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Effects of multiple use of water on the sustainability of rural water supply services in Honduras

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The de facto use of rural water supply systems for productive purposes is a practice that has recently received recognition in Honduras. This paper presents the results of a study that tried to further characterise this existing practice in a more structured way through 14 case studies, in particular analyzing its effects on people's livelihoods as well as on sustainability in service provision. The cases show the nearly universal existence of productive use of rural water supplies, but showed that the extent of the uses and the relative importance in people's livelihoods differs a lot between different user categories. Although this de facto use of rural water supply systems may bring risks for sustainability in service provision, the cases also showed that a number of relatively simple measures can help in regulating water use. The authors believe that multiple use of water can be accommodated into service provision in such a way that it doesn't cause negative impacts.

Introduction

Multiple-use of water in Honduras

The multiple-use approach has gained increasing international attention over the last few years (see for example Moriarty et al., 2004, Van Koppen et al., 2006). Yet, until recently it hadn't been officially discussed in Honduran water sector fora, even though some organisations had recognised that many of the rural water supply systems were de facto being used for small-scale productive uses, sometimes with negative impacts on their sustainability.

A collaborative programme between the RASHON (Water and Sanitation Network of Honduras) and IRC International Water and Sanitation Centre (the Netherlands), focuses on strengthening capacities at decentralised level for sustainable water services provision in Honduras. In the frame of that programme, it was agreed to develop a better understanding of multiple-use practices and their impact on sustainability of water supply services. A first activity was a workshop held with field technicians and engineers as well as with researchers and students from the university to exchange field experiences (RASHON and IRC, 2007). At this workshop, NGOs, such as CARE and Entre Pueblos, showed interest in developing multiple-use services. However, field staff from the two main government agencies, SANAA (Autonomous National Water and Sewerage Service) and FHIS (Honduran Social Investment Fund), expressed the view that most rural water supply systems they know are used *de facto* for productive purposes. Although they recognised the importance of these activities in people's livelihoods, they also identified sustainability problems related to multiple-use of water, such as over-exploitation of water resources, inequity within communities and unauthorised connections and use of infrastructure. In the past the productive use of rural water supply was explicitly discouraged or prohibited, something to which they as technicians and engineers had contributed. One of the recommendations coming out of the workshop was therefore a need to further analyse and document this practice, and to take a fresh look at it both in terms of providing support to the management of existing systems as well as for the design of new systems. It was recognised that productive uses could perhaps be looked at as an opportunity rather than just as a threat.

Objective

To follow up to the workshop a study was undertaken by IRC and RASHON, the latter represented by SANAA, FHIS, Entre Pueblos and CARE. The objective of the study was "*to develop a better understanding of actual practices of multiple use of water and its impacts on the livelihoods of users, as well as on the sustainability of rural water supply services*". A full report of the study can be found in Smits et al. (2008) (in Spanish). This paper presents the main findings of that study, focussing specifically on:

- characterising water use practices for multiple purposes by different user groups
- characterising the impact of multiple-use practices on users' livelihoods
- analyzing the impact of multiple-use practices on sustainability of services

Methodology

The methodology used was a series of community case studies. This section presents information about case study selection, a conceptual framework for the studies and data collection methods.

Case studies

Case studies were carried out in a total of 14 communities across 5 Departments in the centre and south east of the country. The sites were purposively selected to cover a diversity of contexts, including the sustainability category of the services, predominant livelihoods characteristics, geographic conditions, size of the community and certain known practices related to multiple-use. The selection was informed by field experiences of the TOMs2 (Operation and Maintenance Technicians) who were to carry out the field work, and who had detailed prior knowledge of these communities. Table 1 provides details of the selected case communities. All are piped water systems with household connections, which is the norm in Honduras. With the exception of two, all are gravity-fed from surface water courses.

Table 1. Basic information of the case communities

Name of community and Department	No. of households	Sustainability category[1]	Predominant livelihoods activities
Bella Vista, La Paz	36	D	Coffee growing
Cancire, La Paz	72	D	Subsistence agriculture and coffee growing
Chirinos, Francisco Morazán	31	B	Livestock and subsistence agriculture
Durasanal, La Paz	27	N.a. (under construction)	Subsistence and vegetable production
Guajiquirito, La Paz	40	D	Subsistence agriculture and coffee growing
Manzaragua, El Paraíso	181	B	Commercial vegetable production
Panuaya, Olancho	138	B	Livestock
Paso Alianza, Choluteca	36	B	Subsistence agriculture
Quebraditas, Francisco Morazán	30	A	Subsistence agriculture and livestock
Río Hondo, Francisco Morazán	222	A	Off-farm employment and subsistence agriculture
Santa Ana Yusguare, Choluteca	520	B	Off-farm employment and subsistence agriculture

Santa María, El Paraíso	432	A	Off-farm employment and subsistence agriculture
Talgua, Olancho	496	B	Livestock and agriculture
Terreritos, Francisco Morazán	96	A	Subsistence agriculture and livestock

Conceptual framework

The study followed an adapted version of the conceptual framework presented by Van Koppen et al. (2006). Central to this framework is the level of individual users that use water for different parts of their livelihoods to generate various types of benefits in cash, in kind or other. At this level it is important to characterise these livelihoods benefits and to differentiate between different user groups, in aspects such as wealth, gender and main form of livelihoods.

The extent to which households can use water depends on their actual level of access. According to the framework, access at household level is shaped by the interplay between 4 factors at the second (community) level being:

- Water resources: this refers to the way in which communities are able to access surface of groundwater sources
- Technology: often water resources may be relatively plentiful, but technology or infrastructure to abstract, convey and distribute is lacking. Different types of technology create different access levels.
- Community institutions: The way community institutions are set up and managed may also affect access. For example, internal allocation rules may limit access to some.
- Financial arrangements. Access can be limited or facilitated by the price people have to pay for investment and/or operational costs.

For each of these factors, we looked into how these actually shape access, but also into the sustainability of these. For example, if the tariff is very low, actual access may not be limited by this tariff, but it puts the sustainability of the system at risk.

Data collection

Data collection focused on obtaining information on the different aspects of the first two levels in the analytical framework (household and community). Data collection methods consisted of participatory tools such as community mapping, wealth classification, and focus group discussion, in combination with consumption measurements and technical reviews of the systems. In addition a household survey was carried out covering 200 households across the 14 communities. These were selected on the basis of a classification according to type of users. Further information, including a detailed overview of the data collection tools can be found in Smits and Mejía (2008).

Results

Household level water use and benefits

Water consumption

Consumption for domestic uses (drinking, cooking, washing, cleaning and sanitation) between the 25th and 75th percentile of the interviewees, oscillated between 51 and 92 litres per person per day (l/p/d), with a median of 64 l/p/d. These ranges are in line with most gravity-fed piped systems with household connections in rural areas of Honduras.

Productive use of water happens nearly universally, with only 12 of the 200 interviewees not reporting any productive use of water. The mean consumption across all categories is 59 l/p/d. However, these uses differ considerably between different user categories, as shown in Table 3. Nearly all categories have a base consumption of a few litres per day for some chickens, a cow and a garden. For subsistence and smallholder farmers, these quantities become bigger as they tend to have a few more animals or bigger plots, which are their main source of livelihoods. The category of small and medium scale farmers represents the category of highest diversity. It includes for example rainfed-dependent farmers, who may use some water for a number of cattle. Others may use large quantities in certain periods, for example for emergency irrigation of crops in the dry summer, as is seen among the vegetable farmers in Manzaragua, food-crop farmers in Quebraditas

and Terreritos, or for coffee bean processing in Bella Vista and Cancire. The larger quantities in the table are not year-round consumption levels, but do occur in certain periods and often with a number of users at the same time. Finally, the large farmers, cattle ranchers and commercial non-farm users do have high consumption levels year-round.

Table 3: productive use of water by different users categories

User category	Types of productive use	Range of typical consumption for productive purposes (l/p/d)[3]
1. Day labourers and people dependent on off-farm activities	Some small animals (chickens) and a few herbs	0-5
2. Poor subsistence farmers	Some animals (chickens, pigs and a few cattle), alongside a kitchen garden	10-60
3. Small and medium scale farmers	Some animals (chickens, pigs and a few cattle), crop irrigation and coffee bean processing	10-20 for animals During certain short periods up to 1000 l/p/d
4. Large farmers and ranchers	Crop irrigation, cattle watering and pig farms	> 200
5. Commercial off-farm users	Industrial and construction related activities, such as brick making, a cheese factory, kiosks	> 100

Water sources

Only a relatively small percentage of the water used for productive uses comes from the main water supply schemes. The median consumption from the main water supply system for productive uses is only 13 l/p/d, representing some 10% of the mean total consumption from the water supply system. The other sources of water for productive uses are either private sources, such as wells or individual surface water intakes, or open sources, like rivers and streams.

The types of sources used for productive purposes are closely related to the type of user groups mentioned in Table 3. The first two categories of small users exclusively use the main water supply system. The latter two categories in majority use private sources; 36 of the 48 interviewed families from these groups used private wells or surface intakes for their productive purposes. The middle group of small and medium farmers represents a mixed case. Most of them do not use the water supply system year round for productive purposes, mainly because they are rain-dependent, and some have private sources. But, during the periods indicated above or when private sources dry out they may resort to the water supply system, sometimes through unauthorised connections.

Benefits and contribution to livelihoods

The benefits and the relative importance of the productive use of water within a family's livelihood are obviously linked to the scale of these uses. For the first two categories mentioned in Table 3, productive activities are mainly geared towards production of food for home consumption, i.e. eggs, chicken, some vegetables etc. This production is a complementary activity next to the main source of livelihood in farming or off-farm labour. The value of these products, if they were bought at the market, would be between 80 - 250 US$/family/year for families in category 1 and up to 1000 US$/family/year for those in category 2. For small and medium farmers, the activities for which water is used does often represent the main source of livelihood. Water is used as input into products which are sold, such as coffee, vegetables or food crops. The value of this production forms a main part of these families income, and oscillates between 1000 and 7000 US$/family/year. Finally, for the big farmers, ranchers, and industries, water is used productively in their main livelihood activity, and hence represents an important component of their income. The value of the production by families in this category starts at 2000 US$/family/year, and goes up from there.

Access to water for multiple uses, through service provision

The previous section has characterised practices of multiple use at household level. This section analyses the implications of these practices at the community level. It looks on the one hand at how access is created and facilitates multiple use, and on other hand, how multiple use impacts on sustainability of service provision. In this, it mainly looks at the communal systems and how these are managed, not to the private sources.

Infrastructure

Water quantity

The findings from the previous section imply that water infrastructure needs to be able to provide water for both a differentiated demand, and a demand which at times is much higher than the domestic demand only. This is particular the case in larger communities, which are more heterogeneous in terms of presence of different user groups, such as Santa Ana Yusguare and Santa María, and communities with a relatively large presence of small and medium farmers, where occasional high demands on the water supply systems are made, such as Manzaragua, Paso Alianza, Quebraditas and Terreritos,.

System capacity is mostly not limiting the quantities that are available to meet these demands. The measured intake amount into the system was in most cases 2 to 3 times higher than the gross demand. Only two of the cases (Manzaragua and Terreritos) had intake levels close to actual consumption levels, and both also report occasional water stress. A possible explanation for this high water availability within the systems is that nearly all systems are gravity-fed so the intake of additional amounts of water comes at little or no cost (unless chlorinated, see below). Besides, such systems are often overdesigned, and are being used at full capacity from the beginning of their life span onwards.

Whereas total system capacity may not be limiting, certain sectors in communities, such as Bella Vista and Paso Alianza, reported getting little water. This is due to problems in the distribution system, often caused by too high pressures, high distribution losses, and malfunctioning distribution and pressure-break tanks. Though system capacity may thus create generally high access levels to water, this is not necessarily equally distributed within the community. Poor design and operation of distribution systems is an important factor affecting this.

Water treatment and chlorination

With respect to water treatment infrastructure, only Río Hondo has a MSF (Multi-Stage Filtration) potabilization plant. Interviewees mentioned that water use patterns have changed in that community since the plant was put into use. Water for productive uses is increasingly being taken from alternative (private) sources, so as to use the relatively expensive treated water for domestic use only, and reduce the operational costs of the main water supply system. Although the other communities do have chlorination devices, these are used only in a third of the cases. Water committees from these communities mention various reasons for not using chlorine such as their cost and lack of knowledge about operation of chlorination devices. The fact that expensive chlorinated water is used for productive purposes is considered only an additional factor for not chlorinating.

Water resources

In nearly all communities, access to water resources was not found to be a limiting factor. Most take in much more water than needed, as shown in the previous section. In 6 of the communities, there is even much more water is available in the sources, without any other claims from neighbouring communities. The relative water abundance of the cases is also manifest through the large number of individual intakes, indicating a kind of a “free for all” situation, in which an individual or community can develop yet another intake without causing competing claims with others users. This may be an adequate approach whilst resources are still plentiful available, but not when there is increasing demand and limited resources, as in Quebraditas. This community shares a mountain stream with two downstream communities. These put forward complaints when Quebraditas was developing its domestic supply system, fearing that their water availability would reduce. In absence of clear water resources planning and allocation instruments, or customary law around sharing of these sources, this conflict has gone on for years. Users in Quebraditas use the system for small-scale productive purposes, but in a hidden form, often through unauthorised connections or at night, in order not to increase the conflict with the neighbouring communities. Even though access to water resources isn’t an immediate limitation to multiple use of water in most cases, it may

become so in the future. This will require planning and allocation of water, particularly at local level, to avoid situations as in Quebraditas.

Community institutions and regulations

All cases studied are community-managed systems, with arrangements typical for rural water supply in Honduras. Responsibility for executive management lies with the Water Committee (JAAP), sometimes hiring a plumber or operator. Final decision-making resides with the community assembly.

Many of the communities, including some of the ones studied here, are struggling in various aspects day-to-day management. Problems include poor financial administration (see also next section), conflicts between the JAAP and the broader user community, non-payment of tariffs, etc. Most of these problems are not specific or related to multiple-use, yet ultimately have a negative impact on sustainability, and hence on access to water for multiple uses.

Table 4: internal rules and regulations around water use

Community	Internal rules and regulations around use of water
Bella Vista	None
Cancire	None
Chirinos	None
Durasanal	System still under construction. Internal rules not yet defined
Guajiquirito	None
Manzaragua	Irrigating flower gardens is allowed, but not crops. People cannot water more than 2 heads of cattle from the supply system. Unauthorised use of the supply system during summer to irrigate vegetable crops is a recurring subject in assemblies.
Panuaya	None
Paso Alianza	Productive use is happening nearly universally and explicitly accepted by the community and JAAP, but without regulations or specifications.
Quebraditas	Productive use is prohibited and the JAAP carries out an active control over unauthorised use, and fines infractions.
Río Hondo	Starting the installation of micro-metering to control use and promote equitable payment of tariffs. Proposals are developed for using overflow from the distribution tank for productive purposes.
Santa Ana Yusguare	Higher tariff for users who have household storage tanks, as they tend to use more water. Discussions are starting to install micro-metering. Medium and large scale productive use prohibited, though not specified.
Santa María	Internal regulations permit small-scale productive uses, specified as using water for chickens and not more than 3 pigs. Watering cattle and irrigating crops are prohibited. Brick making for building of one's own house is allowed, if prior notification given to the JAAP. Discussion started on tariff differentiation and micro-metering.
Talgua	None
Terreritos	Productive use is prohibited and the JAAP carries out an active control over unauthorised use, and fines infractions.

One aspect of community institutions affecting multiple-use, are internal regulations around water use. JAAPs are supposed to develop internal statutes and by-laws, following the General Regulations for Water Committees, as established by law. In these, they may specify local regulations around water use, including for multiple purposes. The Table below provides an overview of the internal rules and regulations found across the cases.

Three types of arrangements can be distinguished:

- None. There is no explicit regulation that prohibits or allows productive use, or tries to differentiate between consumption levels. These tend to be the smaller communities with less differentiated consumption patterns, and where it is tacitly allowed (Paso Alianza), or simply never considered (as in Bella Vista and Cancire). This may well work in these cases, but may lead to inequity, especially when a community grows and diversifies.
- Permitting multiple-use, but regulating it through a differentiation between small and large scale users. This is done either by specifying which uses are permitted or not (as in Manzaragua and Santa María), or by starting to consider differential tariffs and installing micro-meters (as in Río Hondo and Santa Ana Yusguare). These tend to be relatively bigger communities, with a more heterogeneous population.
- Prohibiting multiple-use and imposing sanctions, as in Quebraditas and Terreritos. In practice, these JAAPs are mainly controlling the bigger users, and allowing the ones who use small quantities only to continue.

These types of regulations show that having access to water resources and infrastructure is not enough. Multiple use of water generates a diversified demand for water. Locally relevant arrangements are needed to ensure equity in access. Some communities can develop these arrangement themselves; others may need support.

Financial management

In the cases we looked into two aspects of financial management: 1) tariff structures, as these determine how access to water is governed financially, and 2) performance in financial administration, with respect to the way book-keeping is handled, non-payment rates, etc.

In all systems a flat rate tariff is applied. Only, in Santa Ana Yusguare and Santa María are higher flat tariffs applied to those considered bigger users: those who have household storage tanks in Santa Ana Yusguare, and owners of shops, kiosks and hotels in Santa María. In these and some of the other larger villages, discussions have started about volumetric payment and metering of water, to have more equity in payment for water, to move away from these current criteria for what constitutes a bigger user.

The tariffs that are charged are considered very low, with 12 out of 14 cases having tariffs of between 0.40 and 1.20 US$/family/month. Most of these tariffs are typically not established based on a communal agreement of what is considered fair, not on the basis of what is actually needed to run the service. Only in Río Hondo, Santa Ana Yusguare and Santa María, tariffs are regularly revised to check whether these are in line with operational expenditure, and if needed, adjusted. These are also among the few who have a reasonably good financial administration, with up-to-date books and low non-payment rates. Others are struggling in basic financial administration activities.

Although the water services bring a range of benefits to the users, including financial ones through multiple-use of water, this doesn't automatically lead to payment by users or re-investment in the system. The reason for that doesn't lie in multiple-use of water as a practice in itself, but rather in the generalised limited financial management capacity of JAAPs to establish adequate tariffs, keep track of non-paying users and basic book-keeping.

Sustainability and multiple use

In the previous sections, we have seen how each of the four factors of access, facilitates multiple use, and how multiple use, in turn affects these factors. The diagramme below summarises for each of the villages, the relative contribution of these factors to overall system's sustainability. Those cases where multiple-use is a factor directly affecting sustainability, either positively or negatively, have been made grey.

Table 5: overall sustainability of service

Factors / Community	General state of infrastructure	Infrastructure: quantity	Infrastructure: water quality	Water resources	Community institutions	Financial management	Overall degree of sustainability
Bella Vista	-	+	-	+	-	-	D
Cancire	-	+	-	+	-	-	D
Chirinos	+	+	+/-	+	+	+	B
Guajiquirito	-	+	-	+	+/-	-	D
Manzaragua	+	+/-	-	+	+/-	-	B
Panuaya	+/-	+/-	+	+	+/-	+/-	B
Paso Alianza	+	+/-	-	+	+	-	B
Quebraditas	+	+/-	+	-	+/-	+/-	A
Río Hondo	+	+	+	+	+	+	A
Santa Ana Yusguare	+	+	-	+	+/-	+/-	B
Santa María	+	+	+	+	+	+	A
Talgua	+	+	-	+	+	+/-	B
Terreritos	+	+	+	+/-	+	+	A

+ = good performance on this factor, contributing to service sustainability
+/- = medium performance, with no immediate negative impact on service sustainability, but with risks
- = poor performance in this factor, with negative effect on service sustainability

This matrix shows that most of the factors that contribute positively or negatively to the sustainability of the service are not directly related to multiple-use. Most are related to poor financial management or problems around community management, which over time reflect themselves in the state of the infrastructure and its operation. Cases like Bella Vista and Cancire show very poor performance, without multiple-use having affected the performance.

However, in a number of cases, multiple-use was found to pose a risk to sustainability of services:

- By contributing to conflicts over water resources between communities, as in Quebraditas
- By contributing to inequitable water distribution and over-use during certain periods of the year, as in Manzaragua and Paso Alianza
- In turn, they may lead to conflicts and impact on community institutions. Manzaragua is a community which presents such risks.

Equally important, multiple-use wasn't found to have an impact on factors, which were considered beforehand, particularly payment of tariffs and chlorination. Although performance in the cases on these aspects is not always good, multiple-use isn't considered a main factor affecting that.

Some of the cases show that it is possible to provide a sustainable service, whilst providing water for multiple uses, as in Santa María. The previous section has shown a number of measures that can facilitate the sustainability provision of water for multiple uses:

- Regulating water consumption, through internal rules and regulations, which differentiate between different consumption patterns and user groups. Small-scale uses can mostly easily be accommodated, while special measures are needed for the larger ones, including caps on their consumption.
- Planning and allocation of water resources at catchment level to deal with competing claims on water resources, between communities, as well as between large numbers of individual users.
- Differential tariffs, including volumetric payments, to achieve equity in payment for operation and maintenance costs.

These are especially relevant in larger communities, with a larger diversity of user categories and demand patterns. In smaller, homogeneous, communities, such measures may not be needed.

Conclusions

Before this study was carried out, anecdotal evidence abounded of the de facto use of rural water supply systems in Honduras for small-scale productive uses, and that this sometimes caused negative impacts on sustainability of services. In fact, that formed the reason to undertake this study. The objective of this study was to develop a better understanding of multiple-use practices, and its impact on people's livelihoods and on sustainability of service provision.

This study confirmed that productive use of rural water supply systems is common across systems and users. However, its scope differs between user categories. On one end of the spectrum are day labourers and subsistence farmers who use a few litres per day for some small animals or irrigating a kitchen garden. These bring additional food for home-consumption and occasionally some complementary income. For these uses, they exclusively draw from water supply systems. The other end of the spectrum sees large farmers and ranchers, who may use up to 1000 l/p/d for farming and livestock at large scale. Most of them use water from their private wells or surface water intakes for that. Finally, there is a group of small and medium farmers, who use water for their farm animals, crop irrigation or coffee bean processing, these being their main source of livelihoods. They tend to use the water supply systems for this, but only requiring large quantities during certain short periods of the year.

Most of these demands can easily be accommodated within current water supply system design and management practices, particularly the small-scale ones. As the larger users tend to have their own sources, they do not pose challenges for service provision either. The consumption pattern of the middle group poses the biggest challenge. Because of the quantities they require, particularly in peak periods, their water use may have a negative effect on sustainability, as it can contribute to conflicts over water resources with neighbouring communities or to inequitable distribution of water within a system. However, it is one out of many factors affecting sustainability, and in most case studies, not the most important one. The cases also showed ways, through which these types of use can be facilitated without causing sustainability problems, including:

- Improved mechanisms planning and allocation of water resources at catchment level.
- Regulating water consumption, with clear differentiation between consumption patterns and user groups.
- Establishing differential tariffs and volumetric payment, so as to generate more equity in access and payment for the services.

In addition, there is need for continued support to community management, so as to address other factors affecting sustainability.

We believe that through this combination measures, multiple-use of water can be turned from an unrecognised de-facto practice, into a regulated component of sustainable rural water supply services provision, contributing to the livelihoods of subsistence and small-scale farmers.

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Note/s

[1] All rural water supply services in Honduras are classified with a mark from A to D. A represents systems performing adequately; B are systems that do not need infrastructure improvements, only improvements in management; category C systems require minor investments in infrastructure which can easily be covered by the community itself; the ones in D need major infrastructure investments.

[2] SANAA runs a programme called "sustainability support". In this programme, the TOMs, who are SANAA, employees, provide support to community-managed water services in aspects such as book-keeping, training, technical supervision, etc. Their main effort is ensuring that communities categories B and C improve to category A. They can identify investments needed to upgrade the ones in category D, but this programme is not responsible for carrying out such interventions.

[3] For ease of comparison, all consumption levels have been converted to litres per person per day (l/p/d).

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