Difficulties in the scaling-up of decentralized technologies in drinking water, sanitation and small scale irrigation in rural areas of developing countries. Wolfgang Buchner, emas@entelnet.bo

Author's Note

These observations are based on 25 years of experience working in developing nations primarily in Bolivia but also in much of the rest of South America, Central America, Africa and Asia. The purpose of this document is to explain the failures of the modern water system in rural communities and identify the difficulties of the large scale application of decentralized household water systems based on appropriate technologies.

1. INTRODUCTION

1.1 Decentralized Technologies

Decentralized technologies refers to systems of water at household level which are operated and maintained by the users themselves. Examples of this are a household rain water capturing system, a family well or a spring. Decentralized technologies use locally available materials and are designed such that the users themselves can construct and maintain the systems. These types of systems have shown the highest sustainability rate in rural area with dispersed and semi dispersed population.

1.2 Failure of Historical Water Supply Systems

Every household has some sort of access to water. Historically, this has been in the form of a river, lake, dam, rain water, spring, etc. However, the growth of population has directly increased the contamination of these water supplies with waste water, fertilizers and chemicals. Now, many of these natural water sources are unsuitable for drinking water. and do not meet accepted drinking water standards. Many rural and semi-rural communities do now not have a good access to clean water. Further to this, required cleanliness standards for drinking water have advanced such that the historical methods of supplying and treating water are no longer acceptable today.

1.3 The Objective

Whether by a modern communal system or decentralized technologies, the goal is water for everyone, of good quality and with continuous service 24hrs a day and throughout the year as is provided in modern cities and towns.

2. FAILURE OF MODERN WATER SYSTEMS IN RURAL AREAS

2.1 Water Systems in the Urban and Rural Environment

Governments are under an obligation to provide both the urban and rural population with high quality water. Modern water systems are sophisticated and complex and in developed nations deliver high quality water directly and continually to households both in the cities and in rural communities. However, in developing nations the successes are far less evident. It is common to find that in developing nations the modern water systems deliver with a high level of success in the towns and cities but they often fail in the same application in the rural and semi-rural environment. This is mostly due to extremely high costs and low rates of sustainability for the rural water systems projects. Systems which rely on advanced technology to meet high cleanliness standards are very often not appropriate or transferable to rural or semi-rural requirements.

2.2 The Political Push for Modern Systems in the Rural Areas

Politicians often promise water to every household as a means of gaining popularity. Non Government Organizations (NGOs) see water in every household as a principal objective for their targets. This concept of every household having potable water has become engrained in the imagination of the rural people, causing many of them to believe that having a water service by a modern piping network is essential for a better life. The governmental development institutions, local NGOs, consulting and constructing companies capitalize on these targets both economically and politically. Community centralized water projects guarantee votes. Economically, they ensure the transfer of huge quantities of money to municipalities, NGOs and communities. With the UN declaration that drinking water is a human right, many states believe that it is their exclusive right and obligation to supply their rural people with expensive piping networks. These large and expensive rural water projects are justified by their improved hygienic standards over existing water supplies. Politicians are given the parameters by laws and standards which specify what should be the exact composition of water as it arrives at the household. However, these specifications are very often in ignorance of the rural reality. The technology required to comply with these regulations is extremely costly and there is no long-term requirement for these expensive systems to continue functioning. What is important is the immediate benefit for all involved – i.e. financial benefits for the construction company, votes for the politicians, bribe money for the local decision makers and in the short term, clean but expensive water for the rural communities.

2.3 Unsustainable Modern Water Systems in the Rural Environment

The centralized system of water supply in dispersed rural communities is often much more complicated than believed. When the water source is a drilled well the problems often start with infiltration of fine sand. The fine sand damages the water meters and without an equitable distribution of consumption costs, nobody is willing to pay to replace the meters. Without a willingness to pay, there is no sustainability. When water is taken from a surface source such as a lake or river, treatment is needed and the problem becomes even more complicated. In addition to the pumping costs, there are the costs associated with ingredients for treatment such as flocculants or chlorine. The resulting drinking water is so expensive that many families prefer to use their own traditional source. Less water sold means less money for the company maintaining the system and leads to increasing water cuts. Finally, the families abandon the tap water system and return to their traditional source.

2.5 Successive Failures of Community Water Systems

There exist communities with several drinking water networks, but without any water. This phenomenon occurs for several reasons. Although disillusioned for some time after a failed municipal water project, people start dreaming again about a communal water supply system. The dream builds up through travels to the local town or city, from modern films, and visits to similar communities where simple communal systems can work by gravity. Additionally, it should be mentioned that living without tap water is seen as living in poverty and underdevelopment; similar to the social stigma associated in much of Latin America of living in a house made of “non-modern” materials such as adobe (blocks composed of mixture of sand and mud). The bodies of development promise each time “better” solutions and assure that this time it will work, but this is often just a fabrication to push through their policies. Usually, the failures of the systems are claimed to be social and organizational issues, but the

true reason of the failure seldom changes. Human behavior cannot be changed through instructions in cooperative systems, trade-unionism or other forms of theoretical preparation for running a complex water supply system. It is much more difficult to adapt humans to a technology than the technology to the human. However, this adaptation is not desired because of the money and political power at risk.

2.6 The factor of public or private ownership regarding maintenance

Generally in every water project, it may be a small network or only a public hand pump; local people are trained for maintenance and small repairs. In the beginning the damages are normally little and relatively easy to repair, but if this is not done in time, the damage will increase and can make the pump or the network unusable. After analyzing the problem it often results that the person in charge, although he was trained for that case he did not act in time and responsibly. The reason was the fear to make a mistake while trying to repair and make things worse. So the members of the community could make him ridiculous or make derogatory remarks. For most of the people embedded in a small community this is mortal. But if he does not act and lets the thing get destroyed by itself, than he committed only the mistake of omission what brings less bad comments. Because this is the way normally it happens.

It is very different when he is the owner of the system. In this case he is the only responsible for maintenance and repairs. For sure he may be also frightened to tinker on it, but in case he makes things worse nobody can criticize him because it is his property. In the worst case he has to call a technician who repairs it finally. Regarding maintenance of communal systems, the fact to become ridiculous as an incompetent man in charge of the public water system is often ignored by the organizations when they entrust him the communal system.

3. ADVANTAGES OF APPROPRIATE TECHNOLOGIES

3.1 Sustainable, Low-Costs and Pride in Self-Construction

Appropriate technologies are of low cost and ideal for self-construction. As they are used at family level, the community does not need additional organization, they are easy to maintain, do not need electricity or fuel and importantly they bring self-esteem and dignity to the families because they themselves solved one of their greatest problems. The systems are simple and can very quickly be installed. A hand drilled well can be perforated up to 30m in one day for as little as $6US per meter drilled thus bringing clean water directly to the door step of a family that have historically had to walk great distances to bring often dirty water back for household use and consumption. The water is free and the only cost to the user is the installation and what little maintenance is needed. There is no bureaucracy involved in the management of the system and these types of systems have been proven to show far more longevity than communal systems which depend on municipal maintenance, fragile piping network and complicated treatment processes. Furthermore, in a household independent system, additional value can be added to the water by pumping it from the well up to a small house storage tank where by gravity the water is piped to a shower or kitchen sink and even very simply through a solar water heater. Additionally, the danger of epidemics is far less likely than in a communal system because there is no common source.

3.2 Prohibition of Watering Livestock Using the Public Network

It is often the case that the survival of the livestock is more important to the farmer than his or his families own comfort. The cows or sheep are generally watered at traditional water sources such as rivers, lakes or dams. However when these sources dry out, the farmers are often at a loss for how to water the animals because it is often forbidden to use the public drinking well. Therefore, the farmer is obliged to drill or dig a personal well near the house. In the case that they drill a well with reduced diameter, only an EMAS pump can be installed. However, in addition to now watering his livestock, the well now permits pumping for personal use. The water can be pumped up to a house tank from which the entire house including kitchen sink and shower can be supplied.

4. DIFFICULTIES OF THE IMPLIMENTATION OF APPROPRIATE TECHNOLOGIES

4.1 Rural de-population

Due to migration for jobs into towns and cities, mostly elderly people now live in many rural regions. For this elderly population, it is much harder to dig a cistern or drill a well because of the physical strength required for the activities. Many of these elderly residents lose the hope for a better life when their children leave as they are accustomed to hardship and see no reason to invest in improving their situation. Often the fields lie un-worked and there is little incentive to do anymore than is required to survive. There is neither the physical ability nor will power to alter the existing systems with something such as a new well or latrine.

4.2 Learning New Skills and Obtaining New Knowledge

Learning new skills which are not traditional in rural areas such as building an EMAS hand pump or a rope pump, is seen for many people as exotic and is rejected for reasons of unfamiliarity. People now expect that the government or other institutions will cover the costs of water and sanitation as they have been declared a basic right, promised in the election campaign and therefore it is for someone else to provide. Paying for tin sheeting for the roof of a house is acceptable but paying for a new well, rain water harvesting system or latrine is often considered unacceptable in the rural highlands. (note: it is often harder and more expensive for a municipality to pump water to the highlands than is its to pipe water by gravity to the lowlands, for this reason the rural highlands are often without a network of supplied water). Very often, people lack the basic tools required to create small water systems. Many households do not own screwdriver or pliers. It is very difficult to convince someone to invest money in tools which are not of daily use. Although many people use a bicycle for transportation, few are able to patch the tire or make other small repairs. Should the bike get a flat tyre, the preference is to push the bicycle to the next village. This situation is even worse in water and sanitation because its components are fixed and cannot be brought easily to the workshop of the technician.

4.3 Local Enterprises

Theoretically the concept of decentralized water systems in rural area is based on local enterprises who sell their services to the residents of the region. However, such a network of local technicians mostly does not exist yet except in a few isolated locations. Only a few local technicians have their own vehicle for transportation of material and tools. One of the reasons is the lack of paid labor which make the service unfeasible. Contracting these technicians requires payment for their labor which creates envy amongst the neighbors. The technicians are not locally hired because their neighbours are unwilling to pay for their services. In Bolivia exists another strange barrier for the success of small private water systems. The state's

constitution explicitly forbids the sale of water from private persons. Only public enterprises are allowed to sell water thus limiting the sustainability of a private network.

4.4 High Subsidies in the Rural Water Network

The rural population expects that Water and Sanitation (WATSAN) services are cost-free. The United Nations has declared drinking water a human right and therefore most people now believe they should not have to pay for it. Government and other institutions highly subsidize the service. Without this subsidy, many communities could not afford to run their water system. One example in Puerto Pérez in the highlands of Bolivia is that only the energy costs for the community water system charged to the users. This equates to around $0.50US a month. A rain water harvesting system with a 7000 liter underground cistern costs around 150 US. Dollars to construct. Even after 25 years this inversion would not be cost effective.

4.5 The Public Water Network as a Symbol of Status

For decades development agencies have highlighted the importance of drinking water for every household. This promotion at all levels has left a strong imprint in the minds of people. In the past, the organizations had to stimulate the communities to make the request for a project. Today the communities independently make requests for their own WATSAN projects. Considering that many communities have now a water system (even if it does not work) this is now considered a type of status symbol. An attractive water tower in the middle of the community is more visible than individual small wells or underground rain water tanks.
Many people believe that only tap water from a communal network signifies true advancement and modernism. Using the family well or rain water from the cistern gives the impression of “disconnectivity” from the rest of the community and appears illogical given the extremely low costs of the water service due to heavy subsidies.

4.6 The Raw Water Versus Drinking Water Dilemma.

In many countries there does not exist a clear definition of what constitutes acceptable water quality for distribution by the public network. As the standards should be the same countrywide there are difficulties. By definition, drinking water has to be much cleaner than raw water because it has to be drinkable at any moment. It is well known that raw water is not always safe for drinking and can require treatment such as a household water filter. Raw water can be drank at the risk of the person who decides no treatment is required. The same can be said of decentralized systems such as individual hand dug wells and particularly rain water harvesting systems. Without chlorination they often do not achieve all the hygienic standards and may be rejected by national authorities as a valid option. Hence, no money is set aside for these types of projects. The economic factor also plays an important role because a “drinking water” project ends up being much more expensive than only a distribution system of crude water or decentralized systems like rain water tanks or improved individual wells.

4.7 Strong Social Bindings Through Traditionally Communal Projects.

There are activities where the whole community works together such as building a road, school, church, or a community water system (be it for irrigation or drinking water). These works act to unify the rural community and encourage each member to participate. Drinking water is often seen as a community unifier and for this reason communal systems are often preferred to individual systems.

4.8 The Absence of a Culture of Comfort

Probably the most important factor why people in rural areas refuse appropriate technologies is the absence of a culture of comfort. For example, comfort appears lower in the priority of values in Bolivia than say the need for peer recognition. People prefer to spend money on activities such as annual festivals which promote peer recognition than to spend the same money on improving the family water system or adding insulation to the house walls. It may be that many rural people have an inferiority complex and feel of lesser value than people from the town or city who in the minds of the rural residents, have achieved the “modernism”. This may be the reason why rural people worry more about visible status and peer recognition such as a mobile phone, vehicle model, “modern” brick-built houses, etc, than about water facilities.

4.10 Pumping by Hand is Often Seen as a Symbol of Poverty

The vast majority of people do not want to appear poor, underdeveloped or disconnected from the modern world. Although physical exercises is healthy such as pumping on a manual hand or pedal pump, most people prefer an electric pump, where only pushing a button is needed to fill a tank. Doing the same exercise in a fitness studio is seen as a sign of prosperity but pumping by hand or pedal is seen as a symbol of poverty.

4,11 The Lack of Professionals in the Appropriate Technology Industry

Most appropriate technologies and particularly those from EMAS are free of copyrights and designed for self-construction. This signifies that anyone can build the components as they wish. The results are that some self-made projects are of good quality and others are of bad quality. There does not exist a body which controls quality and designates standards. Poor quality works are counterproductive propaganda for decentralized water systems, particularly when the pump does not function as required or the wells deliver sand or is clogged etc. One of the prime reasons is the lack of highly educated professionals constructing the systems. The vast majority of the decentralized systems are constructed by available local technicians. There are few engineers or specialized technicians constructing appropriate technologies in WATSAN for rural areas. Few universities teach degrees in WATSAN using appropriate technologies because there is very little demand in the market for jobs in this field. The reasons are diverse but the principal factor is that there are not any experienced teachers. For many university teachers making a pump with glass marbles is more like a game than a technology and for that reason they don’t see it as applicable to a university degree. Furthermore, many teachers are afraid to attempt to construct the systems due to their lack of practical skills. The majority of those trained to construct the systems are local technicians, who work in their own small family enterprise where the skills are transferred from father to son or from the well driller to assistant. Their primary objective in running the drilling business is to earn a living. Training others in how to drills the wells and the teaching their client’s family on how to make the system themselves is less important than the profit from the business. The extent of a private well drillers remit is simply to drill a well and install a pump. They normally do not connect the water from the well to the kitchen sink or a shower. Even less common is to develop the system to include a ventilated toilet or allow heating of the water through solar power. Without professionals who are convinced about the successes of appropriate technologies, there will be no funding for major projects and consequently no global implementation on a large scale. However, there are inherent problems with such large scale and systematic implementation of these types of systems. One primary reason is that many of these systems would be fully-subsidized where the users don’t need to contribute. Governments and NGOs often build complete communal systems without any real

contribution from the users either monetarily or through labour. If this same method of gifting decentralized appropriate technology systems were to happen, perhaps the last opportunity would be lost to involve the rural population in a true process of development with dignity. Most decentralized appropriated WATSAN technologies are specifically designed for self construction and it is one of the key added values that the users are proud of their work and what they have constructed.

4.12 The Absence of Continuous Design Reviews and Improvements for Appropriate Technology Systems

Without professionals who can advise users and development institutions on the various options available to them, mainstream central networks or public water points will continue to be built. Although decentralized technologies exist, their design should to be constantly reviewed and improved through lessons learnt. Experiences on how the systems are running should be evaluated, testimonies collected, real costs established, detailed construction plans elaborated, cost benefit ratios carried out, durability verified, etc. The social benefits such as improved self esteem and the effects on the dynamic of a family from having constructed their own water system should also to be taken into account. All of these factors have to be discussed and analyzed. Otherwise, the failings of the past 50 years will continue with communities having more than one water network but less water overall.

4.13 The Aesthetic Factor

The appearance of WATSAN projects also plays an important role in their acceptance. Renowned designer Ralif Sethi famous for the WORLD EXPO 2000 in Hannover described the EMAS pump as “The ugliest pump I have ever seen but the best”. Often appropriate technologies designed specifically for do-it -yourself, at low cost and easy to repair, do not have an attractive design. This can be due to poor workmanship but more often is because to improve the appearance would result in increased costs or a loss of functionality. It is important that appropriate technologies can be easily repaired with simple tools and this often requires less permanent fittings which can aversely affect the appearance of the system. Development institutions and governments require an aesthetically pleasing product for the publicity they aim to gain from the projects they carry out. Often, the “do-it-yourself” approach by the end-users of system results in something deemed non pleasing to the eye and are not accepted the heads of the organizations. The result is that pre-assembled parts and specialists from the towns are contracted to carry out the work in the rural communities with the result of higher costs and less sustainability.

4.14 The Economic Factor

Appropriate technology components are by their nature very cheap. One such example is the EMAS pump which cost around $10US and is designed such that anyone can build them in their own home. This type of pump is of little interest to the development industry as any industrial production would not produce sufficient monetary gains. The costs of the materials which make up the pump are low due to the basic nature of the pump and thus exorbitantly raising the price of the pump to increase profit would not be accepted in the marketplace. In societies where corruption and over-pricing are quietly accepted, all decision makers expect their portion of the benefits. Appropriate technologies which can be created by one self are not useful in such a system because they are too transparent and there is little room for manipulating the figures.

4.15 Administrative Factors

In many countries most of the rural economic activity is informal. Small enterprises are often not legally registered and hence cannot receive contracts from municipalities, developing funds, NGOs, etc. These micro companies are not familiar with tax declarations and the modalities of corruption. To compound the problem, there is generally very little interest to legalize their family enterprise as that would obligate them to declare each month their finances even if for certain months there is no income. Once registered, fines are applied if a months declaration is missed thus further disincentivising a small rural business to become legal. This is why mostly enterprises from the towns (which are legally registered) receive projects in the rural communities. Another reason why appropriate technology in the WATSAN industry is often rejected is because cost calculation is quite difficult. It is simple to estimate the costs of the materials but the service specifications are hard to quantify as the families themselves carry out most of the manual labour and contribute with locally source-able materials which vary from project to project. Additionally, much more flexibility is required in the time schedule than would be acceptable in a normally contracted work. This is due to the normal commitments the families have for earning a living in addition to digging or laying pipes for the new system. Social events in the community, harvesting or family illness may delay the schedule. Normally the executers sign a binding contract with heavy penalties in case of delay. These binding contracts are not applicable in a rural setting with appropriate technologies and for this

4.16 Religious factors

Most of the religions are based on community live and community values. Among their principles they look for the common wealth, mutual activities like cooperatives and as far as possible in equality, also in material goods. Most of the proselytizing religions realize projects of basic needs like water and sanitation in developing countries. Normally they prefer public wells which are natural meeting points where people gather and communicate. Sometimes they also support small public water supply networks where all have to assume responsibilities in operation and maintenance.

In decentralized systems like family owned rain water harvesting systems or individual wells, the maintenance is based on family level. Communal dynamics which may be a result of meetings at a public water point are lost. The same happens with communal activities for operation and maintenance of the water network. That is why religious institutions generally ignore these private options.

In parts of India, for religious reasons, it is not permitted to cover a traditional hand dug well. The sun, stars and moon are intertwined with water as the source of life. For this reason, an open shaft well cannot be covered thus eliminating the protection from contamination that comes from a well cover.

4.17 Political factors

Similar to the religious factor can be also the political factor. Socialistic or so called governments proclaim in their doctrine common property, integration, equality, cooperatives etc. That is why they favour communal works like public wells or public water networks, often ignoring their weakness in operation and maintenance.

In communities with strong popular power, frequently the connection to the public water network is conditioned with a political credo. When the local community authorities don’t

receive sufficient support to a decision, they threaten their opponents with cutting the water service.

4.18 Geological Factors

When a dispersed settlement is supplied with individual drilled wells there is an expectation that in a similar fashion to a communal project, each house will receive the same service of water. However, in reality the water table will vary from house to house. At some points the aquifer delivers a good supply of water up to even small scale irrigation. At other locations, the water is only enough for one household. The water can be brackish, hard, sweet and vary from one location to the next. In some water tables, iron is found in the water and this water can be refused by users because it stains laundry and food. In places, stones or rock obstruct drilling therefore no water is found. Often the blame is laid on the well driller when geological difficulties arise. Sometimes it is practically impossible to predict a successful project with individual wells because of the aformentioned factors. There is always a certain risk of disparity and this does not fit with politics of equality. This insecurity that the potential individual wells will not provide what is required or expected can sway a community into demanding a communal network where all receive the same water. To make matters more complicated for the driller, the real costs are often difficult to calculate. If it was estimated that a 40m well was required but after 20m the depth was deemed sufficient then the actual costs are much lower than anticipated. However, should rocks be found at 10m then whom should pay for the extra costs to complete the well? There can be great profit for a skilled well driller but the risks can be high up to bankruptcy after a number of failed wells. The solutions politicians promise are nearly always associated with the least risk to their political career. For this reason, what appear to be high risk decentralized appropriate technology systems are often rejected for mainstream communal networks. If a communal system fails then the blame can be placed on the community or the management of the system. The risks of placing the power of the success of the project in the hands of each individual user is too great attempt a decentralized system.

5. CONCLUSION AND PROPOSAL

In conclusion, it will be very difficult to change the status quo of attempting to implement large scale modern water systems in the rural environment. Politicians see water as a political bargaining tool and a government obligation to provide and manage. A country is seen as backward if it leaves each family to manage its own water system. The rural community themselves seek modernism in every aspect of their lives including a communal water system delivered by a local authority as is seen in more developed countries.

Decentralized systems are difficult to manage in their construction on a large scale and are nearly impossible to centrally manage on a large scale. Much is left in the hands of the users themselves and it is guaranteed that even if the majority of systems did work there would be thousands of cases of homes unable to maintain the system or at times without water which would overshadow the successful cases.

However, the reality is that there are millions of cases globally where families have to walk long distances to find water. The low costs and high success rates of family sized decentralized water systems could rapidly lower these numbers meanwhile centralized systems for rural areas are developed such that they match the success rates of systems

found in the city. Despite all the cultural and sociological reasons for people rejecting decentralized systems over communal systems, a high demand remains in those who have witnessed countless failed communal systems or have never had a household water system and have to carry water from great distances each day. People living in poverty with difficult access to water deserve better than the countless failures of rural centralized water systems and for the short to medium term the solution is decentralized water systems at a household level using appropriate technologies.

Anders ist es wenn man selber der Eigentümer seiner Anlage ist. Man ist selbst verantwortlich für die Reparaturen. Sicher hat man auch da Angst mehr kaputt zu machen als zu reparieren, aber zumindest hat man, wenn alles schief geht kein Gespött weil man mit den eigenen Dingen ja machen kann man will. Zur Not muss man halt dann einen Techniker kommen lassen der es dann wieder richtig in stand setzt. Der Faktor und die Auswirkungen des möglichen „Gespöttes“ im Unterhalt von gemeinschaftlichen Trinkwasseranlagen wird bei kleinen Dorfgemeinschaften eigentlich nie berücksichtigt.