# 2 A MULTI SECTORAL APPROACH TO SUSTAINABLE RURAL WATER SUPPLY: THE ROLE OF THE ROPE HANDPUMP IN NICARAGUA

*J.H.Alberts[1] and J.J. van der Zee[2]*

[1]Bombas de Mecate S.A., Nicaragua (ropepump@ibw.com.ni), [2]Universidad Politécnica de Nicaragua (UPOLI) & Centro de Estudios y Acción en Desarrollo Rural (CESADE), Nicaragua.

**Summary**

A low cost rope handpump for boreholes and hand-dug wells up to 70 m deep has been developed, marketed, and subsequently mass-produced in Nicaragua by local, small, privately-owned workshops since the early 1990's. It is easy to maintain and highly efficient at the family- as well as community level. The pump has met with high social acceptance amongst rural users ever since the early, rudimentary models were first made available. By 1995 the technology became an integral part of rural water programmes implemented by NGOs and government agencies. Rural water supply coverage since then has doubled from approximately 27.5% to 54.8%. Of this 27.3 percentage point rise, rope pumps account for 23.6% (or 85% of the total increase).

The income generating capacity of the rope pump has been an important reason for its acceptance and successful introduction. In addition credit schemes linked to the introduction of the pumps have proven successful, whilst comparative studies of farm income show that families with a rope pump generate an average US$225 of additional annual income which can represent up to 50% of the total income for the lower income groups.

Production of the technology by about a dozen private workshops has made Nicaragua the country with the highest handpump density per rural capita. Though broad international interest has been received, inclusion of the technology in rural water supply programmes on other continents has encountered serious institutional barriers. Widespread introduction elsewhere requires a multi sectoral approach in a context somewhat broader than the policies of the traditional Water and Sanitation sector. In particular, the impact of income generation on sustainability should be understood and capitalised on, whilst alliances with the private sector are required for promotion and production. Collaboration across boundaries between poverty reduction initiatives and the water supply sector are fully justifiable. However, symbiosis between the private sector user and private sector producer is the essential foundation to make development an economically viable proposition.

## 2.1 Introduction

### *2.1.1 One pump fits all: current universal strategies and policies*

Solutions to rural water supply in developing countries in remote areas in particular are characterised by the installation of community handpumps. WHO/UNICEF recently presented the following figures with regard to progress made on rural water supply coverage around the world during the last decade in their Global Water Supply and Sanitation Assessment 2000 Report. [WHO, 2000]. In Africa rural water supply coverage rose from 44% to 47% or a mere 3 percentage points between 1990 and 2000. In Latin America there was a six percentage point rise over the same period (from 56% and 62%), and in Asia the improvement was best by eight percentage points (from 67% to 75%).

Traditionally in developing countries rural water supply is governed by the national Water and Sanitation sector (W&S sector). Strategy is dominated by the installation of relatively expensive handpumps, supposedly for exclusively domestic water use, at a cost ranging from several hundreds to over a thousand US-dollars depending on the type and brand. Relatively high costs mean that these pumps are usually only procured within the context of a project, more often than not funded by a donor or through an international loan. In exceptional cases they are bought by a private sector user. Most developing countries do not produce these kinds of pumps themselves, which means that they must be shipped from India where mass production was established in the eighties through "special" financial initiatives. In practice national W&S sectors import as well as install all handpumps, including spare parts, as no one else has the required liquidity and administrative capacity to acquire them in sufficient bulk. The limitations of this situation are well recognized and described in the background articles presented around the Supply Chain Initiative of the Water and Sanitation Programme of the World Bank [WSP, 2000].

An active role of consumers or handpump users is usually missing. Though they have an important role to play in the use and maintenance of the pump, the choice has already been made for them. In previous years important initiatives have been taken around the so called "Demand Responsive Approaches" strategies, one of who's objectives was to increase community participation: allowing them to take informed choices. This initiative has certainly helped to initiate discussions, but so far it has not made a tangible difference to pump technology selection in most countries.

#### *2.1.2 Impacts of handpumps at the grassroots*

Improved rural water supply and safe water typically translate, in practice, into at best a water source with handpump near the centre of a settlement, but otherwise located within reasonable walking distance. The water quantity delivered per person will be limited because of the high number of users, and low norms for 'domestic' water supply. A standard of 250 persons per pump is most common – providing yields in the region of 20-40 l/p/d. The highest priority concerns improved health, which is governed by respectively: standards of hygiene (education), water quantity and water quality, combinations of which are more effective than the sum of each part.

Generally speaking, with few exceptions communities historically are located in the vicinity of water sources such as rivers, streams, ponds, dams, handdug wells, etc. The installation of a central source of high quality water is an important improvement and a must for the eradication of water borne diseases. However, in practice the population, including young children, will still use their traditional and more abundant water sources for washing and simultaneous bathing. The positive health effect therefore is practically wiped out. In case of failure of the pump, the urgency to have it repaired is minimal because other sources can be used, causing the well-known maintenance and sustainability problems. In fact, the much less common, albeit striking success stories about health improvement and sustainability of water supply are limited to communities who depend on a handpump as their only source.

#### *2.1.3 A need for alternative strategies*

Considering the previous, present policies do not appear conducive to increasing the present rate of rural water supply coverage or to having a noticeable impact on health. Principal obstacles include a high dependence of host countries on funding by bilateral and multilateral organisations. Second, funding, procurement, and maintenance in these countries is controlled by the national W&S sector, whilst further taking into account its role as a political entity and thus in determining priorities with regard to their distribution. The private sector will only move if there is a purchase order or when they are contracted to install the handpumps. The role of the users or communities has been marginalized.
On the other hand, initiatives by private enterprise to improve the existing situation are not an option. Given the cost of required investments versus expected returns this is just not viable, whilst further considering the high risk with regard to credit repayments by poor communities.

Efforts in Nicaragua during the past 15 years have focused on attempts to lower and, if possible, eliminate these aforementioned barriers. More specifically, this has meant local development of a multipurpose rope handpump made of locally available materials at a fraction of the cost of traditional pumps, easy to install, and easy to maintain. So far 25,000 units built by a dozen workshops have been installed. They are principally used on farms for domestic purposes, watering of livestock, and irrigation. Individual use has further enabled water supply to a significant amount of families who live and work beyond the boundaries of communities, and who normally are not included in the customary water supply projects as well as being left out of the statistics. Total rural water supply coverage at present amounts to 54.8%. Total coverage with rope handpumps equals 23.6% whilst coverage through other technologies is 31.2%. Perhaps as a superfluous comment it is worth noting that the coverage achieved by the rope handpumps alone in so short a time span is considerable. How it was done and what impact this has had, is the subject of this paper.

### 2.2 Profile of Nicaragua

#### *2.2.1 Dependence on agriculture and livestock*

The economy of Nicaragua largely depends on the agriculture and livestock sector, with a share of 26.5% in the Gross Domestic Product. Its importance is underlined by an almost exclusive dependence on agricultural (mainly coffee) products, beef, and timber for exports. The country is 80% self sufficient in food. Of the remaining 20% it imports, 76% are staple foods. Of the economically active population 35%

are employed in the agricultural sector. However, another 25% depend on this sector as well (part time labour, agro industry, agricultural services, transport, marketing).

**Table 1: Socio-economic indicators Nicaragua 2000**

| | |
|---|---|
| Area ($km^2$) | 121,000 |
| Population | 5,000,000 |
| Rural population | 1,850,000 |
| Rural population density (pers/$km^2$) | 15.3 |
| Income per capita (US$) | 480 |
| Income distribution – top 20% : bottom 20% | 65:1* |
| Human Development Index (country ranking) | 117 |
| Agriculture as % of GDP | 26.5 |
| % Labour force in agriculture | 35 |
| Access to safe water in rural areas (%) | (54.8) |
| Number of hand dug wells | (100,000) |
| Life expectancy at birth (years) | 67.5 |
| Mortality rate children < 5 years old | 50 |
| Illiteracy (%) official | 18.8 |
| Rural population functionally illiterate (est.) | 49+ |

Source: Human Development Report 2000, UNDP.
* Dierckxsens (1994)
+ van der Zee (2001)
() Estimate by the authors

The bulk of meat and staple foods is produced on farms of less than 20 ha. These farms account for 77% of beef production, 70% of pork, poultry and eggs; 80% of maize; 90% of beans, and 95% of sesame. Their share in the coffee production amounts to 50%, another 50% for sorghum, and 70% of the banana and plantain crop.

Nicaragua will remain an agricultural country until full economic integration of the Central American countries can be achieved as a prerequisite to industrialization. Its survival meanwhile will largely depend on how it can increase agricultural production for domestic consumption and for export. Development of abundant groundwater resources on the Pacific Coast at an affordable cost to low income smallholder producers will play a crucial role.

### *2.2.2 Poverty*

Poverty has different definitions in different countries. In Nicaragua the poverty line has been defined as the sum of the cost of minimum food requirements equalling 2,226 kcal a day, minimum clothing, shelter, health, education and transport, amounting to US$ 425 per capita per annum. Absolute poverty is defined on the basis of minimum food requirements per capita, corresponding to US$225 per annum. Table 2 gives an impression of the average cost of minimum annual basic needs for a family of 6, which is more or less the average national family size. When using the previous criteria, average poverty amounts to 47.9% with urban poverty at 30.5% and rural poverty at 68.5% [INEC, 1998]. Chronic malnutrition in rural areas ranges from 20% on the Pacific Coast to 28% inland.

Independent random field samples taken by one of the authors of 2216 families in 9 municipalities covering roughly 50% of the farms (Table 3) show a reasonable comparison with the national average and the regional average where these municipalities are located. However, if poverty figures can be presumed to be correct, this means that the average income per capita in Table 1 is too low. This is most likely due to not including income from a considerable informal sector in the Gross National Product.

**Table 2 Minimum annual basic needs for 3 adults and 3 children**

| Cash requirements | US$ |
|---|---|
| Food and house cleaning | 776 |
| Health | 188 |
| Schooling 2 children | 283 |
| Clothing | 176 |
| Transport | 113 |
| Agricultural inputs | 235 |
| *Sub total* | 1771 |
| *Sub total per capita* | *295* |
| Requirements supplied on farm | |
| Minimum food production | 376 |
| Farm inputs (animal feed) | 197 |
| Opportunity cost house rent | 95 |
| Opportunity cost water | 38 |
| Opportunity cost firewood | 31 |
| Minimum cost electricity | 41 |
| *Sub total* | 778 |
| *Sub total per capita* | *130* |
| TOTAL | 2549 |
| *Total per capita* | *425* |

**Note:** Expenditure as related to line items and the total of US$2,549 in Table 2 reflect averages of real expenditure of 5,025 families on the Pacific Coast surveyed by one of the authors, and further closely corresponds to the poverty line established by the Government of Nicaragua and UNDP.

**Table 3 Percentage absolute poverty and poverty based on farm income and total income of 2216 families surveyed in 9 municipalities**

| Municipalities | Based on Farm income per capita | | Based on Total income per capita | |
|---|---|---|---|---|
| | US$225 | < US$425 | < US$225 | < US$425 |
| S. Tomás | 48 | 87 | 30 | 77 |
| S. Pedro | 29 | 78 | 24 | 73 |
| S. Francisco | 17 | 59 | 10 | 51 |
| Cinco Pinos | 45 | 71 | 21 | 60 |
| Villa Nueva | 70 | 89 | 27 | 79 |
| Somotillo | 61 | 84 | 41 | 77 |
| S. F. de Cuapa | 59 | 75 | 25 | 35 |
| LPC/NAG | 48 | 61 | 23 | 48 |
| Weighted average | **54** | **77** | **28** | **65** |

## 2.3 Evolution and adoption of the rope handpump in Nicaragua

### *2.3.1 Leading role of private enterprise and rural entrepreneurs*

Water supply strategies in Nicaragua took a radical departure from the previously described common international approach from 1990, prompted by a need to find more satisfactory solutions and facilitated by a change of government which promoted decentralization and private enterprise.

Rope pump technology has been known for centuries in different parts of the world as a means to draw water for private and communal use, the mining industry and even on merchant vessels. However, its application was always restricted to water depths of only a few metres and as such described as well in the World Bank – UNDP standard book Arlosoroff [1987] page 188: "The Rope Handpump is essentially a very low lift pump with a high discharge rate" In Nicaragua first steps towards technological improvements had already been made by the end of the 1980's through different projects involving national institutions, multilateral donors, universities, and cooperatives.

Initial social acceptance of the rope pump was high due to another two important factors. Though it's development was undertaken to make clean water available to rural populations, farmers and cattle holders saw it as opportunity for irrigation and, more importantly, for watering of their livestock. In fact, the dual purpose of the pump was the basis to make its production economically feasible. Second, the product was manufactured and marketed by private enterprise from the start without undue interference by government, including a cumbersome bureaucracy. The cost is within reach of even the poor (though not the poorest), and people themselves at hardly any cost can repair the pumps. Workshops can even make the pumps in accordance with people's private specifications. It nevertheless took several years of intensive marketing and promotion through fairs and house-to-house visits to make the existence of the product known, and to generate sufficient demand to make production a profitable undertaking. Also, important technical improvements were still required to increase efficiency, durability, and to broaden its applications to wells of greater depth. For additional information on the history of developing the rope pump in Nicaragua the interested reader is referred to the earlier publications of Sandiford [1993] and Alberts [1993].

#### *2.3.2 Adoption by the government sector and NGOs*

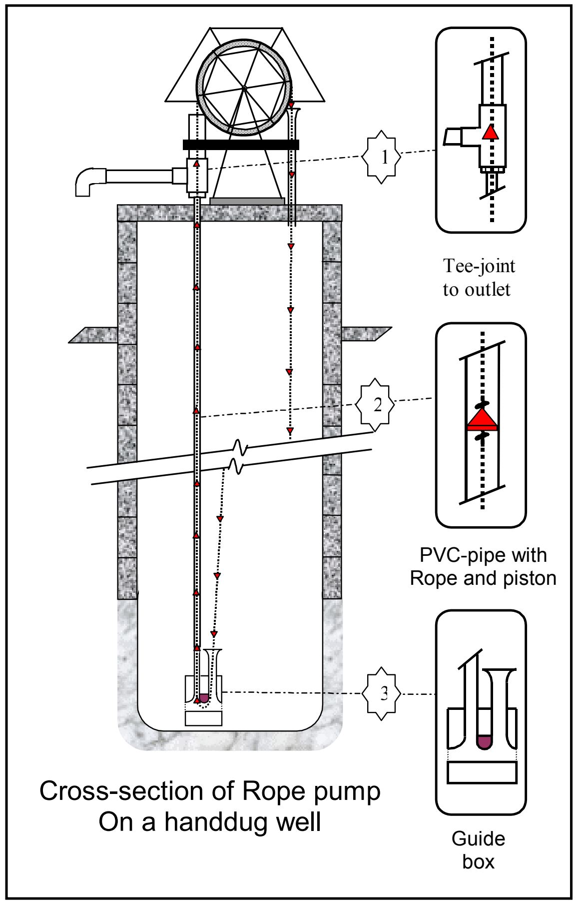
This economic process, based on the demand by private sector users and supply by the private sector manufacturers, and the accompanying promotion campaign during the initial stages caught the attention of several NGOs and later on the national W&S sector. By the mid nineties the rope pump was accepted by the W&S sector as an additional option in rural water supply activities. At this stage the network of independent rope pump producers grew to about a dozen workshops throughout the country. Whereas initially customers were a mix of small farmers, wealthier farmers, and some owners of weekend cottages on the beach, subsequent market expansion saw the introduction of the pump for water and sanitation purposes at the family and community levels on handdug wells as well as on boreholes. By the time the W&S sector got involved, the population was already familiarized with the technology and an infrastructure of small workshops was in place. This was a principal factor in preventing the sustainability problems so frequently encountered in the traditional unisectoral community water supply strategies.

The widespread use of the pump, accompanied by some basic training, and readily available spare parts undoubtedly contributed to overcoming maintenance and repair problems. However, the productive use of the pump was one of the main reasons for its social acceptance and consequently the need to give it the maintenance or repair when required. The earlier mentioned supply chain limitations related to the traditional handpumps and its spare parts in the context of rural water supply never existed for the rope pump.

#### *2.3.3 Involvement of other organizations*

The private sector introduced the rope handpump, partly aided at critical moments by a local NGO. Once this was achieved, government and organizations of civil society involved in rural development followed by including the pump as part of their different activities, and the pump became practically the national standard by the year 2000. Multilateral organizations like UNICEF and larger NGOs like CARE were amongst the first to use the pump on a significant scale for the purpose of water and sanitation. But even more important, thanks to the local availability and social acceptance, many organizations traditionally not involved in rural water supply included them in their activities, thus giving an important boost to the national water supply coverage figures.

In rural water supply projects the distribution of handpumps is in most cases through donations, but in rural development programmes it is common that credit schemes are used to recover capital costs. The experiences with these credit schemes and rope handpumps are quite positive. A variety of conditions and down payment periods are used, but commonly a recovery percentage of 90 to 95% of the amount agreed on is reached. An outstanding example is the Nicaraguan CARE-PALESA project where the users pay the cost of the rope pump and contribute with labour. This financial contribution represents 40% of the overall costs, which include the well improvement too. The PALESA project itself includes as well hygiene education, sanitation and support to income generating through small agriculture activities. These high recovery percentages can thus be attributed to the low price and the income generating capacity of the rope pump at the family level. Cost recovery percentages in community water supply aim usually at 5-10% of the capital costs



Cross-section of Rope pump
On a handdug well

## 2.4 Rope handpump technology

### *2.4.1 Description of the technology*

The pumping elements of the ropepump are the pistons and the endless rope, which pull the water to the surface through the pumping pipe made of PVC or plastic. The rotation of the wheel, moved by the handle, pulls the rope and the pistons. The pistons, made of polypropylene or polyethylene injected into moulds, are of high precision to prevent hydraulic losses. The structure is basically made out of angle iron, piping and concrete steel. The pulley wheel consists of two internal rings cut out of lorry tires, joined by staples and spokes. A guide box at the bottom of the well leads the rope into the pumping pipe. The guide box is made out of concrete with an internal glazed ceramic piece to prevent any wear. It is a high efficiency and low cost technology, but includes some pieces of high precision and high quality. Rope pumps are installed on handdug wells and on drilled wells or boreholes. There is no need for the pumping pipe to be installed vertically, which means that rope pumps can be installed as well near riverbanks or dams for irrigation.

The type of rope pump differs according to its application, and its cost is in the range of US$50 to 100, depending on the model. In general the rope pump used at community level requires the highest technical standard. The least expensive and simplest model will do for domestic use or irrigation at the household level. However, all can be fitted with the same spare parts. Maintenance costs are minimal in the range of US$0 to 5 per annum for the family well pump and up to around US$10 for the very intensive used community pump.

### *2.4.2 Field performance*

The maximum standard depth reached by the rope pump is 40 m. This can be increased to 60 m with adjustments and a double crank. Presently, experiments are being conducted to reach a depth of 80 m.

The minimum water depth in a well required for a rope pump is only 10 cm. The guide box is positioned on the bottom of the well, as sand does not affect the functioning of the rope pump, which normally happens with other brand pumps. During the dry season, when the water table goes down, the rope pump will keep on working until the well really dries up. The latter has been found to be an important factor related to social acceptance. When the water table in a well goes down and the traditional pumps can't reach the water any more, users blame it on the pump as they can still draw water with their rope and bucket. Actually it's not the pumps, but the need to place the foot-valve at a certain distance above the bottom of the well to prevent sand coming into the pump that causes the problem.

A handdug well should preferably contain at least 1 m of water. In practice the older wells have a depth of about 1 m below the groundwater level of the driest season during the last decades. Of the handdug wells in Nicaragua 45% have a depth of less than 10m; 30% have a depth from 10-20 m; 15% from 20–30 m, and 10% are deeper than 30 m. The maximum depth of handdug wells is about 100 metres although these are only found in exceptional cases.

A 100 mm casing is normally the minimum diameter for drilled wells to install standard rope pumps. However, if necessary this can be reduced to 50 mm, and a rope pump with a small diameter guide adapted.

**Table 4: Pumping capacity of the rope pump according to depth**

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

Table 4 shows the pumping capacity of the rope pump-based on operation under normal conditions. Even for children it is easy to fill a bucket thanks to the high efficiency of the pump. The latter is another important factor in obtaining social acceptance.

## 2.5 Impact of the rope handpump on people and poverty.

### *2.5.1 Impact of water on farm incomes*

Table 5. shows the difference of income between 1,469 farms of different categories with and without a well in 8 municipalities on the Pacific Coast. These are the not rented farms smaller than 21 ha of a total data base of 1,806 farms. Approximately half the wells are equipped with a rope handpump. The impact of the total of the wells and rope pumps is self-evident. In the 6 municipalities that make up the north of Chinandega, poverty disappears on farms with a well and a pump from 14 ha upwards, whereas in the 2 municipalities of La Paz Centro and Nagarote this already tends to occur at 7 ha. As yet there is no complete analysis available to differentiate between the impact of a well by itself and a well in combination with a rope pump according to property size. However, on average in the range from 0-21 ha the difference made by the rope handpump alone amounts to US$225.

The impact of a well or alternative source in combination with the rope pump could be larger still if soil fertility is improved, which at the smallholder producer level means an organic approach. Preliminary results obtained by one of the authors indicate that through this method yields of rainfed staple crops, fruits and vegetables can be doubled, and probably trebled. The proportional, added impact of water will be similar, if not more, than the results shown in Table 5. Of course, in such a scenario additional income in absolute terms will be considerably higher.

It is worth noting that organic methods on well maintained soils by themselves do not usually increase production. However, in Nicaragua, like elsewhere in Central America and many parts of Africa, soils are exhausted and/or depleted by slash and burn practices, followed by monoculture, and often subject to erosion. Trials conducted by local universities and the Ministry of Agriculture in conjunction with FAO in Nicaragua have shown average production increases of maize of 66% when adding manure (10 tonnes per ha) and 100% when maize is cultivated in association with legumes. Informal trials, however, have shown that the use of compost (two handfuls in each planthole) as an alternative to manure is more effective than manure, as well as a buffer against unreliable rainfall and drought.

### *2.5.2 The role of water and the rope pump in a strategy for poverty alleviation.*

The impact of water in terms of basic needs like food or conversely undernourishment is proportionally highest for the smallest categories of farms with the lowest incomes. Also, for families living in absolute poverty this may mean a change of status, though they'll still be poor, and for the poor an opportunity to rise above the poverty line.

As can be seen from table 6 a major part of the income obtained from these small properties comes from the so-called “patio”. A patio can be compared to a kitchen garden, but is not the same. It’s an area around the farmhouse varying between 900-1800 m$^2$, surrounded by fruit trees, firewood species, and shrubs. Within the area one finds a dozen or so of chickens, a few pigs, herbs like basil and mint in flowerpots, the washing area, the social area, and perhaps a well and a latrine. The patio in general is the domain of women.

**Table 5. Farm income (US$) according to property size with and without a well**

| Farm category (hectares) | North of Chinandega | | | | La Paz Centro and Nagarote | | | |
|---|---|---|---|---|---|---|---|---|
| | No Farms | Well US$ | No well US$ | % incr. | No Farms | Well US$ | No well US$ | % incr. |
| 0 – 0.7 | | | | | 11 | 640 | 514 | 25 |
| 0.7 – 1.4 | 324* | 740 | 542 | 37 | 22 | 843 | 713 | 18 |
| 1.4 – 2.8 | 324 | 1224 | 951 | 29 | 42 | 2040 | 1059 | 93 |
| 2.8 – 4.2 | 108 | 1572 | 1189 | 32 | 57 | 1366 | 868 | 57 |
| 4.2 – 7 | 120 | 1752 | 1384 | 24 | 65 | 1762 | 1605 | 10 |
| 7 – 14 | 156 | 1747 | 1519 | 13 | 117 | 2389 | 1575 | 52 |
| 14 – 21 | 60 | 2599 | 2019 | 29 | 63 | 2530 | 1175 | 115 |

Note: * These data concern the sum of the categories 0 - 0.7 and 0.7 - 1.4 ha.

The in the table presented average patio income is approximately US$280.- in the municipality of San Francisco de Cuapa without water and an average patio income of US$740.- with a well and a pump in the municipalities of Nagarote and La Paz Centro. In the latter case this is further related to good soils, sufficient space, two local markets and one metropolitan, with good access roads at less than 30 km, and producers who derive their income almost exclusively from the farm. Well developed patios (found on approximately 25% of the farms), with incomes up to US$2100.- , are characterised by a poultry component and 5-10 pigs as a basis, fruit trees as the next component, and irrigated vegetables as the final stage of development. The availability of water and a pump in this scheme is essential. Differences between well developed patios without water and the latter may range from US$560 to US$1,050.

**Table 6 Patio as a percentage of farm income for different categories in 3 municipalities**

| Category (ha) | Nagarote-La Paz Centro | S.F. de Cuapa |
|---|---|---|
| 0 – 0.7 | 56 | 40 |
| 0.7 – 1.4 | 48 | 37 |
| 1.4 – 3.5 | 47 | 40 |
| 3.5 – 7 | 31 | 29 |
| 7 – 21 | 28 | 19 |
| 21 – 35 | 21 | 9 |
| 35 – 70 | 15 | 4 |

Between 1999 and 2002, socio-economic data were collected in the field on 5,025 families in 23 municipalities along the Pacific coast of Nicaragua. The minimum sample of farms taken in each municipality is 15%. The corresponding data bank in Access is available in CD Rom at the Universidad Politécnica de Nicaragua. The data bank includes information on the 2216 families in 9 municipalities in this paper. Based on this data bank a scenario has been drawn up, which shows that under the right conditions a patio of 1800 m$^2$ with a well, pump, a rudimentary low pressure irrigation system, and a groundwater table of no more than 10 m depth (quite common on the Pacific Coast of Nicaragua) can easily produce an annual gross income US$3500 at an investment cost of US$837 and a recurring annual cost (seeds etc) of US$760, labour not included. Daily labour requirements are 3 hours a day. Patio development around the limits of the big cities Managua, León, and Chinandega offers the best potential in the struggle against poverty, given that a sizeable proportion of the poor and very poor are concentrated here. Good soils and water are further abundant, and ready markets for produce available. Selection of the right beneficiaries for a programme of this kind must be limited to those of proven vocation. Normally these amount to about 50% of all landowners.

#### *2.5.3 Specific findings of two related studies*

In her study of the rope pump in Nicaragua in the context of financing rural water supply systems from a rights perspective, [Blackman, 1999] reached the following conclusions:

- The rope pump has user and institutional acceptance. The common belief that sustainability is dependent on recovery of capital costs is brought into question, given that rope pump users take responsibility for maintenance and repair regardless of whether they paid for the capital cost of the pump, and further facilitated by fact that this is simple and inexpensive to do. Therefore government donation of rope pumps to beneficiaries should not come under fire, although the study finds that this limits coverage, especially as subsidies are not targeted effectively.
- User financing of the capital costs of the rope pump should be encouraged where possible, especially as its low cost is affordable for many. Findings show that credit programmes have been successful at facilitating this, although the importance of a flexible repayment mechanism is emphasised.
- The study finds that user financing does not have to conflict with the labelling of water as a basic right. The state has a responsibility to see rights met, but other development actors, including the people themselves, have an obligation to contribute to the practical fulfilment of their rights.
- The study concludes by recommending that the experience with the rope pump in Nicaragua be transferred, promoted and implemented in other developing countries.

Evaluation of the rope pump in 5 community water supply projects in Nicaragua and 1 in El Salvador [Post Uiterweer, 2000] showed that a majority of families maintain and repair their rope pumps whether they paid for it or not. Also the dropout rate of the pumps is low. Only 6.6% were found to be out of order due to technical failures or negligence by the users. The pump proves to be a sustainable solution for water supply in rural Nicaragua

### 2.6 Improved health

The objective of improved rural water supply generally is limited to improved health. Implementation should, where possible, be based on scientific- and field studies. Already before and during the development of the rope pump an integrated research programme on the causes of diarrhoea with emphasis on children was conducted by Gorter (1998). The study concludes that water quality improvement does not generally have as great an impact on health compared to interventions that increase the availability of water or provide human faeces disposal facilities. Interventions that improve hygiene behaviour at the household- and/or community level seem to have the greatest impact. Improving the level of hygiene practices may be highly effective, but depend on preconditions such as the mother's level of education, facilities for water, and for the disposal of faeces. Social and cultural factors may also have a reinforcing or a restraining influence.

Based on the previous studies and literature surveys there are 3 main points to support the rope pump strategy. These are:

- To make more water readily available, thus improving hygiene conditions (water washed diseases).
- To improve water quality (water borne diseases).
- To keep the population away from rivers and streams (possible by making water easily accessible).

The water quality delivered by a rope pump on a borehole fits perfectly well within the standards for drinking water quality. (< 3 Coliform/100 ml). On handdug wells the quality of the water delivered depends on the additional infrastructure improvements made on and around the well. Replacing the traditional rope and bucket by a rope pump without additional infrastructure improves considerably the quality of the water delivered, and makes more water easily available.

It would require an extensive stepwise design of random control trials to conclusively establish the impact of different interventions on the improvement in health conditions. Studies of this type have not been conducted for rope pump related interventions. However, after hurricane Mitch USAID financed an environmental health project, implemented by several NGOs, which included the installation of 2,500 rope pumps [USAID, 2001]. Monitoring of diarrhoea incidence amongst children under 4 years of age was included before, during, and after implementation. It is interesting to note that incidence came down by 60 to 100 percent.

### 2.7 Rural water supply coverage

Rural water supply coverage is currently defined as the percentage of the population with access to improved water supply. The definition of what should be considered as coverage is subject to discussion. The earlier mentioned WHO/ UNICEF Global Water Supply and Sanitation Assessment 2000 Report [WHO, 2000] tries to narrow down this definition. The report attempts to present survey-based coverage figures rather than estimates provided by those who carried out the improvements. In the Nicaraguan case the first important reference is the national census of 1995. The previous census was taken in 1971.

According to the 1995 census 27.4% of the rural population had access to a piped water system in or outside their house or through a public source. Another 37% obtained its water from a community- or private well, which only in a few cases can be considered as improved water supply. The questions used in this survey were not very specific, leaving room for different interpretations. A second source of information is SINAS (a national system that produces the statistics for rural water supply), which has been in operation since the end of the 1990's. This system includes all the larger improvements, the performance of which is subsequently monitored on a three monthly basis. The organizations and/or contractors who carried out the projects provide the data. Only the improvements that are operational and reported are included in the statistics.

In order to determine the contribution of the rope pump to total coverage, a third database was established, based on the rope pump production figures provided by the leading workshops, earlier evaluations and other sources. These data were cross referenced with information provided by the SINAS statistics For example, the average number of users per drilled well with a rope pump is known from the SINAS figures, and the total number of rope pumps on drilled wells is obtained from the rope pump producers.

By 2001 the total of rope pumps installed was about 22,000, however, this figure does not always take into account the number of pumps installed by other sectoral programmes such as, for example, rural development. Also, most workshops don't keep reliable figures with regard to output. In fact, Holtslag (pers.comm.) estimates that the total of various types of pumps produced may be in excess of 30,000.

Based on the SINAS figures, figures obtained from the rope pump producers, and various evaluations by independent parties it is inferred that 90% of the pumps installed on drilled wells are operational, whilst this is 80% for pumps on handdug wells. These conservative figures take into account pumps of lesser quality produced by the smaller workshops, and at times the higher estimates reached by evaluation missions.

Table 7 shows the number of operational rope pumps and users per pump divided into 3 categories, based on the projects included in the SINAS statistics, projects carried out by NGOs, and clients from the private sector. Coverage of the number of persons that benefit from each pump is derived from the SINAS figures, evaluation studies, and some rough estimates. Rural water supply coverage as related to the total rural population is shown in Table 8.

The previous data lead to some important conclusions. By 2001 23.6% or almost a quarter of the rural population received its daily water needs through a rope pump. Needless to say this is impressive, further considering that the vast majority of the pumps was installed during the past 7 years. The sum of the coverage by other technologies and the rope pumps included in the SINAS statistics gives a number of 38.6%, which is close to the 41.6% coverage presented by the Nicaraguan Government (2001). The WHO 2000 report on the other hand presented rural water supply coverage of respectively 44% for 1990 and 59% for the year 2000. These figures are considered rather high.

Table 7 further shows the very important role of the NGOs and different projects. They contributed to over 50% of the rope pump coverage reached in the country while the government sector contributed 31%. It is perhaps worth mentioning that in other countries NGOs have steadily withdrawn from rural water supply, whilst in Nicaragua they were given the opportunity to show their worth, and responded to the challenge by making the largest contribution.

### 2.8 Technology dissemination internationally

A number of dissemination products produced since 1993 have generated contacts with over 70 countries, with more than one thousand formal letters and e-mails sent. Trials with rope pumps sent over from Nicaragua were conducted in Ecuador (2), Angola (3), Zambia (6), Madagascar (3), and Mozambique (8). Production subsequently got underway in some of these countries, as well as in Laos and Ghana. Other countries started independent initiatives based on the documentation provided, in which the initiatives taken in Zimbabwe are probably the most conspicuous.

**Table 7 No. of rope pumps, users per pump, and total beneficiaries by category**

| | Users per pump | Number of pumps | | Total beneficiaries | |
|---|---|---|---|---|---|
| SINAS * | 96 | 1711 | 9.4% | 164,407 | 31.5% |
| NGOs | 31 | 9303 | 51.3% | 286,639 | 54.9% |
| Private sector | 10 | 7118 | 39.3% | 71,176 | 13.6% |

Note: SINAS, pumps included in the national statistical system concerning rural water supply

Between 1996 and 2001 the Swiss Agency for Development and Cooperation (COSUDE) supported the transfer of technology through various activities. These are:

- Documentation which includes (i) Rope Pump Production Photo Manual; (ii) Manual of Technical Drawings; (iii) Installation and Maintenance Manual; (iv) Experiences and Tolerances in Rope Pump Production; (v) Guide for Introducing the Rope Pump, and (vi) Requirements to start Production of Rope Pumps. All of these are available in Spanish, English and French. A video of the Central American experiences with the rope pump is further included.
- Financing the construction of a training centre, used for meetings and to receive international trainees.
- Financial support to keep up international communication (stamps, photocopies etc.)

**Table 8 Rural water supply coverage**

| | Rural water supply coverage (%) | | |
|---|---|---|---|
| Coverage with Rope pumps not included in SINAS | 16.1% | | |
| Coverage with Rope pumps included in SINAS | 7.4% + | | |
| Total Coverage with Rope Pumps | | 23.6% | |
| Coverage through other technologies | | 31.2% + | |
| Total Rural water supply coverage | | | 54.8% |

In May 2001 the “First International Rope Pump Policy Workshop” was held in Nicaragua. Representatives of governments, international support agencies, NGOs, and private sector enterprise from 23 countries attended the workshop. [Keen, 2001]. The Workshop was jointly organised by COSUDE, the Regional Water and Sanitation Network for Central America (RWSN-CA), the Network for Cost Effective Technologies in Water Supply and Sanitation (HTN), the Technology Transfer Division of Bombas de Mecate SA, the World Bank Water and Sanitation Programme (WSP), and the International Water and Sanitation Centre (IRC). The Swiss Development Cooperation (SDC) financed the event. The above-mentioned organizing institutions of the workshop are all directly involved in water supply activities.

Despite a widespread acceptance by organizations of civil society, including international NGOs, users and potential users, private enterprise, and a majority of bilateral donors, this is not necessarily the case with multilateral donors and recipient governments. It is understood, as a matter of course, that management of the complex system constituting the W&S sector cannot include the rope pump without careful prior consideration and study. However, indifference and consistently leaving the debate about the rope pump from the agenda suggest that vested interests are at stake in favour of the traditional pumps.

## 2.9 Conclusions

Cooperation between private sector users, private sector producers, and the national water and sanitation sector in Nicaragua has proven successful for various reasons, and additionally involved NGOs as important actors in rural development and rural water supply. The characteristics of the Nicaraguan rope handpump, such as low cost, easy maintenance, high efficiency and local production were a prerequisite to make this development possible. The initial introduction took place independently of the water and sanitation sector, whilst its successful, widespread use was made possible through the adoption of the pump as an additional option in rural water supply by the water and sanitation sector. Later on it became a de-facto national standard. The two most important areas of impact are on income generation, including poverty alleviation, and overall rural water supply as evidenced by significantly increased coverage, which presumably includes improved health.

Of the total of over 25,000 rope pumps that were installed, at least 20,000 can be considered to generate an additional income of US$225 a year, which results in a minimum additional annual rural income of US$4.5 million (roughly 0.5% of countries GDP). This figure amounts to at least twice the total cost of all the rope pumps installed. Given the simple technology and wide range of operating environments – with proven effectiveness to depths of 70m, there is no reason to believe that similar success and cost effectiveness should not be met in other countries. The cost to set up a rope pump production unit in a new area, including promotion, is estimated to be in the range of US$50,000 to US$100,000 depending on the local conditions.

Cost comparisons with more conventional handpump-based rural water supply are striking. Traditional handpumps cost somewhere around US$500, whilst maintenance amounts to between US$60 and US$100 in countries where these have been installed. In Nicaragua roughly 3500 rope pumps are installed on community wells (drilled or handdug) with an average of approximately 100 users per well at a cost of US$350,000 in high quality rope pumps at US$100 per unit. If traditional handpumps had been used, this would have equalled US$1,750,000 or a difference of US$1,400,000 without taking into account the added benefits of saving foreign exchange, generating local employment, and improving local skills. Additional annual savings of around US$250,000 are further made, as maintenance costs of the rope pump are minimal.

Because of the cheapness and versatility of the rope pump, a minimum additional 10% of the rural population has been provided with improved water supply (cases of up to 20 users per pump), than would have been the case with costlier handpump designs.

The background paper for this symposium emphasize the necessity to reassess traditional approaches to water supply, the break down of sectoral boundaries, and a search for new, practical solutions (policy, technical, institutional, financial) in addition to collaborating across boundaries within the water sector.

Many organizations and persons around the world know the experience in Nicaragua and most of the results presented in this paper. This has generated new initiatives in other countries, but so far has failed to result in the adoption of rope pump technology as a viable alternative within the rural water supply sector. In fact, traditional, donor supported technologies and related policies are blocking the process, excluding the rope pump from rural water supply policies. There are a variety of likely reasons for this blockage, ranging from institutional inertia and rigid sectoral thinking to vested interests and corruption (importing and having a monopoly on expensive handpumps is an often lucrative business).

International acceptance of the rope pump may perhaps be aided by its introduction through rural development activities. Generally this sector is more open to innovation, with recent examples of innovate approaches including animal traction, post harvest silos, or the treadle pump, which has had such a large impact in Bangladesh. Nevertheless, resistance is expected to remain until the barrier can be levelled by sheer critical mass.

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