Recognizing reality; multiple use of rural water supply systems[1]

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Abstract

In rural areas, there is often a clear demand for water for small-scale productive uses such as irrigation, livestock watering, post-harvest processing or micro-enterprises. These productive uses can generate income and hence contribute to fighting poverty. However, all too often, water supply systems are only designed to meet domestic demands and do not account for these small-scale productive uses, or even prohibit this practice. This might have a negative impact on the sustainability of water supply systems. Experience shows us that this enhances illegal connections, generates conflict and contributes to over-exploitation of water resources. On the other hand, supplying water for productive uses implies various considerations in the design and management of water schemes. Two cases studies from the Colombian Valle del Cauca Department illustrate some of these considerations and show possible solutions to these water demands. Based on these cases, a call is made to the responsible institutions to recognize and accept multiple use of water as a challenge which means concrete and integrated solutions to peoples' water needs.

Key words: water supply, multiple use, water demand

Introduction

A large part of the world's water supply systems in rural and peri-urban areas are used for both domestic and productive uses. However, this practice is often not officially recognized nor is it considered in the planning, design and management of these systems. At the same time, small-scale productive use of water supply systems can contribute significantly to households' economies and to the fight against poverty.

Despite its relevance, multiple use of water has not been studied nor documented widely. Of the few existing materials, very little is available in Spanish (see, for example NRI-IRC-DWAF-IWMI, 2003[a]; Moriarty and Butterworth, 2003).

This paper presents two cases illustrating the reality of planning, design and operation of water rural supply in de Valle del Cauca Department, Colombia. This is compared to the existing legal and institutional framework for water supply. The cases illustrate various issues regarding multiple use of water. Based on this analysis, we would advocate for recognising multiple use as a reality in rural water supply, and make appropriate changes to the project approach.

Multiple use of water within the legal and institutional framework for water supply

Purpose and regulation for the design of water supply systems

In Colombia, traditionally, investments in water supply have been oriented towards solving public health problems. This means that the orientation is on *potable* water and that the amounts supplied try to meet demands for improved hygiene, such as for sanitation, washing and cleaning. Through this health focus attempts are made to reduce peoples' spending on the treatment of illnesses and to improve quality of life and peoples' dignity. In this way, there is a contribution to the fight against poverty.

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On the other hand, in the rural and peri-urban areas it is common to find people needing water for other small-scale productive uses, such as irrigation, livestock watering or post-harvest processing. The smallholders' irrigation programme that the Government of Colombia promotes is an example of trying to meet these demands. However, for reasons of economy of scale, it is not feasible to develop small-scale irrigation systems in the entire country. Drinking water supply systems can often meet part of the demands for productive uses at small-scale. These then become *multiple use* systems. These systems have the objective of fighting poverty in all its dimensions, including health improvement, income generation and food security.

The Technical Regulation for the Water and Sanitation Sector (RAS or Reglamento Técnico del Sector de Agua Potable y Saneamiento) gives general guidelines for planning and implementing water or sanitation projects (Ministerio de Desarrollo Económico, 2000). Article 18 of the RAS mentions *"the entity that promotes and develops investments in the sector needs to determine the actual and future water demands of the supply systems in order to project the design parameters of the works and define the design period and needs to consider the effect of the different permanent and temporary economic activities within the system that might imply an increase in water demand"*. This article forms the basis for the regulation of productive uses of water within the existing legal framework.

Although the RAS clearly shows that the design of water supply systems needs to be based on water demands, including those related to economic activities, in practice these are hardly ever considered.

Institutional framework of the water sector

The institutional framework of the water sector is, as in many other countries, organised in a sectoral way. In the case of drinking water supply, Municipalities are responsible for guaranteeing this service. The Municipal Health Secretaries normally make the investment in rural water supply and give institutional support to water service providers. This has lead to a situation in which the focus of water supply has been on public health and therefore on provision of potable water only.

The State through different other entities (e.g. Departmental Agricultural Secretaries, and UMATAS (Unidades Municipales de Asistencia Técnica en Agricultura) invests in water supply for agricultural purposes. These only focus on agriculture and often only on medium or large scale.

No clear responsibilities exist for multiple use systems. The health issue is not under the mandate of the agricultural entities, and the productive uses of water are not the responsibility of the health entities. Due to the sectoral approach it is rare that a combination of efforts and resources is sought between institutions of the different sectors.

Another important role player in the water sector is the Regional Autonomous Corporations (CAR or Corporaciones Autónomas Regionales), which is responsible for the management, administration and monitoring of water resources, both in quantity and quality. One of the ways this is done is by assigning water use concessions for different purposes.

The reality of multiple use of water

"Welcome to La Castilla, water is a challenge here; there is no water"

This inscription can be read when entering the village of La Castilla, located within the Municipality of Santiago de Cali, in the western Andes range. It is a village with 515 inhabitants living in 103 homesteads. During weekends there may be an increase of about 50 people. The main economic activity of the population is extensive subsistence agriculture (27%). The next largest activity is engagement in commerce and livestock rearing. Martinez , 2000.

La Castilla is located within the Aguacatal sub-catchment and the main stream of water that passes through is the Chocho. The community water supply system gets its water from three small springs that show high variability between the wet and dry seasons. The gravity supply system consists of

three intakes, a reticulation system and community and household storage tanks. As the raw water is not fit for human consumption, a treatment plant is being constructed by the Municipal Health Secretary, with a design flow of 1.6 l/s.

The planning and construction of the plant was done with minimal community participation. The government entities decided that water use would be limited to domestic use only, once water had been treated. As will be shown below, water use in agriculture is of importance to peoples' livelihoods, and community members do not agree with the construction of the plant, or at least not with the future quantities and uses that have been decided by the government officials. One of the interviewees commented jokingly on this situation, saying: "*We rather have more water than better water. We can always drink coffee instead"*.

During the dry season, the flows from the sources may be reduced to such an extent that not enough water enters the system for the treatment plant to function normally. Although the community has a water use concession of 1.6 l/s, the flow available in the sources may now be approximately 1.0 l/s, according to measurements by Cinara and CVC (Sánchez Torres, 2003). Still, the sum of the three sources is equivalent to 363 l/p/d – sufficient to meet all communities' demands.

Water is used for domestic purposes and for productive activities such as irrigation of crop land and vegetable gardens, processing of harvested coffee beans and watering livestock. On average, 424 m^2 per household are irrigated, although one person has up to 3.000 m^2 under irrigation. Hosepipes are the main technology used for watering plants. The net demand for water, including for productive uses was estimated[5] as in Table 1. The average demand for the area was determined considering that not all households use water for productive purposes. The latter form 18% of water demand in the area.

Table 1: Water demand in La Castilla

Use	Percentage of households where applied	Estimation of the demand (l/household/day)	Average demand for the area (l/household/day)	Contribution to water demand (%)
All domestic uses	100%	650	650	82
Irrigation	70%	150	105	13
Livestock watering	60%	70	42	5
Sub-total of productive uses			147	18
Total water demand			**797**	**100**

The need for frequent opening and closing of the sector valves complicates the operation of the system. This is aggravated by large differences in household storage tanks. One family has a tank of 22 m^3. In order to evaluate the functioning of the reticulation system, it was modelled using the EPANET (version 4) software. This gave the following results:

- The distribution system is subject to high dynamic pressures of between 50 and 100 metres of water. This can generate large losses and an unequal distribution.
- The capacity of the pipeline coming out of the treatment plant is not enough to transport the required flow.

This illustrates a badly designed or constructed distribution system, and leads to water scarcity due to unequal distribution. Therefore, the community uses other sources of water, especially rainwater harvesting to complement the amounts provided by the reticulation system. Figure 1 shows the sources of the water used for irrigation (vegetable) gardens. One of the interviewees re-uses grey water for that purpose. For processing of coffee beans, rainwater is used as the wet season coincides with the harvesting period. For livestock (cows, pigs and poultry) watering, users indicate that only the main water supply system is used.

[5] For more details on the methodology used to come to this estimation, see Sánchez Torres, 2003

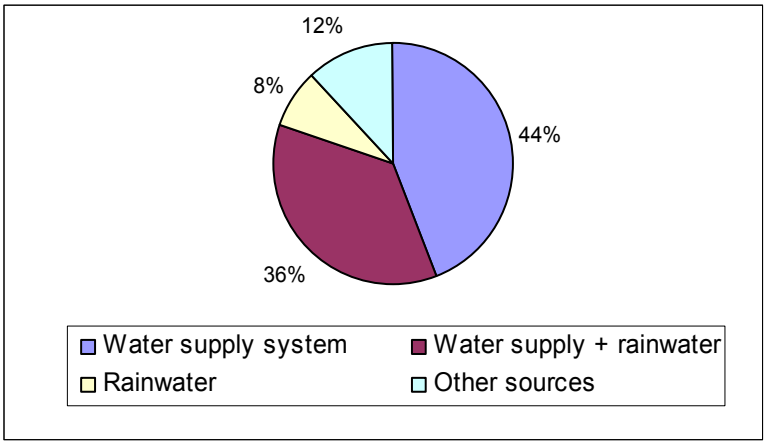

Figure 1: Sources of water for irrigation (Source: Sánchez Torres, 2003)

Water consumption of a sample of households was established in two ways: by looking at the volume of 12 storage tanks, and by reading 14 water meters. The first method showed an average consumption of 250 l/p/d, the latter showed consumption varying from 172 l/p/d to 919 l/p/d. This means that there is sometimes a very high consumption, but also an unequal distribution of use. Still, it appears that there is enough water to meet the demand, even if productive uses are included. The high consumption might be partly due to losses in the pipelines, related to the complex hydraulic operation of the system. The exact amounts that are leaking away could not be assessed.

The Ambichinte micro-catchment

The Ambichinte micro-catchment is located within the Municipality of Dagua, close to Santiago de Cali[6]. In this micro-catchment five communities are located, with a total of 5 600 inhabitants. The communities are supplied with water by jeans of seven different water systems. In addition, 37% of the population uses alternative sources such as bottled water, springs and own individual systems as, according to the users and water quality tests, the main supply systems don't supply water of good quality. This means people spend relatively large amounts of money to get good quality water.

The large number of individual systems is reflected in the concessions that have been issued (see Table 2). It is also noted that most of the concessions are for domestic purposes for individual households. Only some of the concessions are for productive purposes, but none for mixed purposes. The table also shows that a lot of people are not regularly paying for their concession

Table 2: Water use concessions in the Ambichinte micro-catchment

Type of use	Number of concessions	Number of concessions that have not been paid for
Domestic	282	125
Water supply system	1	1
Irrigation	15	4
Livestock watering	3	1
Hydro-power	2	0
Ornamental	1	1
Not specified	7	2
Total	311	134

Source: Univalle/Cinara-CVC, 2002

Although no concessions for mixed use have been issued, mixed use is commonplace, as shown in Table 3. Irrigation is used in 25% of the households. This is mainly vegetable gardening for home-consumption on small plots of less than 75 m^2. Irrigation of ornamental gardens at weekend houses is included. Although this does not represent direct production, it has an economic impact on the region. The area is popular with rich people from Cali, for its green and fresh environment, of which the gardens form an important part. Access to water for this use contributes to the tourist

[6] For more details on this, see Univalle/Cinara-CVC, 2002 and Pérez *et al.*, 2003.

development of the area. In 15% of the households water is used for livestock. Most families only have a small number of animals, although some larger animal farms exist. Fishing ponds are also common, though the amounts used for this were not established. Next to irrigating ornamental gardens, swimming pools make up a large recreational demand for water, again adding to the tourism development of the area. Finally, there are some micro-enterprises in the zone, such as shops, restaurants and bakeries. However, their demand was not established.

Table 3: Water demands in the Ambichinte micro-catchment

Use	Percentage of households where applied	Estimation of the demand (l/household/day)	Average demand for the area (l/household/day)[7]	Contribution to water demand (%)
All domestic uses	100%	600	600	80
Irrigation	25%	471	118	16
Livestock watering	15%	77	12	1.6
Swimming pools	8%	214	17	2.2
Sub-total productive and recreational uses			147	20
Total water demand			**747**	**100**

Source: Univalle/Cinara-CVC, 2002

Attempts were made to quantify the economic importance of the productive use of water, through a Willingness to Pay (WTP) study. This showed that 80% of the actual users would be willing to pay a tariff increase in order to maintain access to water for productive uses. The average increase people were willing to pay was equivalent to US$ 0.73, but there was a high standard deviation. This shows that the demand for productive water differs substantially between households. Although not statistically significant, women are willing to pay 16% more than men. A possible explanation for this is that women perceive and/or receive more benefits from productive water uses at household as men are often doing migrant labour. The survey showed that the WTP depends also on the income of the household. The study indicated that WTP for improved drinking water supply was much higher than for access to water for productive uses, which suggest that, contrary, to the users in La Castilla, the inhabitants of Ambichinte find water quality more important than water quantity.

Impacts of multiple use of water

Experience shows us that people in rural and peri-urban areas use multiple sources of water for multiple purposes. This has two major impacts: on people's livelihoods and on systems' sustainability.

Impact on households' livelihoods

The cases in two different contexts (the one more agriculturally-oriented than the other) show that 25-70% of the families use water for a large number of productive uses, through which they can generate income. Besides, it reduces their need to buy food and so family expenditure is reduced. Although at the moment no data is available on the value of the production generated at household level, the WTP results show that people perceive that production is of great importance. If the families consume the food they grow there might be a higher degree of food security. Besides, the quality of nutrition would be improved. As a last point of consideration, home production of food could be a strategy to reduce the risk of running out of food, or a supplement to the more "formal" agricultural production.

Next to food production, water is used for tourism development through swimming pools and the watering of ornamental gardens. In fact, tourism forms one of the major sources of employment in the Ambichinte area (Univalle/Cinara-CVC, 2002).

[7] This date represents the demand as an average of all households in the community.

Analyzing the impact on households' livelihoods, it is important to realize that there might be large differences within communities and families. The WTP study shows that such differences exist between the different income levels and between men and women.

Sustainability of the water supply systems

Use of infrastructure
It is well known that community participation in the entire project cycle is a determining factor for having a greater chance of ensuring a sustainable water supply project, especially in the rural and peri-urban areas. In the La Castilla case the lack of community participation has led to problems. By not responding to peoples' needs, the treatment plant has created a large conflict within the community. Likewise, the design of the distribution network does not allow for an efficient use, nor for an equal distribution, of water.

Water quantity and quality
Bad water quality may force people to use alternative sources of water – with high cost implications. On the other hand, the quantity needs to be sufficient to meet the different needs of the population. The higher the flow of water to be treated is, the higher the costs of the treatment. This argument is often used to prohibit the use of treated water for productive uses. Multiple use systems need to find the balance between quantity and quality of water to be supplied. Finding this balance can generate conflicts, and will differ from community to community. The two cases presented have shown that productive uses are around 18-20% of the total demand of water; this demand can be assumed for water supply systems that were designed for domestic use with a good management.

It is also important to consider efficiency. In many cases, water losses in distribution networks and storage tanks can be very high, like in La Castilla. They might even be higher than the amounts used for productive purposes. Increasing efficiency can be considered as a source of water in itself for meeting the production demands. There should be incentives for communities and government entities to come up with efficiency plans. Efficiency and (un)equal distribution are often closely related. Therefore, multiple use of water could be an entry-point for beginning to improve efficiency and equity of water supply.

Water resources management
Multiple use of water is often not considered when assigning concessions and, in this case, would not be legal. Besides, there seems to be a discrepancy between water resources management and reality: concessions and actual abstractions are often not monitored and administrated adequately and records are not up to date.

It is also felt that too often the emphasis is put on formal piped water supply systems. In reality, people use multiple sources, including rainwater and reused grey water, to complement their multiple water needs. In planning water supply, these other sources are often not looked at, putting more pressure on piped supply systems.

Searching for alternatives

In January 2003, water professionals met in Johannesburg (South Africa) to exchange experiences with multiple use systems (NRI-IRC-DWAF-IWMI, 2003a). This symposium resulted in a statement, including the following points (NRI-IRC-DWAF-IWMI, 2003b):

- Productive use of water at household level by poor people reduces poverty;
- People require more than their domestic water needs to be productive;
- Productive use enhances the sustainability of water supply systems and services;
- People need local solutions and multiple sources for multiple uses;
- An integrated approach is essential to achieve significant impacts on poverty.

All these points are reflected in the cases presented above, and present challenges for the water supply sector. Below, we present possible strategies to meet these challenges.

Towards a better understanding of peoples' needs

A large part of the problems associated with multiple use systems is due to a lack of understanding and recognition of peoples' needs. At household level, people, in an explicit or implicit manner, plan the resources available to them for different purposes. Factors that influence this planning include men and women's role in the household and their participation in decision making around available resources. Another determining factor is the environment in which the homestead is located, both in a physical and socio-economic sense. The third determining factor is formed by the livelihood strategies of the household and its members. People might use access to water to diversify production, might go for agricultural and non-agricultural livelihoods at the same time or use water to reduce sanitary risks.

When planning water supply services, it is necessary to understand what the livelihood strategies of the population are and what the role of water in these is. In such an analysis it is important to realize that differences might exist between and within families and between men and women. It is recommended that such an analysis is included in the project appraisal and in decision making when developing a water supply system. Above all, it requires participatory methodologies so communities will be able to take decisions based upon an analysis of their own situation.

Defining new design criteria

The RAS indicates that for settlements having a population of between 2 501 and 12 500 inhabitants, the gross maximum water supply is 175 l/p/d. In both cases presented above, water demand is greater than this number. One might ask whether this number is not very low, reflecting an urban reality and not a rural one. The use of 175 l/p/d does not necessarily mean that water is not used efficiently: farmers are producing food. This means that new design criteria, that reflect actual demands in rural areas, are required. It is also a challenge to find creative ways to meet actual demand, like for example the use of alternative sources. Especially, more attention should be placed on promoting a more efficient use of water and so make more water available for the different uses.

Institutional changes

To bring about the above changes, institutional aspects of the sector also need to be addressed, such as the education of professionals, water resources management and inter-institutional cooperation.

In the education of water professionals the sectoral approach is evident. Students in agricultural, sanitary and civil engineering hardly ever work together, let alone work together with their colleagues from social and economical sciences. The first challenge is to educate professionals to work in inter-disciplinary teams. That allows students to develop a more integrated approach to problems and possible solutions in rural areas. Additionally, professionals working in rural water supply need to understand rural realities. To get to understand this, students need to work in and with communities.

With respect to water resources management, there is a need to review the concession system. These should be based on water availability and hence needs to be accompanied by adequate monitoring and control. Besides, it should allow for people to use water for multiple purposes. Finally, alternative sources such as rainwater and grey water should be promoted by the responsible authorities.

Institutional roles and responsibilities, especially on investments and institutional support, also need to be clarified. Multiple use systems will cost more in terms of investment and running costs than single purposes ones. These extra costs should come from different entities that promote these uses. Municipal Health Secretaries might combine their efforts and resources with agricultural entities such as the UMATA's and the Departmental Agricultural Secretaries. Institutional support should also be provided to communities, so they can manage their multiple use systems in efficient and effective ways.

Conclusion

Many water supply systems are planned, designed and managed without a clear understanding of the needs of the user.. One of the interviewees said: "*a farmer has his cows and his plants and these need water as well. But then rich people from the city come and say we can not use it for those purposes, while they fill their swimming pools".* Not taking cognisance of this reality endangers the sustainability of many water supply systems, as well as the effectiveness of many investments in the sector, and has negative impacts on users' livelihoods. Illegal connections and excessive use of water then become common to meet water demands for irrigation. Users can not access institutional support as these uses are not legally recognised and there are no institutions that could give them support.

This situation goes against the RAS, which insists in making designs based on the needs of the users, specifically considering the economic activities of the population. This situation goes against global action plans to eradicate poverty. This situation goes against the reality and necessities of the people in rural and peri-urban areas.

Productive use of water is possible but it requires considering alternative design criteria, alternative water sources and a more efficient use of water, so that communities can manage their own multiple use systems. It also requires institutional changes. It means that professionals need to think in an integrated way and understand rural realities. It means that water resources management should respond to peoples' water needs. It means that institutions should be allowed to make investments in and provide support to multiple use systems. But above all we need to recognise people's real needs, and base changes on those.

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