del Sur	n.d.	365
16	Taller de Mujeres Xochilt Acalth	Siuna	1994	1000
17	Taller Don Pompilio	Malpaisillo	1983	500
18	Taller sin nombre	Esteli	n.d.	500
19	Taller Ernesto	Boaco	1992	600
20	Miguel Matamoro	Somotillo	2010	150
21	Perfor (Roger Rio)	Dario	2005	50
22	Taller Las Planetas	Leon	1990	400
23	El Porvenir	Sebaco	1995	800
TOTAL				87715

Figure 3: Estimate of rope pumps manufactured and sold since 1990.

[23] Henk Holtslag provided the following figures for 2005: BOMESA (32,000), Taller Electromecanico (12,000), AMEC (8,000) for a total of 52,000 plus an estimated additional 9,880 produced by as many as 10 smaller local producers.

Only AMEC shared actual sales data from 2021 reflecting a total sale of 212 rope pumps, of which 108 (51%) were sold to NGOs, 80 (38%) to local distributors (hardware stores) and 14 (7%) directly to the general public; the remaining 10 (5%) were sold to a client in Honduras. None of the other rope pump manufacturers shared actual sales data, either because they do not keep accurate or well documented records or because they were unwilling to share such information.

Photo 1: Assembled rope pumps and parts at the AMEC factory in Managua.

The survey conducted of municipal government WASH units and NGOs identified that in 2022, as many as ten additional local artisans currently make and sell rope pumps at a much more local level in as many as 7 of Nicaragua's 17 departments and autonomous regions (41%). Since the rope pump was first introduced a total of 19 small local artisans have been identified. These artisans generally sell their pumps directly to the end user or to local sales points and it is estimated that they have collectively produced and sold as many as 13,850 pumps in total.

No.	Artisan	Location	Department or Autonomous Region
1	Taller Artículos Metálicos / Nelson Morazán*	Ocotal	Nueva Segovia
2	Juan Carlos Gil	Juigalpa/Comalapa	Chontales
3	Silvio Meléndez	El Sauce	León
4	Bernardo Vivas Gonzalez	Morrito	Rio San Juan
5	Victor Montoya	Estelí	Estelí
6	Yasser Maradiaga	Estelí	
7	Roger Jose Picado Herrera**	Estelí	
8	Taller Parales	San Juan de Limay	
9	Carlos Vidal Tenorio Corea	San Juan del Sur	Rivas
10	Bernardo Polema Falcon	Siuna	RACCN

Figure 4:.Currently active rope pump manufacturers

Notes:
*Nelson Morazán also appears as Somoto, Madriz.
**Roger Jose Picado Herrera also appears for the municipality of El Jicaro, Nueva Segovia.

Models and Pricing
There is no formal standard of the rope pump; this may be considered to be a result of its evolution as an alternative technology and there has been no registration of a patent let alone a standard design. Manufacturers in Nicaragua offer a series of models of rope pump and what might be considered as the "standard" model also differs between manufacturers. The model that became more or less the industry standard for hand dug wells consists of a metallic structure that is fixed or mounted on top of the well cover which is commonly a slab of reinforced concrete. Examples of this model are shown on the following page. Although the pump structures differ, the most important parts being the PVC pipes and the pistons (washers) are standardized so each pump model uses the same pipes and pistons.

Pricing for rope pumps varies slightly on the basis of details of the construction with respect to the use of industrial ball bearings or iron bushings, galvanized pipe or construction steel rebar for the structure, depth of well and type of well (hand dug versus borehole).

These are referential January 2022 prices obtained from some of the manufacturers:

Manufacturer	Standard Rope Pump	Notes
AMEC (Managua)	USD 120 – 190	The higher price range is for pumps made with ball bearings instead of bushings; structure uses galvanized iron pipes; installation cost is USD 25 + transport
Taller Electromecánico (Managua)	USD 120	
BOMESA (Los Cedros, Mateare)	USD 140	
Fabrica de Artículos Mecánicos (Ocotal)	USD 190 – 230	Pumps are made with ball bearings and are fully covered; Rebar of 5/8" and 3/8" is used for the structure; installation costs range from USD 30 – 40 + transport
Taller Bernardo Polema (Siuna)	USD 140	

Photo 2: Standard rope pump manufactured by Bombas de Mecate, S.A. (BOMESA), El Cedro.

Photo 3: Standard rope pump manufactured by AMEC, Managua. This model uses galvanized pipe, wheel cover and a smaller wheel

Photo 4: Standard rope pump with protective covering made by *Fabrica de Artículos Metálicos*, Somoto.

In addition to what has become the “industry standard” in Nicaragua, a number of alternative models of rope pumps has been developed, including:

1. The “bomba kit” model: the simplest version of the rope pump for hand dug wells and mounted on wood posts
2. The “bicibomba” model: operated by pedalling a bicycle to activate the drive shaft
3. The “bomba elevada” model: that elevates the water column several meters above the well head
4. The “aerobomba” model: driven by a wind-mill
5. The “bomegas” model: driven by a gasoline engine
6. The “bometran” model: driven by animal traction, most commonly a horse

Of these alternative models many have been sold over the years and are still available on the market. For instance[24]:

- Of the “bomba kit” (basic rope pump) some 200 have been sold. In recent years this model has been promoted for use in indigenous communities of the Caribbean Coast on traditional unlined family wells with wooden covers. The wooden posts need to be replaced with a certain frequency in dependence on the durability of the wood.
- Of the “Bicibomba” (bicycle rope pump) some 350 have been installed but somehow did not take off as much as expected, probably because it was less convenient and was more expensive.
- Of the “bomba elevada” (elevated rope pump) some 500 have been installed by AMEC and more by BOMESA. This model is used to fill up an elevated tank and has been implemented primarily in rural schools and health clinics.
- Of the “Aerobomba” (wind-powered rope pump) over 420 have been sold and used mainly for irrigation and cattle watering. This model was evaluated in 1991 with funds of the Dutch embassy resulting in an international workshop. (https://www.arrakis.nl/wind-energy/supporting-studies). The wind-powered rope pump technology was transferred with one short mission to Guatemala, Bolivia, Peru and Argentina. In none of these countries did the technology take off. Reasons were lack of funds for a long term follow up, for installation of a critical mass and hence a lack of market.
- Of the “Bomegas” (gasoline powered rope pump) and “Bometran” (animal traction powered rope pump) models were developed with support of Practica foundation and some 120 have been installed mainly on wells of 20 to 70 m deep. More recently the “Bomegas” model has been promoted for emptying and cleaning hand dug wells.

Recently the concept of the rope pump has also been adapted to develop a model for extracting highly fluid fecal sludge from poor-flush septic tanks. The prototype for this has been trialed and is currently in the process of marketing.

Production/Sales: Historical Trends and Actual State of Affairs

Few of the manufacturers maintain or were willing to share accurate statistics on the volume of production and sales of rope pumps neither historically nor recently (2021).

[24] These estimates were provided by the Managing Owner of AMEC which is the main supplier of these alternative rope pump designs.

In general terms, sales of the rope pump have declined considerably since the height of its promotion with the significant support of cooperation agencies (SDC, SNV, UNICEF) in the 1990s. It could be considered that the market in some areas is saturated and that current sales levels are more consistent with a stable market with some potential for minimal growth in a diversified market that includes other SMART pumping options, water filters, replacement parts and post-sales services. Another reason is the increased access to electrical energy services in rural areas and to a lesser extent the option of solar-powered pumping.

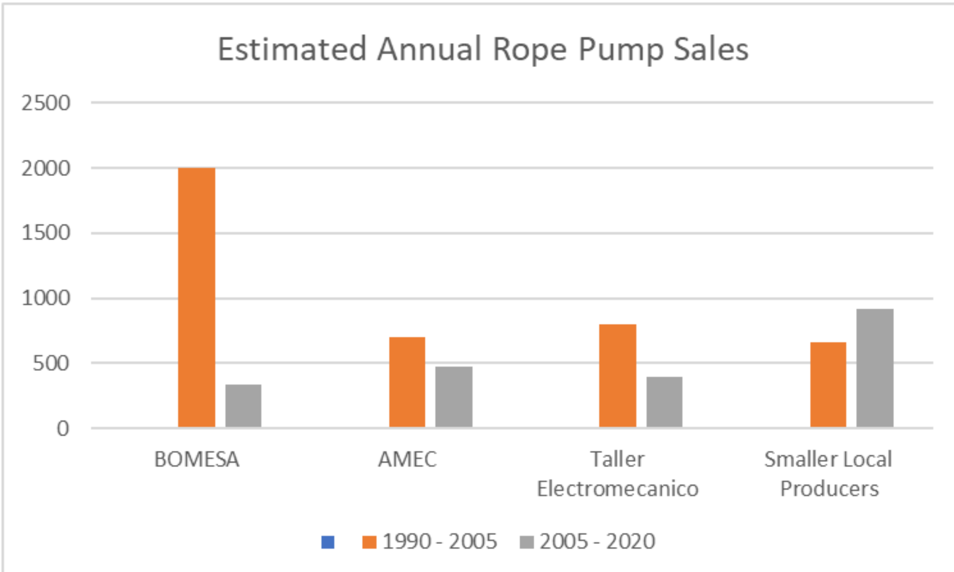


Figure 4: Trend in estimated annual sales of the 3 main producers and a variable group of smaller more localized producers between two 15 year periods.

Supply Chain and Self-supply

Coherent and established supply chain for the rope pump and its spare parts, linking manufacturers directly to end users as customers seems either not to exist currently in Nicaragua or to have stagnated in the absence of efforts to accelerate it in recent years prior to renewed efforts in this regard by the Nicaragua SMART Centre. Generally, maintenance is limited to replacing the rope periodically and this is often done with any similar commercially available rope on the market. There is very little testimony with regards to replacing other parts of the rope pump.

Nicaragua SMART Centre Sales:

The Nicaragua SMART Centre[25] was launched in 2018 under the auspices at the time of the Nicaragua Country Program of the international NGO WaterAid, and following three years of promoting the initiative to potential donors in the name of the Nicaragua Water and Sanitation Network (RASNIC).

During a four-year period from 2018 through 2021, the SMART Centre has made total sales of:

- 55 rope pumps
- 28 sales of various spare parts (guides, pistons, rope)

[25] The Nicaragua SMART Centre's official name is *Centro de Tecnologías SMART de Agua, Saneamiento e Higiene* and it is known commercially as *Centro SMART*.

In 2020, sales volumes increased 3.5 times over 2018 and in 2021, sales volumes increased another 4.9 times for a total increase in sales volumes of more than 17 times, reflecting what could be a latent demand.

Of this total:

- 82% of total sales volume has been to NGOs (78%) and private contractors (4%)
- 19% of total sales volume has been directly to the end user

There is a significant difference however with respect to sales of complete rope pump kits and replacement parts:

- For complete rope pump kits, 80% of unit sales has been to NGOs (76%) and private contractors (4%)
- 59% of sales volume of replacement parts has been directly to the end user with 41% to NGOs

As of July 2021, the SMART Centre has a formal consignment agreement with AMEC - one of the three main manufacturers of rope pumps – with its products on display and sales at the Centre including personalized service in accordance with the precise needs of each client in dependence on the conditions of the well (depth), water level, well head conditions, etc.

Market Assessment and the Evolution of the Supply and Value Chain

The Evolution of the Market for Rope Pumps in Changing Contexts in Nicaragua

A number of external contextual factors have had a significant influence on the market for rope pumps as a SMART solution to improve access to water in Nicaragua and particularly in rural areas.

1. The initial introduction of the rope pump as an alternative technology occurred in the 1980s via the Centre for Investigation of Alternative Technologies (CITA) under the government agency for agricultural reform (INRA) following on the Sandinista Revolution of 1979 and a context of innovation for rural development, trade embargos and/or economic blockade due to the US-backed contra revolutionary war; the 1980s also coincided with the **International Drinking Water Decade (1981 – 1990)**
2. Significant progress was achieved during the decade of the 1990s following the peace agreements, the reduction of the public sector, the return of combatants to work the land, and the expansion of the agricultural frontier.
3. Important reasons for the success of the rope pump was its low cost so it was affordable for families and farmers. Another reason was that it became a profitable product for a burgeoning local private sector and small entrepreneurs.
4. **Rural electrification:** In 2001 rural electrification was reported to be 47%. The efforts of the National Energy Commission with funding from IDB, World Bank, and the Swiss Counter-Value Fund for Rural Electrification raised rural electrification to 55%. This was followed by the National Rural Electrification Plan 2004 – 2013 which led to rural electrification reaching 96.7% by 2019 according to official reports. SIASAR however reports of rural electrification having reached 74% of the rural communities with the highest percentages of unserved populations in the North Caribbean Autonomous Region or RACCN (61%), South Caribbean Autonomous Region or RACCS (56%), Rio San Juan (53%), Jinotega (40%), y Chontales (40%). The fact that there is not

a direct correlation between levels of rural electrification and estimations of the current geographical distribution of rope pumps would seem to contradict the case study conducted in three rural settlements in the municipality of Villanueva where the introduction of rural electricity within 5 years of rope pumps being installed led to more than 80% of households abandoning their rope pumps and replacing them with low-cost electrically-driven centrifugal pumps. One explanation for this situation is the limited outside support after 1995 for efforts to promote the rope pump in what could be considered "new" domestic markets where the agriculture frontier expanded post-war and rural electrification has lagged behind due to issues of accessibility and historic exclusion or abandonment of the eastern and/or Caribbean regions of Nicaragua.

The Current State of Marketing, Supply and Value Chains and the Role of the Nicaragua SMART Centre

Since the marketing study report published in 2008 and until the launching of the Nicaragua SMART Centre with its mission of building multi-sector alliances to promote SMART WASH technologies in general, there is little evidence of specific marketing (promotion) efforts for the rope pump.

- None of the existing rope pump manufacturers has established a stable distribution network for pumps or spare parts
- Financing options for acquiring rope pumps have not been created
- After-sales servicing schemes are informal or non-existent
- Brand design and registration has not occurred

The Nicaragua SMART Centre aims to make a contribution in these areas based on its experience to date with the promotion of household-level water filters for household water treatment and storage (HWTS) and an updated mapping of the current market potential for the rope pump taking into account the option of low-cost electric pumps and solar pumps for shallow wells.

Manufacturers and Service Providers

In the previous section, three larger and centrally located rope pump manufacturers and ten smaller and local rope pump manufacturers have been identified and the majority of these have been confirmed. The three larger and at least one of the locally situated rope pump manufacturers does offer installation services. The assessment was not able to identify any certified independent service providers for rope pump installation and maintenance.

Local sales points

The municipal survey that was conducted as an integral part of this assessment has reflected the existence of local sales points for standard rope pumps with metallic frames in 14 municipalities of Nicaragua; this represents 16% of the 86 municipalities that responded to the survey confirming presence of the rope pump, and 9% of the total of 152 municipalities.

Non Governmental Organizations (NGOs) that implement (or have implemented) projects using the rope pump for community systems with a focus on pumps for self-supply for individual family, farm water systems

Non-governmental organizations have over the years played a key role in funding and implementing projects involving the rope pump.

An online questionnaire was circulated amongst the members of the Nicaraguan Water and Sanitation Network (RASNIC[26]) which agglomerates approximately twenty NGOs currently active in the WASH sector. Five organizations responded, of which four reported having implemented projects with the rope pump.

1. El Porvenir
2. World Vision
3. American Nicaragua Foundation (ANF)
4. Water For People
5. Fundación para el Desarrollo Social de Nicaragua

No.	Organization	Type of NGO	Total Number of Rope Pumps Installed	Number of Rope Pumps Installed in 2021
1	World Vision	International NGO	200 since 1990	5
2	Water For People	International NGO	None	
3	El Porvenir	US-Nicaragua NGO	350 since 1990	2
4	American Nicaragua Foundation (ANF)	US-Nicaragua NGO	400 since 1992	30
5	Fundación para el Desarrollo Social de Nicaragua	Nicaraguan NGO	45 since 2001	None

The four organizations that responded to the survey report having implemented rope pumps in all but two of the 17 departments and autonomous regions of Nicaragua. Two NGOs (World Vision and ANF) report having donated rope pumps to individual family wells (primarily for human consumption) in addition to communal wells and wells for schools and healthcare facilities. Rope pumps have been installed by these NGOs on both hand dug and borehole wells. These NGOs report purchasing rope pumps from the two most centrally located rope pump manufacturers (AMEC and Taller Electromecanico).

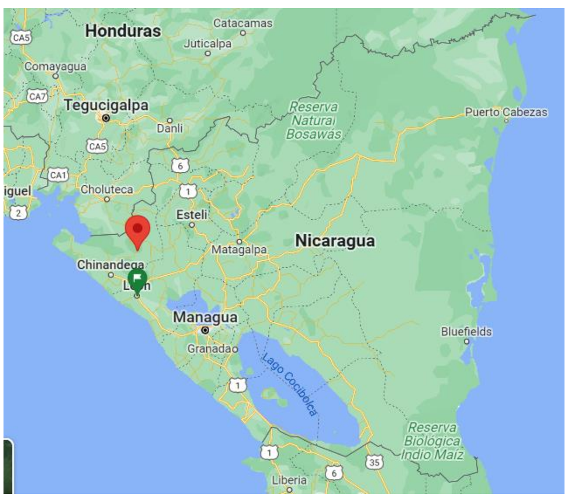
It is important to note that the involvement of large international NGOs in the WASH sector in Nicaragua has diminished in recent years and that major funding agencies – SDC, SNV and UNICEF - have also

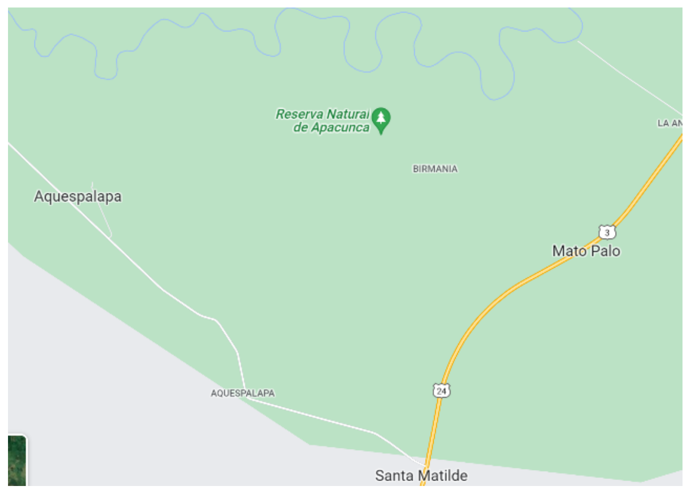
[26] *Red de Agua y Saneamiento de Nicaragua (RASNIC)*

ended their WASH programs. Large scale WASH programs implemented by international NGOs such as CARE, Plan International, SNV, ADRA, and others including Nicaraguan NGOs (CEPAD, AMC, FUPADE) all of which have either closed operations or eliminated their WASH programs in Nicaragua during the last 10 years would likely have accounted for the 20,000 subsidized rope pumps installed between 1990 and 2005 as per Henk Holtslag's total estimate of 61,880.

Case study of the evolution of accelerated self-supply: from rope pumps to electric pumps

Part of this assessment of the current status of the rope pump in Nicaragua and its impact as SMART technology and the SMART approach involved a case study of a project implemented in three rural communities in the municipality of Villanueva in the Department of Chinandega originally carried out in 2009. These findings are the result of two field visits conducted in the three communities.





The project was funded by a Dutch Rotary Club and its Nicaraguan partner; it was carried out in 2006 and involved the following activities:

- Manual drilling of shallow (8 – 18m) borehole wells applying the rota sludge method; the drilling was carried out by a local drill crew that received training onsite from rope pump manufacturer AMEC; each family provided additional unskilled manual labour during the drilling process
- Installation of rope pumps
- Construction of concrete troughs for water storage with an approximate volume of $2m^3$
- Distribution of locally produced ceramic pot household water filters[27]

[27] The ceramic pot household water filter is commercially sold in Nicaragua under the brand name FILTRON.

This case study provides insight and learnings into multiple aspects of the dynamic and potential impact of the SMART approach to sustainable access to clean water.

1. Water source availability:
   - groundwater is available at shallow depth (<20m) in the area of intervention which has characteristics of being a flood plain

2. Water quality:
   - water quality (taste) was reported to be a concern in 2 of the 39 wells (5%) visited and where the water from the well is used for cleaning, bathing and small-scale irrigation but not for human consumption

3. The technology:
   - standard rope pumps were installed in all of the wells initially and bicycle pumps were installed for trial on two existing hand dug wells
   - with the advent of rural electrification the vast majority were removed by the owners and replaced by electric-powered centrifugal pumps (ranging from 3/4 – 2hp); the rope pumps were reported to be still functioning at the time of replacement by electrical pumps

4. Training of the local private sector (drill crew/s and pump mechanic/s):
   - at the time of the project local capacity was established but lacked seed funding to be able to acquire drilling equipment and materials. as many as 9 additional privately-funded wells were constructed and rope pumps installed during the initial project implementation phase
   - business skills training was also lacking
   - in 2021, Centro SMART and AMEC established an incipient alliance so that one of the local drillers trained by the original project could offer services to local farmers to construct private wells; of an initial client base of 8 families, 4 (50%) were provided with wells (pump installation was not included in the services); the local drill crew rented the drilling equipment from the SMART Centre while AMEC supplied the materials for well construction

Photo 5: Luis Roman, owner-manager of rope pump manufacturer AMEC providing training at the Nicaragua SMART Centre technology demonstration site on the installation, operation and maintenance of a simple version of the rope pump..

5. Establishing and consolidating supply and value chains:
    - In relation to the previous aspect about training local drill crews and pump mechanics, the lack of financing (accompanied by business skills training)
    - Rope pumps and their spare parts are not readily available in the local market, despite claims by AMEC to have tried to establish a local point of sales within one of the communities; replacement parts are located in Managua at a distance of 150km
    - Low-cost electrical centrifugal pumps are readily available in the local market in Chinandega at a distance of less than 50km

6. Private/family systems versus communal/institutional systems:
    - The primary focus of the project was private/family systems whose functionality has been resilient as a result of an evident necessity and the initiative for self-supply

Photo 6: A still functioning original rope pump on family well (shared by two households) used for human consumption, washing, bathing and irrigation of patio garden, Matapalo village.

Photos 7: Original rope pump still in use, Matapalo village, Municipality of Villanueva, Chinandega.

Photo 8: Original rope pump no longer in use, replaced by electric centrifugal pump (Truper, 1HP), Aquespalapa, Municipality of Villanueva, Chinandega.

The total number of family wells drilled was fifty (50), forty (40) officially funded by the project and ten (10) additional wells that were paid for by the users. On average there are 5 inhabitants per household which means that approximately 250 people were reached.

The direct cost of each well was in the order of USD$ 850 including the well, rope pump and ceramic pot filter (given the brand name Filtron in Nicaragua)[28]. Households contributed with unskilled manual labour during the drilling process and local materials for the borehole well filter pack.

Of the total number of fifty wells, the field evaluation team was able to visit 39 due to 3 being considered off access by the owner and the rest due to accessibility and time constraints. Of the 39 wells visited, 4 (10%) were no longer in use. The reasons for disuse varied:

- In one case, the family had sold the land to a large landowner and the plot was no longer inhabited
- In another case the house is uninhabited
- In another, the family receives water from an electrical pump installed on a nearby neighbours' hand dug well
- In the fourth well that is no longer functioning, the well casing collapsed

The wells range in depth from 12 to 18 meters apparently in dependence of the soil conditions taking into account that the drilling method (rota sludge drilling) is a manual process. The static water level ranges from 7 to 10 meters in all of the wells. None of the wells visited reported drying up during the drought or dry period of the year (November through April) although one household reported low yields year round.

Of the 35 functioning wells visited, the original rope pumps were found to be still in use (and functioning) on 7 wells (20%) while in the remaining 28 wells (80%) the original rope pumps have been abandoned and replaced by small electric centrifugal pumps of ¾ - 2HP; in most cases the original structures of the rope pump can still be found near the well. Two of the 7 functioning rope pumps were found in a small sector (La Huerta) which remains without electricity while the rest of the functioning rope pumps (5 of a total of 33, equivalent to 15%) were found in the communities of Aquespalapa and Matapalo, which were reached by a rural electrification project in or around 2011, five years after the Rotary Club funded project was completed. It has been reported that gasoline combustion engines are used for two wells but the field investigation team was unable to visit these as they are on private land without permission to enter.

[28] This figure was provided by Luis Roman Rivera who was in charge of the project as managing owner of Aerobomba de Mecate (AMEC), one of the rope pump manufacturers and a multi-service water supply system contractor that offers well drilling, water tank and distribution system installation services.

Photo 9: Sign indicating rural electrification project in Aquespalapa (exact date unknown but sometime around 2011).

It should be noted that the purchase and installation of the 28 electrically-powered centrifugal pumps was the result of pure self-supply with households purchasing pumps in hardware stores in the city of Chinandega (approximately 50km away). The cost of these pumps (not including wiring and piping) is in the order of USD 40 to 50 and households reported having to replace them with relative frequency (every 2 – 3 years). Electricity costs for households with electrically-powered pumps were reported to be in the range of USD$ 10 per month.

The level of service should be considered to continue to be at the top of the drinking water ladder (safely managed) while 80% of households have moved up the "technology ladder" from manual pumping to electrical pumping.

Regarding water quality however, it should be noted that household filters for removing bacterial pathogens was evidenced in only 2 (5%) of the 39 households visited. In one case the family was using a clay pot (or FILTRON) filter while in the other case the family had purchased a sophisticated ultramembrane filter. In general, there was limited recollection of the filters that had been donated nor why they were no longer in use. None of those interviewed knew where filters could be purchased.

Drinking Water Ladder

Safely managed
Drinking water from an improved water source which is located on premises, available when needed, and free of faecal and priority contamination

Basic
Drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip, including queuing

Limited
Drinking water from an improved source where collection time exceeds 30 minutes for a round trip to collect water, including queuing

Unimproved
Drinking water from an unprotected dug well or unprotected spring

Surface water
Drinking water directly from a river, dam, lake, pond, stream, canal, or irrigation channel

In the vast majority of the households the water from the well is used for drinking; only in one case did the household report that the smell and flavor of the water meant that they brought drinking water from another community. Besides domestic uses, 30% of the households reported using it for small livestock (chickens), 27% to water the patio, and 15% for irrigation of crops, primarily feed crops for cattle. Two wells are used to irrigate areas of ½ manzana or 0.85 acres.

Annual income data was collected for 12 of the 50 households with wells that were visited by asking the homeowner to provide an estimate. Reported income ranged from USD$ 667 to USD$ 4,167 with an average of USD$ 2,083 per household.

Well	Community	Annual Income		Monthly Income		Daily Household Income
POZO 3	Aquespalapa	C$ 150,000	$ 4,167	C$ 12,500	$ 347	$ 11.57
POZO 4	Aquespalapa	C$ 108,000	$ 3,000	C$ 9,000	$ 250	$ 8.33
POZO 6	Aquespalapa	C$ 48,000	$ 1,333	C$ 4,000	$ 111	$ 3.70
POZO 7	Aquespalapa	C$ 30,000	$ 833	C$ 2,500	$ 69	$ 2.31
POZO 8	Aquespalapa	C$ 120,000	$ 3,333	C$ 10,000	$ 278	$ 9.26
POZO 9	Aquespalapa	C$ 120,000	$ 3,333	C$ 10,000	$ 278	$ 9.26
POZO 10	Aquespalapa	C$ 108,000	$ 3,000	C$ 9,000	$ 250	$ 8.33
POZO 12	Aquespalapa	C$ 60,000	$ 1,667	C$ 5,000	$ 139	$ 4.63
POZO 21	Matapalo	C$ 48,000	$ 1,333	C$ 4,000	$ 111	$ 3.70
POZO 47	La Huerta	C$ 24,000	$ 667	C$ 2,000	$ 56	$ 1.85
POZO 48	La Huerta	C$ 36,000	$ 1,000	C$ 3,000	$ 83	$ 2.78
POZO 50	La Huerta	C$ 48,000	$ 1,333	C$ 4,000	$ 111	$ 3.70
	Average	C$ 75,000	$ 2,083	C$ 6,250	$ 174	$ 5.79

Comparative case study of the sustainability of the rope pump for community and individual family use in a rural setting

Although this assessment was unable to carry out a comparative case study of the sustainability of the rope pump for community and individual family use in a similar rural setting, reference is made to the results of an evaluation conducted in 1999 – 2000 of five projects implemented in Nicaragua (4) and El

Salvador (1), each by a different organization (4) or government entity (1)[29]. The evaluation inspected 166 rope pumps and interviewed 139 families.

The most important results of the evaluation were the following:

1. All projects evaluated with family level service were considered to have been successful, by both the implementing organizations and protagonists. The families expressed their preference for rudimentary family wells over well-built communal wells.
2. The majority of the families interviewed expressed being capable to maintain and repair the rope pump when necessary.
3. The installation of rope pumps resulted in a change of habits in relation to clothes washing for 50% of the protagonists that stopped washing clothes in the river. All interviewed used the well water where the rope pump was installed for drinking.
4. 6.6% (11 of 166) of the rope pumps inspected were found to be out of service due either to technical faults or neglect

At a national level, there is currently 85% functionality of communal well rope pumps as reported by FISE based on the SIASAR information system which presents the results of the evaluation of 2,416 of a total of 3,119 registered communal wells with rope pumps. Of these 50% of the pumps have been assessed to be in good condition and 35% in regular condition. It is notable that functionality is 90% on borehole wells while it is 74% on hand-dug wells.

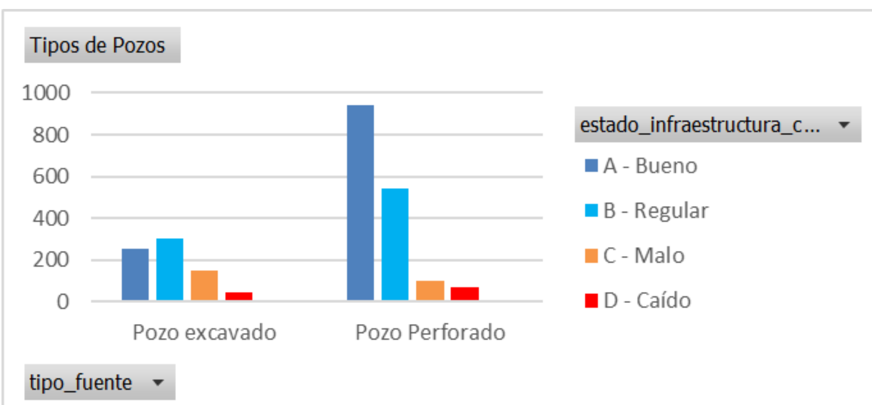


Figure 4: Degree of functionality of rope pumps on all registered communal wells.

Conclusions

The conclusions drawn by this rapid assessment are as follows:

1. Forty years after being introduced to Nicaragua, the rope pump continues to play a significant role in affordably improving access to water in rural and peri urban areas, particularly for dispersed

[29] Centro de Estudio y Promoción Social (CEPS), CARE, Plan International, Instituto Nicaragüense de Tecnología Agropecuaria (INTA), Doctors without Borders Holland.

settlements and rural farming families where the rapid expansion of rural electrification has yet to reach. Family wells with self-supplied rope pumps on premise may account for as many as 50,000 households (14%) of the 356,655 households currently considered to be without access to water supply based on the SIASAR information system. The SIASAR information system reports that are more than 3,119 registered communal wells equipped with rope pumps of which 85% are functional.

2. The effect of the introduction of this low-cost technology and the long-term technical assistance (coaching) in production, quality control and marketing resulted in the fact that an estimated 450,000 people in Nicaragua have access to a basic water supply.

3. The history of the introduction, development and scaling up of the rope pump in Nicaragua is an example of the positive cost-benefit ratio and potential impact of applying the SMART approach to introduce innovative technology solutions. The total donor investment between 1983 and 2005 is estimated to be around $2 million USD in technical assistance. The initial investment led to lasting capacity and conditions in both the private and public sectors to provide an affordable water pumping option for both households and rural communities, and so the per capita costs of that investment have reduced year by year as client numbers have grown.

4. The rope pump in Nicaragua can also be seen as an example of not only the social but also the economic impact that technical assistance in SMARTechs can have. Assuming that replacing a rope and bucket on household wells by a pump increases yearly incomes of rural families on average with US$225[30], the total increased incomes in the past 16 years of the 50,000 rural families who had or still have a rope pump on their own well could be in the order of $180 million USD. This economic impact is a direct result of the donor investment of $2 million USD in technical assistance.

5. Different from what is often assumed, subsidizing rope pumps for (targeted) families did not distort the market but stimulated the sales to families who knew they would not get a subsidized pump.

6. The history of the introduction, development and scaling up of the rope pump in Nicaragua also highlights the following challenges:
    - Long-term investment is required for technical assistance to iron out technical details, build local capacity to manufacture and build up the market, despite the apparent simplicity of the technology
    - The importance of a successful and adaptive marketing strategy, taking into account changing contexts

[30] This was the conclusion of a survey of more than 4,000 farming families conducted in Nicaragua in 2001 (*The Impact of Farm Water Supply on Smallholder Income and Poverty Alleviation along the Pacific Coast of Nicaragua, J.J. van der Zee, A. Fajardo Reina, H. Holtslag, 2002).* This is the only study of its kind comparing the income of families with wells without pumps and wells with pumps. Although income estimates are difficult to verify and the causality of the pump versus the causality of higher income being a factor in acquiring a pump should be further investigated. The positive economic impact of a pump on a well can be attributed to: (1) a reduction in the recontamination of water in open hand dug wells and thus a reduced health related cost of water borne diseases; (2) time saving due to the ease of extraction of water, and (3) more water readily available for both personal hygiene and productive uses given the ease of lifting water as long as the well produces sufficient water.

- The competition with low-cost options[31] from an initial capital investment perspective; over 3 years the cost of a rope pump is roughly US$120 in initial capital investment and $10 per year in maintenance for a total cost of US$150, while a low-cost electrical pump is roughly US$50 in initial capital investment and $60 per year in electricity for a total life-cycle cost in the order of US$230 and a replacement cost of US$ 50. The life-cycle cost of the rope pump over 5 – 10 years is ca $150 USD.
- The need for the decentralization of skills and the local availability of spare parts to ensure timely repair and/or replacement
- The need for government support for the technology

7. The introduction and scaling up of the rope pump in Nicaragua also highlight the key role that context plays, taking into account:
   - The initial trend during the 1980s towards self-sufficiency and rural land reform and development following the 1979 Sandinista revolution, a move towards socialism and a trade embargo (or blockade) from Nicaragua's primary trading partner (USA)
   - The expansion of the agricultural frontier in the post-war years of the 1990s,
   - Advances with rural electrification and communal water supply systems in the 2000s
   - The recurrence of hurricanes causing disaster situations for highly vulnerable populations – particularly, but by no means exclusively, on the Caribbean Coast – which trigger humanitarian responses, in this case the rehabilitation of hand dug wells with a "new" low cost hand pump. This stimulated interest, further development and scaling of this technology. A similar story is true for the Nicaraguan ceramic pot filter which now is produced in Nicaragua and in more than 30 other countries. The response tends to focus on the rehabilitation of existing hand dug wells primarily on communal and institutional wells (for schools and health posts).

   The role of the rope pump as a family-scale self-supply technology, although accepted as a national standard pump for rural water supply, is still not widely recognized in the sector as contributing to the goal of universal water access (SDG 6.1) and water related SDGs for food and income. As such it is not explicitly considered in the national register of waterpoints, their conditions and functionality

8. Renewed efforts at marketing the rope pump and expanding its supply/distribution chain, in all of its applications, particularly in regions with limited levels of rural electrification and shallow groundwater, could generate an interesting market opportunity if combined with other SMART solutions (water filters, solar-powered pumps, rainwater catchment, etc.); in this sense the rope pump is not an end point but a valuable step leading to a natural progression of improved access.

[31] A commercial electrically powered centrifugal pumps with capacity of 1HP has an initial cost in the order of $50 USD in Nicaragua. The user does not generally consider the monthly electricity consumption that the pump generates, and which is in the order of $5 USD per month. Nor does the user consider the need for replacement every 2 – 3 years which is equivalent to a life-cycle cost of $230 USD based on 3 years of use compensating this with the ease of availability and low initial investment.

Recommendations

This assessment has also generated a few recommendations aimed at sustaining and expanding the success and positive impact achieved by introducing the rope pump to Nicaragua using the SMART approach:

1. Encourage the WASH sector (Nuevo FISE, municipal technical WASH units) to incorporate a register of private/family water points in the SIASAR information system for rural WASH, including hand dug wells, low cost manually drilled wells, rooftop rainwater catchment systems, and spring catchments

2. Conduct a market study to determine where the existing and potential demand is for technologies fit for **self-supply** like the rope pump other low-cost pumping alternatives[32] and WASH technologies and products in general, and the relative access of these to local distributors. Also, the opportunity to increase sales through a communications campaign and the establishment of local producers and/or distributors.

3. Use the example of the positive impact and the lessons learnt from the introduction and scaling-up of the rope pump in Nicaragua to inform and motivate other efforts, to accelerate self-supply and reach Sustainable Development Goal 6 for sustainable and equitable universal access to WASH and water related SDGs for food and income through the SMART approach

[32] The Nicaragua SMART Centre offers a low cost solar pumping system for combined elevations or heads up to 20m, including well depth and the height of elevated water storage tanks.

Annexes

Annex A.1: Chronicle of Information Gathering Activities

No.	Activity	Date	Comments
0	Literature Review		
1	Interview with Luis Roman Rivera, Proprietor of AMEC	Jan 23	
2	Interview with Reinhard Erhard, Co-Proprietor Taller Electromecánica	Jan 23	
3	Visit to BOMESA, Los Cedros, Mateare	Jan 26	
4	Phone call with Ricardo Guzman, Contact BOMESA		
5	Phone calls with Nelson Morazan, Proprietor of Fabrica de Artículos Metálicos, Somoto	Mar 11	
6	Visit to rope pump manufacturer Bernardo Polema, Siuna	Feb 12	
7	SIASAR working sessions with FISE (2)	Feb 4 / Mar 16	
8	Online survey with NGOs	Mar 1 – 9	
9	Online survey with Municipal WASH Units (UMASH)	Mar 9 - 16	
10	Online survey with rope pump manufacturers	Mar 16 - 30	
11	Field visit to Aquespalapa, Municipality of Villanueva, Chinandega Department	Nov 26, 2021	
12	Field visit to Matapalo and La Huerta, Municipality of Villanueva, Chinandega Department	Jan 28, 2022	

Annex A.2: Key persons involved in the introduction and development of rope pumps in Nicaragua

Jan Haemhouts:

Jan introduced the pump around 1983 via CITA INRA in Esteli as a “do it yourself pump”. Some 200 farmers did this but it did not scale up.

Bernard van Hemert

Bernard worked for SNV. He saw the potential of this technology and started with the first 200 pumps in Bluefields after hurricane Joan. He is author of the book La Bomba de Mecate: El desafio de la tecnologia.

Anneke Gorter

A doctor who installed the first 20 rope pumps in Los Cedros in 1989 to test the impact of pumps replacing rope and buckets on open wells to reduce diarroea. Pumps had huge positive impact.

Henk Alberts

Partner of Anneke Gorter. Via DGIS he was the manager of a large irrigation windmill project from 1978 to 1991; the project failed completely. After the project Henk Alberts assisted BOMESA and did a lot to get the pump recognized by government, in cooperation with SDC and Francois Muenger (SDC/WB staff).

Henk Holtslag

Henk was a technician via SNV in the same irrigation windmill project as Henk Alberts. After the project he started AMEC with Luis Roman in 1991. He trained pump producers like AMEC but also producers in Leon and Chinandega. AMEC made the galvanized model hand rope pump and developed other models powered by pedals, engines, and wind. Via AMEC Henk cooperated with the Dutch Practica Foundation to develop the horse powered rope pump and the introduction of manual well drilling (Rota sludge) in Nicaragua.

Annex A.3: SIASAR data on rural water supply and community wells with manual pumps

Gobierno de Reconciliación y Unidad Nacional
El Pueblo, Presidente!

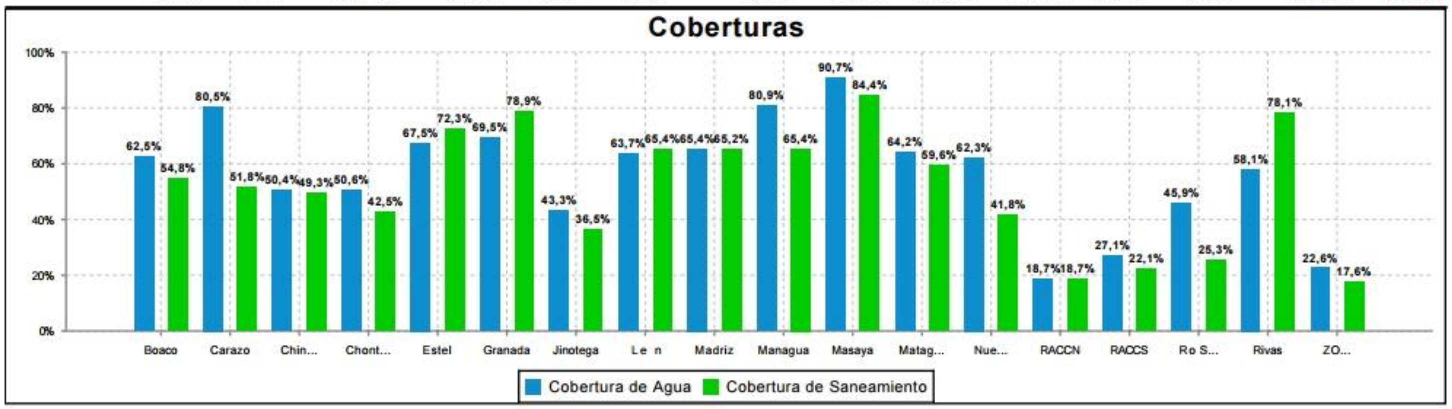
2021 ESPERANZAS VICTORIOSAS! TODO CON AMOR!

SIASAR

Situación de Agua y Saneamiento Nacional

Periodo de levantamiento del: 20-01-2011 **al:** 16-02-2022

Departamento	Comunidades	Población	Viviendas	Sistemas	CAPS	Viviendas con Agua	Viviendas con Saneamiento	Población con Agua	Población con Saneamiento	Cobertura de Agua	Cobertura de Saneamiento	Población sin Agua	Población sin Saneamiento
Boaco	274	123.925	24.639	390	228	15.410	13.510	77.327	67.536	62,5%	54,8%	46.598	56.389
Carazo	213	106.497	22.300	85	31	17.961	11.542	85.637	52.613	80,5%	51,8%	20.860	53.884
Chinandega	406	248.164	53.962	321	206	27.221	26.602	128.674	121.697	50,4%	49,3%	119.490	126.467
Chontales	256	94.969	18.416	509	200	9.317	7.829	47.788	42.209	50,6%	42,5%	47.181	52.760
Esteli	322	111.498	25.467	364	198	17.194	18.422	75.989	82.330	67,5%	72,3%	35.509	29.168
Granada	155	134.486	24.553	50	39	17.055	19.372	97.028	105.705	69,5%	78,9%	37.458	28.781
Jinotega	732	421.040	83.570	447	347	36.177	30.489	177.730	151.077	43,3%	36,5%	243.310	269.963
León	555	209.441	46.568	713	245	29.662	30.437	136.129	136.705	63,7%	65,4%	73.312	72.736
Madriz	314	147.874	31.071	707	237	20.312	20.248	93.798	95.773	65,4%	65,2%	54.076	52.101
Managua	299	368.274	77.528	203	113	62.692	50.729	300.217	250.185	80,9%	65,4%	68.057	118.089
Masaya	159	260.113	49.090	50	33	44.508	41.419	236.022	219.179	90,7%	84,4%	24.091	40.934
Matagalpa	926	399.619	80.973	896	550	51.955	48.236	256.343	240.994	64,2%	59,6%	143.276	158.625
Nueva Segovia	500	230.491	46.864	466	208	29.188	19.588	143.287	97.048	62,3%	41,8%	87.204	133.443
RACCN	766	446.480	77.837	398	165	14.546	14.571	86.292	84.796	18,7%	18,7%	360.188	361.684
RACCS	762	363.682	69.148	230	191	18.738	15.303	94.093	81.142	27,1%	22,1%	269.589	282.540
Rio San Juan	236	115.465	22.552	122	89	10.350	5.710	51.713	26.940	45,9%	25,3%	63.752	88.525
Rivas	212	135.534	30.400	193	88	17.658	23.741	80.185	105.830	58,1%	78,1%	55.349	29.704
ZONA ESPECIAL: ALTO WANGKY BOCAY	69	23.871	3.742	12	12	846	659	6.891	4.508	22,6%	17,6%	16.980	19.363
Totales	7.156	3.941.423	788.680	6.156	3.180	440.790	398.407	2.175.143	1.966.267	55,9%	50,5%	1.766.280	1.975.156



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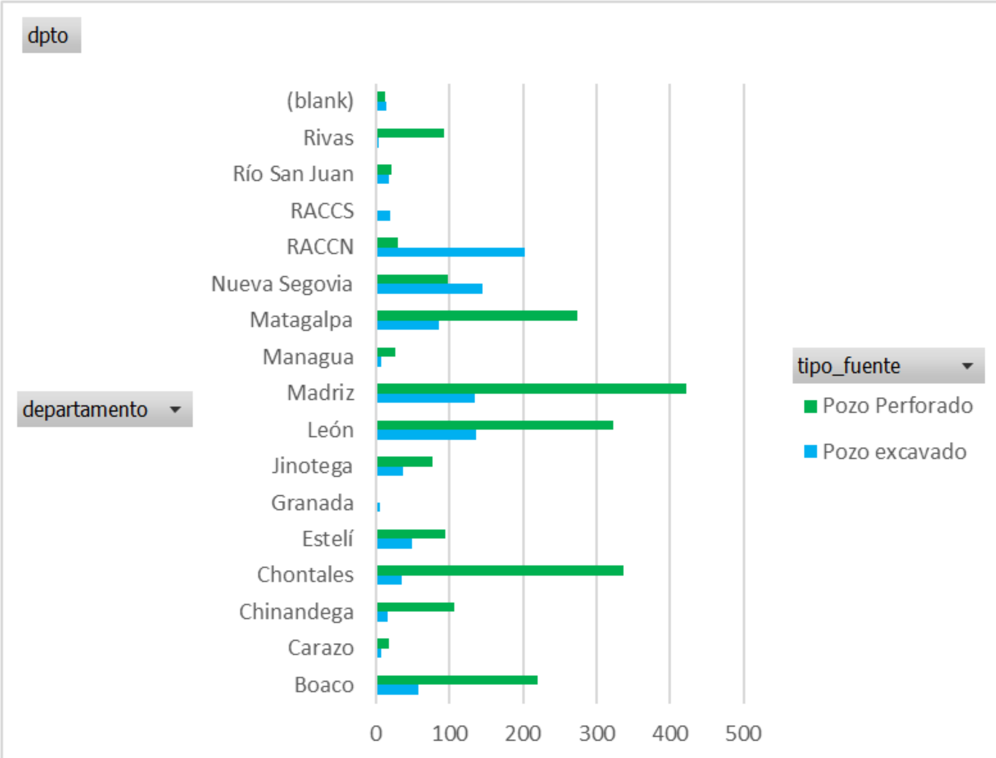

Figure 5: Registered communal wells (by Department)

Department	Hand dug Well	% HDW	Borehole Well	% BHW	Total	% of Total
Boaco	57	21%	220	79%	277	9%
Carazo	7	28%	18	72%	25	1%
Chinandega	15	12%	107	88%	122	4%
Chontales	35	9%	337	91%	372	12%
Estelí	49	34%	94	66%	143	5%
Granada	5	71%	2	29%	7	0%
Jinotega	37	32%	77	68%	114	4%
León	136	30%	322	70%	458	15%
Madriz	135	24%	422	76%	557	18%
Managua	7	21%	26	79%	33	1%
Matagalpa	85	24%	273	76%	358	11%
Nueva Segovia	145	60%	98	40%	243	8%
RACCN	202	87%	29	13%	231	7%
RACCS	19	90%	2	10%	21	1%
Río San Juan	17	46%	20	54%	37	1%
Rivas	3	3%	92	97%	95	3%
Unidentified	14	54%	12	46%	26	1%
Total general	968	31%	2151	69%	3119	100%

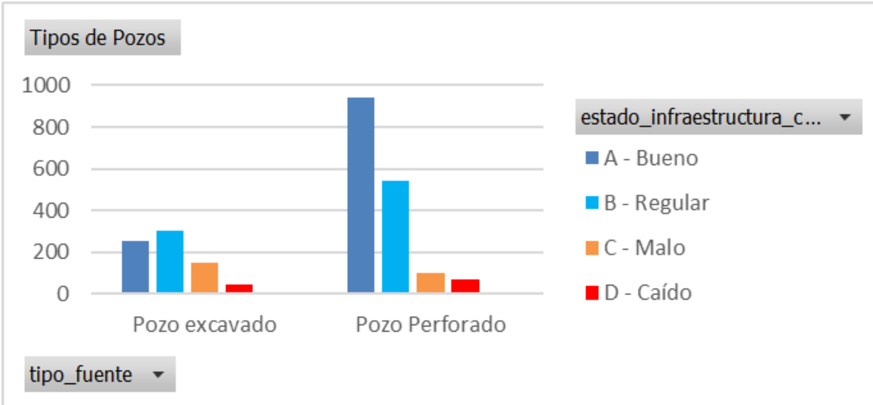

Figure 6: State of functionality of registered communal wells by well type.

Type of Well	A - Good	B - Regular	C - Bad	D - Out of Service	Subtotal	No data	Total general
Hand dug well	257	301	152	46	756	212	968
Borehole well	942	545	104	69	1660	491	2151
Total	1199	846	256	115	2416	115	2531
	50%	35%	11%	5%	100%		

Annex A.4: Estimation of the Number of Rope Pumps in Existence by Municipality

Estimate of Population Not Registered in SIASAR with Family Wells and/or Rope Pump

No.			Department / Municipality	Sum of Population without access to registered communal water supply system (SIASAR)	Families without access to water	Is the rope pump present in the municipality?	% with Hand-dug Well (PEM)			% of Hand-dug Wells with Rope Pump (PEMBM)			Estimate of Family Hand-dug Wells (PEM)			Estimate of Family Hand-dug Wells with Rope Pumps (PEMBM)				
				pers/family	5															
							Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average		
1			Boaco	46598															557	2%
	1.1	1	Boaco	19309	3862	SI	0%	25%	13%	95%	100%	98%	0	966	483	0	966	471		
	1.2	2	Camoapa	14948	2990	–														
	1.3	3	San José de los Remates	2225	445	–														
	1.4	4	San Lorenzo	6744	1349	SI	0%	25%	13%	25%	50%	38%	0	337	169	0	169	63		
	1.5	5	Santa Lucía	2078	416	SI	0%	25%	13%	25%	50%	38%	0	104	52	0	52	20		
	1.6	6	Teustepe	1294	259	SI	0%	25%	13%	0%	25%	13%	0	65	32	0	16	4		
2			Carazo	20860															112	0%
	2.1	7	Diriamba	8578	1716	SI	0%	25%	13%	0%	25%	13%	0	429	215	0	107	27		
	2.2	8	Dolores	20	4	NO														
	2.3	9	El Rosario	90	18	NO														
	2.4	10	Jinotepe	4147	829	NO														
	2.5	11	La Conquista	2508	502	SI	25%	50%	38%	25%	50%	38%	126	251	188	31	126	71		
	2.6	12	La Paz de Carazo	110	22	NO														
	2.7	13	San Marcos	701	140	NO														
	2.8	14	Santa Teresa	4706	941	SI	0%	25%	13%	0%	25%	13%	0	235	118	0	59	15		
3			Chinandega	119490															7641	27%
	3.1	15	Chichigalpa	10845	2169	NO														
	3.2	16	Chinandega	14809	2962	NO														
	3.3	17	Cinco Pinos	2375	475	SI	0%	25%	13%	0%	25%	13%	0	119	59	0	30	7		
	3.4	18	El Realejo	1409	282	SI	0%	25%	13%	0%	25%	13%	0	71	35	0	18	4		
	3.5	19	El Viejo	45127	9025	SI	75%	95%	85%	75%	95%	85%	6769	8574	7671	5077	8145	6521		
	3.6	20	Posoltega	2881	576	SI	0%	25%	13%	0%	25%	13%	0	144	72	0	36	9		
	3.7	21	Puerto Morazán	10458	2092	SI	50%	75%	63%	25%	50%	38%	1046	1569	1308	262	785	490		
	3.8	22	San Francisco del Norte	3065	613	SI	0%	25%	13%	0%	25%	13%	0	153	77	0	38	10		
	3.9	23	San Pedro del Norte	1100	220	SI	0%	25%	13%	0%	25%	13%	0	55	28	0	14	3		
	3.10	24	Santo Tomás del Norte	4547	909	SI	95%	100%	98%	50%	75%	63%	864	909	886	432	682	554		
	3.11	25	Somotillo	13675	2735	SI	0%	25%	13%	0%	25%	13%	0	684	342	0	171	43		
	3.12	26	Villanueva	9199	1840	NO														
4			Chontales	47684															888	3%
	4.1	27	Acoyapa	7243	1449	SI	0%	25%	13%	0%	25%	13%	0	362	181	0	91	23		
	4.2	28	Comalapa	3395	679	SI	0%	25%	13%	0%	25%	13%	0	170	85	0	42	11		
	4.3	29	El Coral	3849	770	SI	0%	25%	13%	0%	25%	13%	0	193	96	0	48	12		
	4.4	30	Juigalpa	4414	883	SI	0%	25%	13%	0%	25%	13%	0	221	110	0	55	14		
	4.5	31	La Libertad	7160	1432	SI	0%	25%	13%	0%	25%	13%	0	358	179	0	90	22		
	4.6	32	San Francisco de Cuapa	1879	376	–														
	4.7	33	San Pedro de Lóvago	2913	583	–														
	4.8	34	Santo Domingo	6640	1328	–														
	4.9	35	Santo Tomás	3774	755	SI	95%	100%	98%	75%	95%	85%	717	755	736	538	717	626		
	4.10	36	Villa Sandino	6417	1283	SI	25%	50%	38%	25%	50%	38%	321	642	481	80	321	180		
5			Estelí	35509															669	2%
	5.1	37	Condega	5232	1046	SI	50%	75%	63%	25%	50%	38%	523	785	654	131	392	245		
	5.2	38	Estelí	10926	2185	SI	0%	25%	13%	0%	25%	13%	0	546	273	0	137	34		
	5.3	39	La Trinidad	5199	1040	–														
	5.4	40	Pueblo Nuevo	7655	1531	SI	25%	50%	38%	50%	75%	63%	383	766	574	191	574	359		
	5.5	41	San Juan de Limay	3261	652	SI	0%	25%	13%	25%	50%	38%	0	163	82	0	82	31		
	5.6	42	San Nicolás	3236	647	SI	25%	50%	38%	0%	0%	0%	162	324	243	0	0	0		
6			Granada	39138															319	1%
	6.1	43	Diriá	545	109	NO														
	6.2	44	Diriomo	4072	814	SI	25%	50%	38%	0%	25%	13%	204	407	305	0	102	38		
	6.3	45	Granada	16520	3304	NO														
	6.4	46	Nandaime	18001	3600	SI	50%	75%	63%	0%	25%	13%	1800	2700	2250	0	675	281		
7			Jinotega	244140	48828														1323	5%
	7.1	47	El Cuá	42432	8486	–														
	7.2	48	Jinotega	26925	5385	SI	0%	25%	13%	0%	0%	0%	0	1346	673	0	0	0		
	7.3	49	La Concordia	1354	271	SI	0%	25%	13%	0%	25%	13%	0	68	34	0	17	4		
	7.4	50	San José de Bocay	84421	16884	SI	50%	75%	63%	0%	25%	13%	8442	12663	10553	0	3166	1319		
	7.5	51	San Rafael del Norte	3878	776	NO														
	7.6	52	San Sebastián de Yalí	11917	2383	–														
	7.7	53	Santa María de Pantasma	34121	6824	–														
	7.8	54	Wiwilí de Jinotega	39092	7818	–														
8			León	73491															1492	5%
	8.1	55	Achuapa	5422	1084	SI	0%	25%	13%	25%	50%	38%	0	271	136	0	136	51		
	8.2	56	El Jicaral	1322	264	SI	25%	50%	38%	0%	25%	13%	66	132	99	0	33	12		
	8.3	57	El Sauce	3894	779	SI	75%	95%	85%	75%	95%	85%	584	740	662	438	703	563		
	8.4	58	La Paz Centro	2003	401	NO														
	8.5	59	Larreynaga	17298	3460	SI	25%	50%	38%	0%	25%	13%	865	1730	1298	0	433	162		
	8.6	60	León	26516	5303	SI	0%	25%	13%	0%	25%	13%	0	1326	663	0	331	83		
	8.7	61	Nagarote	5520	1104	SI	50%	75%	63%	25%	50%	38%	552	828	690	138	414	259		
	8.8	62	Quezalguaque	1425	285	NO														
	8.9	63	Santa Rosa del Peñón	4406	881	SI	50%	75%	63%	50%	75%	63%	441	661	551	220	496	344		
	8.10	64	Telica	5685	1137	SI	0%	25%	13%	0%	25%	13%	0	284	142	0	71	18		
9			Madriz	54076															606	2%
	9.1	65	Las Sabanas	486	97	SI	0%	25%	13%	0%	25%	13%	0	24	12	0	6	2		
	9.2	66	Palacagüina	1878	376	SI	0%	25%	13%	0%	25%	13%	0	94	47	0	24	6		
	9.3	67	San José de Cusmapa	3762	752	–														
	9.4	68	San Juan del Río Coco	24929	4986	–														
	9.5	69	San Lucas	3615	723	SI	75%	95%	85%	0%	25%	13%	542	687	615	0	172	77		
	9.6	70	Somoto	6099	1220	SI	50%	75%	63%	50%	75%	63%	610	915	763	305	686	477		

pers/family 5

	No.		Department / Municipality	Sum of Population without access to registered communal water supply system	Families without access to	Is the rope pump present in the	% with Hand-dug Well (PEM)			% of Hand-dug Wells with Rope Pump (PEMBM)			Estimate of Family Hand-dug Wells (PEM)			Estimate of Family Hand-dug Wells with Rope Pumps (PEMBM)				
	9.7	71	Telpaneca	4853	971	SI	0%	25%	13%	25%	50%	38%	0	243	121	0	121	46		
	9.8	72	Totogalpa	6785	1357	–														
	9.9	73	Yalagüina	1669	334	–														
10			Managua	71578															267	1%
	10.1	74	Ciudad Sandino	1028	206	NO														
	10.2	75	El Crucero	864	173	SI	0%	25%	13%	0%	25%	13%	0	43	22	0	11	3		
	10.3	76	Managua	6276	1255	NO														
	10.4	77	Mateare	4149	830	NO														
	10.5	78	San Francisco Libre	5344	1069	SI	0%	25%	13%	95%	100%	98%	0	267	134	0	267	130		
	10.6	79	San Rafael del Sur	21986	4397	SI	0%	25%	13%	0%	25%	13%	0	1099	550	0	275	69		
	10.7	80	Ticuantepe	717	143	NO														
	10.8	81	Tipitapa	10273	2055	NO														
	10.9	82	Villa El Carmen	20941	4188	SI	0%	25%	13%	0%	25%	13%	0	1047	524	0	262	65		
11			Masaya	24091															2	0%
	11.1	83	Catarina	523	105	SI	0%	25%	13%	0%	25%	13%	0	26	13	0	7	2		
	11.2	84	La Concepción	6674	1335	NO														
	11.3	85	Masatepe	2843	569	NO														
	11.4	86	Masaya	3283	657	NO														
	11.5	87	Nandasmo	773	155	NO														
	11.6	88	Nindirí	6995	1399	NO														
	11.7	89	Niquinohomo	2641	528	NO														
	11.8	90	San Juan de Oriente	321	64	NO														
	11.9	91	Tisma	38	8	NO														
12			Matagalpa	143352															1721	6%
	12.1	92	Ciudad Darío	3590	718	SI	0%	25%	13%	0%	25%	13%	0	180	90	0	45	11		
	12.2	93	El Tuma - La Dalia	34300	6860	NO	0%	25%	13%	0%	0%	0%	0	1715	858	0	0	0		
	12.3	94	Esquipulas	3751	750	SI	0%	25%	13%	0%	25%	13%	0	188	94	0	47	12		
	12.4	95	Matagalpa	18685	3737	SI	50%	75%	63%	50%	75%	63%	1869	2803	2336	934	2102	1460		
	12.5	96	Matiguas	22706	4541	SI	0%	25%	13%	0%	25%	13%	0	1135	568	0	284	71		
	12.6	97	Muy Muy	6337	1267	SI	50%	75%	63%	0%	25%	13%	634	950	792	0	238	99		
	12.7	98	Rancho Grande	24692	4938	NO	0%	25%	13%	0%	0%	0%	0	1235	617	0	0	0		
	12.8	99	Río Blanco	7272	1454	NO														
	12.9	100	San Dionisio	2037	407	SI	0%	25%	13%	0%	25%	13%	0	102	51	0	25	6		
	12.10	101	San Isidro	2375	475	SI	0%	25%	13%	0%	25%	13%	0	119	59	0	30	7		
	12.11	102	San Ramón	14841	2968	SI	0%	25%	13%	0%	25%	13%	0	742	371	0	186	46		
	12.12	103	Sebaco	1808	362	SI	0%	25%	13%	0%	25%	13%	0	91	45	0	23	6		
	12.13	104	Terrabona	958	192	SI	0%	25%	13%	0%	25%	13%	0	48	24	0	12	3		
13			Nueva Segovia	88428															1086	4%
	13.1	105	Ciudad Antigua	2541	508	–														
	13.2	106	Dipilto	2750	550	NO	50%	75%	63%	0%	0%	0%	275	413	344	0	0	0		
	13.3	107	El Jícaro	9549	1910	SI	0%	25%	13%	50%	75%	63%	0	478	239	0	358	149		
	13.4	108	Jalapa	17777	3555	SI	0%	25%	13%	0%	25%	13%	0	889	444	0	222	56		
	13.5	109	Macuelizo	2682	536	SI	25%	50%	38%	25%	50%	38%	134	268	201	34	134	75		
	13.6	110	Mozonte	1220	244	NO	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0		
	13.7	111	Murra	16309	3262	–														
	13.8	112	Ocotal	0	0	–														
	13.9	113	Quilalí	17749	3550	SI	0%	25%	13%	0%	25%	13%	0	888	444	0	222	55		
	13.11	114	San Fernando	926	185	SI	0%	25%	13%	0%	25%	13%	0	46	23	0	12	3		
	13.11	115	Santa María	1219	244	SI	0%	25%	13%	25%	50%	38%	0	61	31	0	31	11		
	13.12	116	Wiwilí de Nueva Segovia	15706	3141	SI	50%	75%	63%	25%	50%	38%	1571	2356	1963	393	1178	736		
14			Río San Juan	63752															527	2%
	14.1	117	El Almendro	6636	1327	–														
	14.2	118	El Castillo	18100	3620	SI	25%	50%	38%	0%	25%	13%	905	1810	1358	0	453	170		
	14.3	119	Morrito	4250	850	SI	0%	25%	13%	25%	50%	38%	0	213	106	0	106	40		
	14.4	120	San Carlos	20111	4022	SI	25%	50%	38%	0%	25%	13%	1006	2011	1508	0	503	189		
	14.5	121	San Juan de Nicaragua	855	171	SI	50%	75%	63%	0%	0%	0%	86	128	107	0	0	0		
	14.6	122	San Miguelito	13800	2760	SI	25%	50%	38%	0%	25%	13%	690	1380	1035	0	345	129		
15			Rivas	55349															741	3%
	15.1	123	Altagracia	4839	968	NO	0%	25%	13%	0%	0%	0%	0	242	121	0	0	0		
	15.2	124	Belén	6255	1251	NO	75%	95%	85%	0%	0%	0%	938	1188	1063	0	0	0		
	15.3	125	Buenos Aires	3043	609	SI	25%	50%	38%	0%	25%	13%	152	305	228	0	76	29		
	15.4	126	Cárdenas	6767	1353	–														
	15.5	127	Moyogalpa	511	102	NO														
	15.6	128	Potosí	4225	845	NO	25%	50%	38%	0%	0%	0%	211	423	317	0	0	0		
	15.7	129	Rivas	8907	1781	–														
	15.8	130	San Jorge	907	181	SI	0%	25%	13%	0%	25%	13%	0	45	23	0	11	3		
	15.9	131	San Juan del Sur	3846	769	SI	75%	95%	85%	75%	96%	86%	577	731	654	433	701	559		
	15.10	132	Tola	16049	3210	SI	25%	50%	38%	0%	25%	13%	803	1605	1204	0	401	150		
16			RACCN	369170			75%	95%	85%	75%	96%	86%	0	0	0				6671	23%
	16.1	133	Bonanza	23897	4779	NO														
	16.2	134	Mulukukú	28854	5771	–														
	16.3	135	Prinzapolka	32818	6564	–														
	16.4	136	Puerto Cabezas	61779	12356	SI	50%	75%	63%	50%	75%	63%	6178	9267	7723	3089	6950	4827		
	16.5	137	Rosita	32952	6590	SI	0%	25%	13%	0%	25%	13%	0	1648	824	0	412	103		
	16.6	138	Siuna	76116	15223	–														
	16.7	139	Waslala	50828	10166	NO	0%	0%	0%	0%	0%	0%	0	0	0	0	0	0		
	16.8	140	Waspam	61926	12385	SI	25%	50%	38%	25%	50%	38%	3096	6193	4644	774	3096	1742		
17			RACCS	269589															3533	12%
	17.1	141	Bluefields	41771	8354	SI	50%	75%	63%	25%	50%	38%	4177	6266	5221	1044	3133	1958		
	17.2	142	Corn Island	3515	703	SI	25%	50%	38%	0%	25%	13%	176	352	264	0	88	33		
	17.3	143	Desembocadura del Río Grande	4419	884	SI	0%	25%	13%	0%	25%	13%	0	221	111	0	55	14		
	17.4	144	El Ayote	9550	1910	SI	0%	25%	13%	0%	25%	13%	0	478	239	0	119	30		
	17.5	145	El Rama	43511	8702	SI	25%	50%	38%	25%	50%	38%	2176	4351	3263	544	2176	1224		

pers/family 5

No.			Department / Municipality	Sum of Population without access to registered communal water supply system	Families without access to	Is the rope pump present in the	% with Hand-dug Well (PEM)			% of Hand-dug Wells with Rope Pump (PEMBM)			Estimate of Family Hand-dug Wells (PEM)			Estimate of Family Hand-dug Wells with Rope Pumps (PEMBM)		
	17.6	146	El Tortuguero	37523	7505	–												
	17.7	147	Kukra Hill	12904	2581	SI	75%	95%	85%	0%	25%	13%	1936	2452	2194	0	613	274
	17.8	148	La Cruz de Río Grande	25215	5043	–												
	17.9	149	Laguna de Perlas	23492	4698	–												
	17.10	150	Muelle de los Bueyes	18911	3782	–												
	17.11	151	Nueva Guinea	36086	7217	SI	25%	50%	38%	0%	25%	13%	1804	3609	2706	0	902	338
	17.12	152	Paiwas	12692	2538	–												
18			ZONA ESPECIAL: ALTO WANGKY BOCAY	16980														
	18.1	–	Kipla Sait Tasbaika	5630	1126													
	18.2	–	Mayangna Sauni Bu	2885	577													
	18.3	–	Miskito Indian Tasbaika Kum	8465	1693													
			Grand Total	1,783,275	356,655	87	57%	70%					54406	107165	80785	15087	47653	28494
						37	24%	30%								4%	13%	8%
						28	18%											
						152		82% responded										

Annex A.5: Survey of Rope Pump Manufacturers and Lists of Number of Rope Pumps Produced

Inventory of Rope Pump Manufacturers 1988 - 2022

Nombre de la empresa:	Año de inicio de operaciones en Nicaragua:	Estatus	Ubicación:	Cuánto es el promedio de persona-días de empleo mensual que crea la fábrica y/o instalación de bombas de mecate?	Para cuáles Departamentos y/o Regiones Autónomas han vendido y/o instalado bombas:	Ofrece servicios de instalación?	Para qué fin han vendido y/o instaladas las bombas de mecate por su empresa?	Para qué fin han vendido y/o instalado las bombas de mecate por su empresa?	Cuántas bombas de mecate se vendieron y/o instalaron en 2021?	Cuantos bombas de mecate fueron vendidas/instaladas hasta 2005?	Promedio Annual 1990 - 2005 (aproximado)	Cuál ha sido el promedio de bombas de mecate vendidas/instaladas anualmente, durante el periodo de 2005 - 2010?	Cuál ha sido el promedio de bombas de mecate vendidas/instaladas anualmente, durante el periodo de 2011 - 2020?	Cuántas bombas de mecate se han vendido y/o instalado desde que se iniciaron operaciones?
Fabricantes Originales / Principales														
BOMESA	1988	Activo	Los Cedros, Mateare, Km 28.5 Carretera Vieja a Leon (cel. 885-6692)						350	35000	2060	350	150	38600
Taller Electromecanico	1991	Activo	Managua, Rotonda Cristo Rey 200 mts al Sur entre SINSA y Profysa	En la fabricacion 5 personas. Tiempo completo	Chinandega, León, Estelí, Nueva Segovia, Madriz, Masaya, Granada, Rivas, Carazo, Boaco, Río San Juan, Matagalpa, Región Autónoma de la Costa Caribe Norte (RACCN), Región Autónoma de la Costa Caribe Sur (RACCS)	Sí	Pozos comunales (compartidos) para consumo humano, Pozos para escuelas, Pozos para centros de salud, Pozos familiares para consumo humano, Pozos para usos productivos	Ambos	360	15000	1070	300	300	20110
AEROBOMBAS DE MECATE	1991	Activo	Managua, Rotonda Cristo Rey 200 mts al Sur entre SINSA y Profysa, patio Interior	En la actualidad son 3 personas , 20 días incluyendo la instalación actualmente anteriormente por la demanda era mas personas	Managua, Chinandega, León, Estelí, Nueva Segovia, Madriz, Masaya, Granada, Rivas, Carazo, Boaco, Chontales, Río San Juan, Matagalpa, Jinotega, Región Autónoma de la Costa Caribe Norte (RACCN), Región Autónoma de la Costa Caribe Sur (RACCS)	Sí	Pozos comunales (compartidos) para consumo humano, Pozos para escuelas, Pozos para centros de salud, Pozos familiares para consumo humano, Pozos para usos productivos	Ambos	212	10000	710	350	300	14962
CITA INRA	1983	Desarticulada 1990	Esteli						0	200	0	0	0	200
								Subtotal	**922**	**60200**	**3840**	**1000**	**750**	**73872**
Fabricantes Menores (locales)														
Taller Metalico (Nelson Morazan)	2000	Activo	Ocotal, Nueva Segovia						40	400	80	40	40	1040
Juan Carlos Gil	1991	Activo	Juigalpa, Chontales						40	400	30	30	30	890
Taller Rafael Castilla Castro	1989	Ya no existe	Juigalpa, de INAA 1/2 c. al sur, 1/2 c. arriba		Chontales, Bluefields (RACCS)				0	5000	310			5000
Silvio Melendez		Activo	El Sauce, Leon						15			40	15	365
Bernardo Vivas Gonzalez		Activo	Morrito, Rio San Juan						15			40	15	365
Victor Montoya		Activo	Esteli						15			40	15	365
Yasser Maradiaga		Activo	Esteli						15			40	15	365
Roger Jose Picado Herrera		Activo	Esteli						15			40	15	365
Taller Parales		Activo	San Juan de Limay						15			40	15	365
Carlos Vidal Tenorio Corea		Activo	San Juan del Sur						15			40	15	365
Bernardo Polema Falcon		Activo	Siuna		Siuna				15			40	15	365
Taller de Mujeres Xochilt Acalth	1994	Ya no existe	Malpaisillo, Leon (tel. 2316-0365 / 2316-01170)		Malpaisillo				0	1000	90			1000
Taller Don Pompilio	1983	Ya no existe	Esteli							500	70			500
Taller sin nombre		Ya no existe	Boaco							500	70			500
Taller Ernesto	1992	Ya no existe	Somotillo, Centro							600	90			600
Miguel Matamoro	2010	Ya no existe	Dario (cel. 8733-1395)		Dario					0	0	30		150
Perfor (Roger Rio)	2005	Ya no existe	Leon, Villa Soberana Costado norte de AGROSA. 2C este, 10 vrs norte http://www.perfor.net/		Leon					50	10			50
Taller Las Planetas	1990	Ya no existe	Sebaco		Sebaco					400	60			400
El Porvenir	1995	Ya no existe								800	110			800
								Subtotal	**200**	**9650**	**920**	**420**	**190**	**13850**
									1334	**77700**	**5130**	**1420**	**940**	**87722**

Estimacion de Ventas al 2005
(Henk Holtslag)

Nombre	Direccion. Tel.	Inicia produccion	Produccion hasta	Ventas al 2005	Total de bombas producido	Observacion
Bombas de Mecate (BOMESA)	Los Cedros KM 28.5 car vieja a Leon. Tel 88566692	1988	Aun activo	32000	>35.000 ?	Inicio produccion commercial
Taller Electro Mecanica	Managua Rotonda S. Domingo 200 vras al sur , mano Iz 22701856	1991	Aun activo	12000	>15.000 ?	
Taller AMEC	Managua Rotonda S. Domingo 200 vras al sur , mano Izq. al Fondo, Tel 22525382, 22706935	1991	Aun activo	8000	>10.000 ?	Tambien producen otro modelos como aerobomba (ca420) Bici bomba, (ca 300?) Bometran, 20? Motobomba (100?)
CITA INRA	Esteli	1980?	1991	200	> 200	Introduccion de bomba. Jan Haemhouts de Haiti y Demotech Holanda
Taller Don Pompillio	Esteli	1983?	?	500	>500 ?	Modelos de madera. Bombas de autoconstruccion
Taller de mujeres Xochilt Acalth	Malpaisillo (municipo Leon) 23160365, 23160117, 231602074	1994	?	1000	1000 ?	Producion por mujeres
Taller Rafael Castilla Castro	Juigalpa, De INAA, ½ C al sur . ½ C arriba	1989	?	5000	5000 ?	Produccion bombas para Bluefields
Taller Gill	Juigalpa	1991	?	400	>400	
Taller ?	Boaco			500	500 ?	
Taller Ernesto	Somotillo, Centro	1992?	?	600	> 600	
Miguel Matamoro	Dario Tel 87331395	2010?	?	30	20-30	
Nelson Morazan	Somoto	2000?	?	400	300-400	
Perfor Roger Rio	Leon. Villa soberana Costa norte de AGROSA. 2C este, 10 vrs norte http://www.perfor.net/ Tel 89953170 www.perfor.net	2005	?	50	50 ?	Hace perforaciones tambien
Taller Edmundo Alvarado	Sebaco. Carretera a Esteli Km105	1995	?			Productor de mecate
El Porvenir		1995	Todavia	800	>800 ?	
Taller Las Planetas,	Sebaco	1990	?	400	> 400	
				61880		

Annex A.6: Survey of Municipal WASH Units

Encuesta a Unidades de Municipales de Agua y Saneamiento (UMAS)

Marca temporal	Municipio	Departamento o Región Autónoma	Nombres y apellidos	Alcaldía / Cargo	No. de Celular	Correo electrónico	Cuáles son las principales fuentes de abastecimiento de agua familiares y comunales en su municipio?	Tiene presencia en su municipio la bomba de mecate?	Para qué fin utilizan la bomba de mecate en su municipio?	Para qué tipo de pozo se han instalado bombas de mecate?	Qué tipo de sistemas de agua están registrados en el SIASAR para su municipio?	[illegible]	[illegible]	¿Existen talleres o puntos de venta de bombas de mecate en su municipio?	[illegible]	[illegible]	¿Cuál modelo de bomba es la que más se utiliza en su municipio para pozos comunales?	¿Cuál modelo de bomba es la que más se utiliza en su municipio para pozos privados familiares?	Comentarios
[illegible]	Nandaime	Granada	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	ACHUAPA	Leon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	CORN ISLAND	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	TICUANTEPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	SAN RAFAEL DEL SUR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	WASPAM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Annex A.7: Survey of Implementing NGOs

Encuesta a ONGs Miembros de la Red de Agua y Saneamiento de Nicaragua

Marca temporal	Nombre del organismo:	Tipo de organización:	Nombres y apellidos del contacto (para mayor información):	No. de Celular:	Correo electrónico:	Año de inicio de operaciones en Nicaragua:	En cuáles Departamentos y/o Regiones Autónomas han hecho intervenciones (selecciona todas las opciones que se aplican):	Han implementado proyectos utilizando la bomba de mecate? Nota: Si la respuesta es sí, favor continuar con el resto de la encuesta. Si la respuesta es no, favor de responder la pregunta y pasar al final para remitir la encuesta.	En cuáles departamentos han implementado proyectos con la bomba de mecate? (selecciona todas las opciones que aplican)	Para qué fin han tenido las bombas de mecate donadas y/o instalados por la organización? (selecciona todas las opciones que se aplican)	Para qué tipo de pozo se han instalado bombas de mecate? (selecciona todas las opciones que se aplican)	Cuántas bombas de mecate se donaron o instalaron en 2021?	Cuál ha sido el promedio de bombas de mecate instaladas anualmente?	Cuántas bombas de mecate se han donado y/o instalado desde que se iniciaron operaciones?	¿Dónde han adquirido sus bombas de mecate? (seleccionar todos los que aplican)	¿Cuál modelo de bomba manual, ha donado y/o instalado en mayor cantidad para pozos comunales?	¿Cuál modelo de bomba manual ha donado y/o instalado en mayor cantidad para pozos privados familiares?	¿Cuál modelo de bomba, ha donado y/o instalado en mayor cantidad para pozos institucionales?
3/1/2022 8:37:54	Water For People Nicaragua	ONG Internacional	Marcos Antonio Corriols Caldera	89137493	mcorriolscaldera@gmail.com	2011	Jinotega	No (Si la respuesta es no, favor de responder la pregunta y pasar al final para remitir la encuesta)										
3/1/2022 9:22:39	ANF	ONG Internacional	Neida Pereira	87200054	npereira@anfnicaragua.org	1992	Managua, Chinandega, León, Estelí, Nueva Segovia, Madriz, Masaya, Granada, Rivas, Carazo, Boaco, Chontales, Río San Juan, Matagalpa, Jinotega, Región Autónoma de la Costa Caribe Norte (RACCN), Región Autónoma de la Costa Caribe Sur (RACCS)	Sí (Si la respuesta es si, favor continuar con el resto de la encuesta)	Nueva Segovia, Madriz, Rivas, Chontales, Jinotega	Pozos comunales (compartidos) para consumo humano, Pozos para escuelas, Pozos para centros de salud, Pozos familiares para consumo humano	Pozos excavados a mano (PEM), Pozo perforado (PP) con Máquina	30	300	400	Aerobombas de Mecate o AMEC, Otro talleres o puntos de venta (especificar):	bomba Afridev o India Mark II	bomba de mecate estándar con estructura metálica	bomba de mecate estándar con estructura metálica
3/1/2022 9:23:05	El Porvenir	ONG Internacional	Rob Bell	2268 5781	nicaragua@elporvenir.org	1990	Managua, León, Estelí, Rivas, Boaco, Río San Juan, Matagalpa, Jinotega, Región Autónoma de la Costa Caribe Norte (RACCN)	Sí (Si la respuesta es si, favor continuar con el resto de la encuesta)	León, Boaco, Matagalpa, Jinotega	Pozos comunales (compartidos) para consumo humano, Pozos para escuelas	Pozos excavados a mano (PEM), Pozo perforado (PP) con Máquina	2	5	350	Otro talleres o puntos de venta (especificar):, Fabrica de Artículos Metálicos, 2722-2762/8831-0868	bomba de mecate estándar con estructura metálica		bomba de mecate estándar con estructura metálica

Annex A.8: Field Survey Data Collected in the Communities of Aquespalapa, Matapalo and La Huerta Municipality of Villanueva, Department of Chinandega

MONITOREO POZOS Y BOMBAS

COMUNIDADES: AQUESPALAPA / MATAPALO / LA HUERTA
MUNICIPIO: VILLANUEVA

POZO	COMUNIDAD	POZO No.		Georeferenciacion	Proyecto Rotario (Assisted	Privado (Self-Supply Puro)	TIPO DE BOMBA		EN USO		Cuantos Viviendas	USOS					FILTRON		En Uso		Observacion
							Bomba Mecate	Bomba Electrica	Si	No		Consumo Humano	Ganado menor	Ganado mayor	Riego Patio	Riego Huertas	Si	No	Si	No	
1	AQUESPALAPA	1			X			X	X												sin permiso de acceso
2	AQUESPALAPA	2			X			X	X												sin permiso de acceso
3	AQUESPALAPA	3	POZO 3		X			X	X		1		X		X			X			riego 1/4mz / sabor por neem
4	AQUESPALAPA	4	POZO 4		X		X		X		1	X						X			
5	AQUESPALAPA	5			X																sin permiso de acceso
6	AQUESPALAPA	6	POZO 6		X					X	1				X			X			se atasco
7	AQUESPALAPA	7	POZO 7		X			X	X		3	X	X				X		X		
8	AQUESPALAPA	8	POZO 8		X			X	X		1		X	X	X	X		X			traen agua de tomar de Villanueva
9	AQUESPALAPA	9	POZO 9		X			X	X		1	X	X		X			X			
10	AQUESPALAPA	10	POZO 10		X			X	X		3	X	X		X	X		X			
11	AQUESPALAPA	11	POZO 11		X			X	X		1	X						X			ausente
12	AQUESPALAPA	12	POZO 12		X			X	X		2	X	X	X	X	X		X			bomba motor
13	AQUESPALAPA	13	POZO 13		X			X	X		1	X		X				X			bomba motor 1.5HP
14	AQUESPALAPA	14	POZO 14		X		X		X		1	X						X			reemplazo polea, guia
15	AQUESPALAPA	15	POZO 15		X					X											
16	AQUESPALAPA	16	POZO 16		X			X	X		1	X						X			
17	AQUESPALAPA	17	POZO 17		X			X	X		4	X						X			sola casa
18	AQUESPALAPA	18	POZO 18		X			X	X		1	X			X			X			poca agua
19	AQUESPALAPA	19	POZO 19		X			X	X		1	X		X				X			
20	AQUESPALAPA	20	POZO 20		X			X	X		5	X	X	X	X	X	X				temblor
		20	17		20	0	2	15	17	2	16	13	7	5	8	4	2	14	1	0	
21	MATAPALO	1	POZO 21		X			X	X		3	X					X		X		
22	MATAPALO	2	POZO 22		X			X	X		1	X	X	X	X	X		X			filtro de membrana (SINSA)
23	MATAPALO	3	POZO 23		X			X	X		1	X						X			
24	MATAPALO	4	POZO 24	12°51.06 - 86°52.44	X		X			X	2							X			usan pozo con bomba electrica del vecino
25	MATAPALO	5	POZO 25	12°50.97 - 86°52.51	X			X	X		1	X						X			
26	MATAPALO	6	POZO 26	12°50.71 - 86°52.78	X		X		X		1	X						X			bomba original en uso
27	MATAPALO	7	POZO 27	12°50.64 - 86°52.8	X			X	X			X		X				X			tiene mal sabor, hierve para ninyos
28	MATAPALO	8	POZO 28	12°50.589 - 86°52.84	X			X	X			X						X			
29	MATAPALO	9	POZO 29	12°50.46 - 86°52.9	X			X	X			X						X			
30	MATAPALO	10	POZO 30	12°50.46 - 86°52.94	X			X	X			X						X			
31	MATAPALO	11	POZO 31	12°50.445 - 86°52.94	X			X	X			X						X			
32	MATAPALO	12	POZO 32	12°50.399 - 86°53.03	X			X	X			X						X			

MONITOREO POZOS Y BOMBAS

COMUNIDADES: AQUESPALAPA / MATAPALO / LA HUERTA
MUNICIPIO: VILLANUEVA

33	MATAPALO	13	POZO 33	12°50.46 - 86°53.05	X			X	X			X						X			
34	MATAPALO	14	POZO 34	12°50.43 - 86°53.01	X			X	X			X						X			
35	MATAPALO	15	POZO 35		X		X		X			X						X			
36	MATAPALO	16	POZO 36		X			X	X			X						X			
37	MATAPALO	17	POZO 37		X																
38	MATAPALO	18	POZO 38		X																
39	MATAPALO	19	POZO 39		X																
40	MATAPALO	20	POZO 40		X																
41	MATAPALO	21	POZO 41		X																
42	MATAPALO	22	POZO 42		X																
43	MATAPALO	23	POZO 43		X																
44	MATAPALO	24	POZO 44		X																
		24	24		24	0	3	13	15	1	6	15	1	2	1	1	1	15	1	0	
45	LA HUERTA	1	POZO 45	14°49.74 - 86°52.33	X					X								X			abandonado por mala calidad de filtro (cambio dueno)
46	LA HUERTA	2	POZO 46		X					X								X			abandonado por venta de parcela a los Coen
47	LA HUERTA	3	POZO 47		X		X		X		1	X	X					X			
48	LA HUERTA	4	POZO 48		X		X			X	1	X	X					X			
49	LA HUERTA	5	POZO 49		X																
50	LA HUERTA	6	POZO 50		X																
		6	6		6	0	2	0	1	3	2	2	2	0	0	0	0	4	0	0	
		50	47		50	0	7	28	33	6	24	30	10	7	9	5	3	33	2	0	
												91%	30%	21%	27%	15%					

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Annex A.10: Photo Gallery

Photo 10: Functioning rope pump on community waterpoint, hand dug well (Las Brenas, Municipio Rosita, RACCN)

Photo 11: Abandoned rope pump on community water point. (Sarawas, Municipality of Mulukuku, RACCN)

Photo 12: Functioning rope pump on communal waterpoint (borehole well) rehabilitated in 2016 (Municipality of Boaco).

Photo 13: Functioning rope pump on communal water point, borehole well (Municipality of Boaco)

Photo 14: Functioning rope pumps on family hand dug wells in urban area (Rosita, RACCN).

Photo 15: Functioning rope pumps on family wells, hand dug (Municipality of Rosita, RACCN).

Photo 16: Functioning rope pump on communal well in indigenous community, recently replaced by an NGO. (Fruta de Pan, Municipality of Rosita, RACCN).