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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Costs and benefits of multiple uses of water: a case from Ethiopia

M. Adank, B. Belete, M. Jeths [Netherlands]

This paper presents a study conducted under the RiPPLE project[1], with the objective to provide better insight in the costs and benefits of multiple use water services. In this study, the costs related to the provision of water services and the benefits related to water use were analysed for two cases in the East Haraghe zone, Ethiopia, each taking a different path towards multiple use services. In the Ido Jalala case, domestic water supply services were upgraded to enable small-scale irrigation, while in the Ifa Daba case, irrigation services were upgrades to also cater for domestic water use. In both cases, water was used for multiple uses by the community members, regardless of the water services provided. The study shows that in the studied cases, the benefits of multiple use easily outweigh the costs involved in providing water services. It also shows that with relatively small additional costs, single use water services can be upgraded to multiple use water services, which facilitate multiple uses, bringing along relatively high additional benefits.

Introduction

Interest in multiple use water systems and services is on the rise in Ethiopia. In recent years, several implementing organisations, mainly NGOs, have been implementing and upgrading water systems that do not only cater for domestic water use or irrigation, but that address the multiple water demands of communities. The sector stakeholders from East Hararghe, united in the East Hararghe Learning and Practise Alliance (LPA) agreed this is an interesting development and felt a need for better insight in the linkages between the provision of water services and growth, especially in the costs and the benefits of multiple use services.

To date, little research has been done on how additional costs and benefits of going from single use water services to multiple uses water services relate to each other. The research that has been done so far is mostly based on projections and estimates (Slaymaker et al, 2007). Under the RiPPLE[1] project, a study was therefore conducted to assess the costs and benefits of going from single to multiple use water services. The objective of this study was to provide a better insight into the costs and benefits of multiple use water services, by analysing the costs and benefits of going towards multiple use water services in several cases in East Hararghe zone, Ethiopia. The hypothesis was that with relatively small additional costs, single use water services could be upgraded to provide multiple use water services, which generate relatively large additional benefits that exceed the additional costs. This paper presents the main findings of this study.

Methodology

Water services can be regarded as the delivery of a certain quantity of water with a certain quality, reliability and accessibility. Water services are shaped by the water "system", consisting of infrastructure and organisational and institutional arrangements. The development and maintenance of these hard- and software components of water services involve costs. The use of the water provided through the water services will result in benefits (see figure 1).

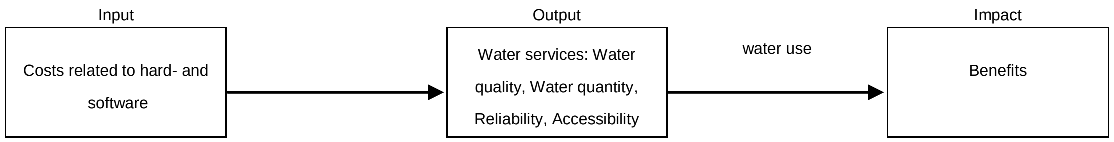

Figure 1. Costs of water services and benefits of water use

This paper looks at the costs of going towards multiple use water services and the resulting benefits. This is done by comparing the additional costs and benefits of steps towards multiple use water services in two cases: one case in which originally only domestic water supply services were provided, and one case in which originally only irrigation services were provided (see figure 2).

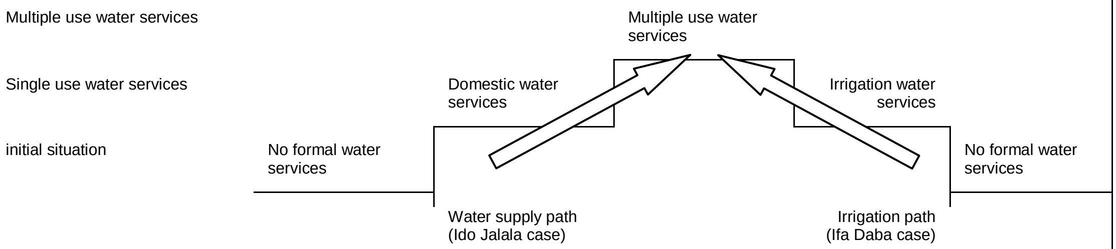

Figure 2. Towards multiple water services

Costs taken into account

The following costs are considered in this paper: Capital investment costs in assets (CapIn), which include all costs involved in the design and construction of a water system; Operating and minor maintenance expenditure (Opex), concerning all costs related to operation and maintenance to keep the system going; and Support costs (SupCo), which include activities supervision of the system's operation and maintenance, resolution of conflicts, refresher training of system users and caretakers and extension work.

In general, costs related to water service vary over the lifespan of the system, as illustrated in the figure below. In order to compare the costs with the annual benefits, the costs will have to be annualised. The CapIn over the lifespan of the system will thus have to be divided over the lifespan of the system. The Opex and support costs, which may vary from year to year over the lifespan of the system, have to be averaged over the lifespan of the system.

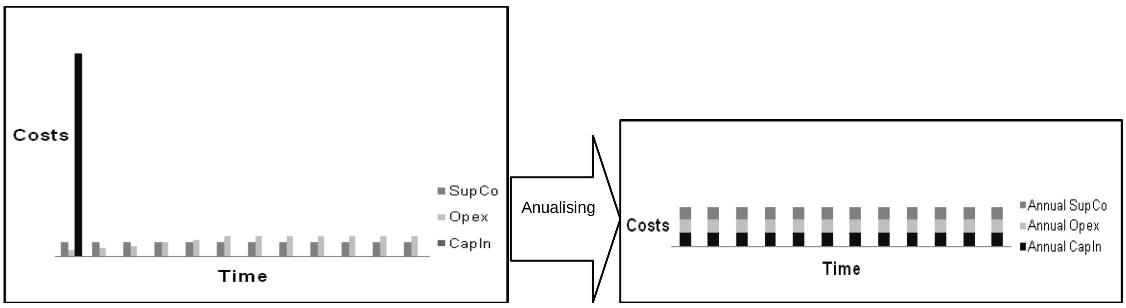

Figure 3: Annualising costs

Unless the total Opex over the entire lifespan of a system are know, it is difficult to determine the average annual Opex based on actual data. Opex can in that case be estimated to be 10% of the annual CapIn costs (5% operation and maintenance costs + 5% source protection (as per Hutton and Haller 2004).

Support costs for different water services can be estimated based on the recurrent expenditure of zonal and woreda government agencies that support community managed water supply and irrigation systems. To determine the different support costs for different systems, the expenditures can be divided over the systems in the area, according to the relative time that support agents spend on providing support services to specific systems.

Benefits taken into account

The paper considers both health benefits, resulting from water for domestic use, as well as benefits resulting from productive uses of water, with a focus on benefits from small-scale irrigated agriculture. Furthermore, time saving benefits related to improved water services have been taken into account.

It is estimated that 88% of global cases of diarrhoea, a diseases which kills around 2 million people each year, can be attributed to unsatisfactory water, sanitation and hygiene services (WHO, 2004; UN / WWAP, 2003). An increase in quantity and quality of water and the use of this water for domestic purposes, including hygiene and sanitation, can contribute to a decrease in expenditures related to diseases and an increase in time available to be spent on economic activities and education. The health benefits related to water services presented in this paper are based on:

- The value of estimated number of days missed due to diarrhoea or dysentery over the course of 1 year before and after changes in water services
- Estimated costs of treatment over the course of 1 year, before and after changes in water services

Irrigated crop production generally brings higher benefits than rain-fed crop production. The availability of larger quantities of water, with a better accessibility and reliability can stimulate change in cropping pattern, increase crop production per unit land and expansion of the cropped area. This can lead to improved household food security, improved nutrition, expenditure saving and increased household income. The benefits from irrigated agriculture in this paper are expressed as additional net benefits in market value of the produce from irrigated agriculture, as compared to rain-fed agriculture.

Besides the benefits generated by the use of the water provided, one of the main benefits of improved water services, is time saving. The time saved can increase leisure time, or can be used for economic or educational purposes. For this paper, time saving benefits have been determined by comparing the time spent on fetching water before and after water services improvements and converting this time into money.

The case study areas

Water is often used for multiple uses, whether water services allow for this or not. In order to get a better understanding of the influence of the type of the water services (domestic, irrigation, multiple use) on the costs and the benefits, other factors that can influence costs and benefits had to be kept as constant as possible. Therefore, cases in the same woreda with similar water supply technology and implemented by the same organisation, were selected: Ido Jalala and Ifa Daba, in Gorogutu Woreda, East Hararghe Zone, Oromia Region, Ethiopia.

In both cases, an unprotected spring was initially used for domestic uses, animal watering and small scale traditional irrigation. From the initial situation, the two cases have taken a different path towards multiple use water services. The Ido Jalala case has followed the water supply path with irrigation upgrade, while the Ifa Daba case has followed the irrigation path, with domestic water supply upgrade. (see Figure 2)

The spring in Ido Jalala with a discharge of 0.4 l/s, was capped in 2005 by the Ethiopian NGO HCS and a domestic water supply system was constructed serving 70 households. People continued traditional irrigation by using the run-off water from the domestic system and the water from other nearby springs. Soon after the implementation of the domestic water supply system, the community requested HCS to assist in developing an improved irrigation system, linked to the domestic water supply system. Although first steps towards this have been made, so far this irrigation system has not been finalised yet, so people are still mainly irrigating in the traditional way by using the run-off from the springs.

In Ifa Daba, the spring with a discharge of 1.4 l/s was used as the source for an irrigation system, which was constructed in the year 2004 by HCS. Since the implementation of the irrigation system, the community consisting of 121 households has been using the system for fetching domestic water as well. In 2007, a stand post, directly connected to the capped spring, was added to the system to facilitate fetching water for domestic use. The stand post which was initially placed in a swampy area, which prevented the users from collecting their water from the stand post, was reallocated in the beginning of 2008.

Results and discussion

Costs

The figures below give an overview of the annual costs of water services per system (figure 4) and per capita (figure 5).

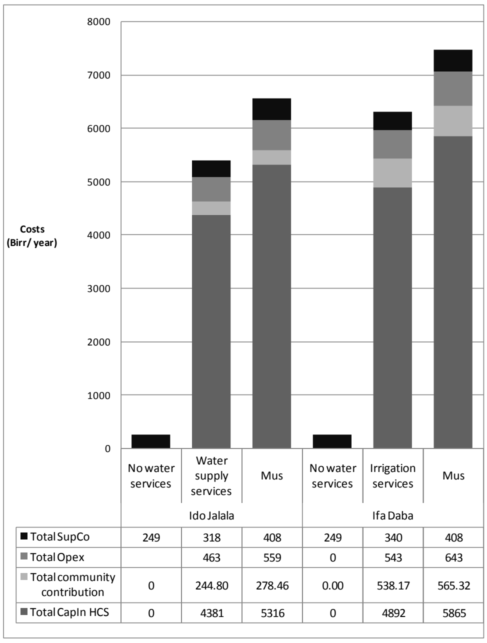

Figure 4. Annual costs of water services

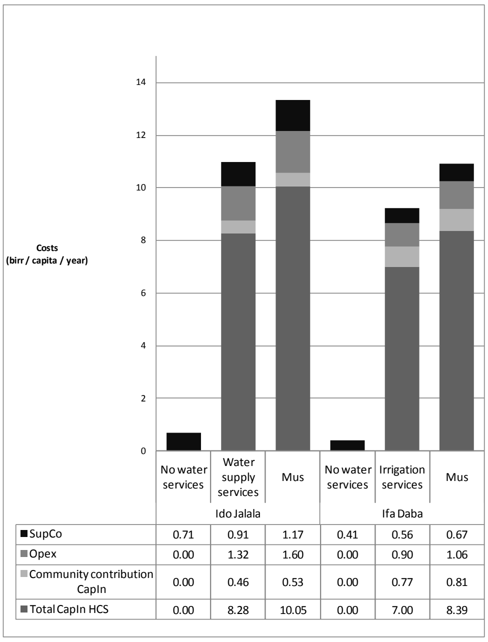

Figure 5. Annual costs of water services per capita

The graphs show that the total costs are higher for Ifa Daba than for Ido Jalala, although the costs per capita are slightly lower in the Ifa Daba case than in the Ido Jalala case.

The SupCo are covered by the woreda and zonal irrigation and water offices and bureaus. The CapIn is covered mostly by the implementer HCS, with the community contributing to some extent as well, as shown in the graphs. The communities also have to cover the Opex. In the two cases, water committees have been established, which have the task to set the water fee, collect the fees and use the money for the operation and minor maintenance. In neither of the cases, separate water tariffs have been set for different water uses. This is largely due to the fact that the case study systems are all gravity systems, which means that providing for the additional water use requires limited increases in operational costs. In case of motorised systems, the additional Opex cost would be much larger since the fuel cost (be it electricity or fuel) to pump up and distribute the extra water needs to be covered ,as well as the extra operating cost for the pump operator and the deprivation costs of the pump and generator.

In Ido Jalala fee collection has only started in October 2007. At that time, the fee was set at 1 Birr$^{\text{Year 2000}}$ per household per month. This is about 12 Birr$^{\text{Year 2000}}$ per year per household, which is higher than the 6 to 8 Birr$^{\text{Year 2000}}$ required per household per year to sustain domestic water supply services and multiple water services respectively. However, collection of the water fees has been a problem, as not all users are willing to pay. In Ifa Daba, the water committee has not been successful in setting a water fee and collecting revenues, although the Opex requirements are estimated to be 4.5 to 5.5 Birr$^{\text{Year 2000}}$ per household per year in the case of irrigation and mus respectively.

It should be noted that the figures presented in figure 4 and 5 are made assuming a lifespan of the system of 20 years in each situation. It could be argued that in a case where no water fees are collected for operation and maintenance, the lifespan of the system will decrease. If the lifespan of the system would be half the expected lifespan, the annual CapIn would double. Providing multiple use water services could enhance sustainability, hence increase the system lifespan and decreasing the annual costs. Unfortunately, determining the actual lifespan of the different water services was beyond the scope of this research and was therefore not taken into account.

Water use and benefits

In both cases, water from the spring was used for multiple uses, including domestic use, watering livestock and small-scale traditional irrigation, whether the water services allowed for this or not. The study has focussed on health, irrigation and time saving benefits related to water services, as described below. Although the study did observe an increase in number of livestock and a diversification in the types of livestock kept with the move towards multiple use services, this was not expressed in monetary terms and will not be considered in this paper.

Domestic water use and health benefits

With the implementation of the single use (domestic) water services in Ido Jalala, the household consumption for domestic use increased from about 20 to 37 litre per household in Ido jalala. In Ifa Daba, domestic water use per household hardly increased with the implementation of the irrigation system (from 30 to 34 litre per household per day).

In the current situation in Ido Jalala, the amount of money spent on diarrhoea related deceases is found to be 82 Birr $^{\text{Year 2000}}$ per person per year lower than in the initial situation. The health benefits related domestic water supply services could therefore be considered to amount to 82 Birr $^{\text{Year 2000}}$per person per year, which is more or less in line with Hutton and Haller (2004), who estimate health benefits of improved water supply in Sub Sahara Africa to be around 89 Birr $^{\text{Year 2000}}$. In Ifa Daba, no health benefits were found with the implementation of the irrigation system.

Irrigation

In Ido Jalala, the total traditionally irrigated area in the initial situation was 2.5 ha, irrigated by a total of 40 users. With the implementation of the domestic water supply system, the irrigated area was brought back to 1.56 ha, serving 25 users, because more water was allocated to be used for domestic use. This brought along a decrease in the irrigation benefits, from a total of 105,325 Birr $^{\text{Year 2000}}$ to 65,828 Birr $^{\text{Year 2000}}$ per year. So far, the step towards improved irrigation has not yet been made in Ido Jalala. In the case of Ifa Daba, the irrigated area increased with 32% as a result of the implementation of the irrigation system. It has been assumed that in the case of the improvement of the irrigation component of the system in Ido Jalala, a similar increase would take place, which would result in benefits of 86,893 Birr $^{\text{Year 2000}}$ per year.

In Ifa Daba, the area that was irrigated by 40 users in the initial situation, covered 5 ha. After the implementation of the irrigation system, the number of users increased to 53, irrigating a total area of 6.625 ha. However, the implementation of the irrigation system has gone hand in hand with a change in cropping pattern, replacing part of the chat cultivation with potatoes, pepper, cabbage, tomatoes and coffee. Because chat cultivation is at first sight more lucrative than vegetable cultivation, this has resulted in a decrease in net benefits from 110,843 to 74,103Birr $^{\text{Year 2000}}$ per year, while it would have increased to 157,087 Birr $^{\text{Year 2000}}$ per year in case the cropping pattern had not changed. However, when chat was the main irrigated crop, women had to go to the market to buy vegetables for the family's consumption. With the introduction of vegetable cultivation, time is saved and family's nutrition improves. The time saved for not having to go to the market to buy vegetables, and the health benefits associated with the consumption of more vegetables have not been taken into account in this analysis. In reality, the benefits of change in cropping pattern are therefore likely to be higher than indicated here. Since the change in cropping pattern in the case of Ifa Daba is not considered to be caused by the introduction of the irrigation system, the benefits that would have been achieved in case of chat cultivation were used in this analysis.

Time saving

In both cases, the majority of the communities used the spring as their main source of domestic water supply, both before as well as after the intervention. The time saving benefits are therefore not that much related to a decrease in distance, but rather to an increase in accessibility because of the installation of a tap, which made it easier and less time consuming to collect water.

In Ido Jalala, the time saving benefits of the domestic water services were estimated to be 123 Birr $^{\text{Year 2000}}$ per capita per year. In Ifa Daba, the implementation of irrigation had led to time saving benefits of about 65 Birr $^{\text{Year 2000}}$ per capita per year. With the implementation of the irrigation system, the accessibility of water for domestic use improved. The accessibility is likely to improve further with the implementation of the domestic water supply component, which will result in more time benefits. Since the domestic water supply component was only installed recently, the time saving benefits for the irrigation system with the domestic water component (multiple water services) could not be determined directly. It is therefore assumed that these benefits will be in line with the time saving benefits in the case of Ido Jalala.

Whether or not the time saved is indeed used for productive activities or for education has not been taken into account. It could be argued that all time saved helps improve quality of life, especially for women and girls who are primarily responsible for collecting water in this area, and should therefore be considered as a benefit, whether or not the time is used 'productively'.

Overview of the total benefits

The graphs below give an overview of the benefits in the two cases per system (figure 6) and per capita (figure 7) per year. The graphs show that in Ido Jalala the decrease in irrigation benefits is compensated by the increase in time saving and health benefits, related to the implementation of the domestic water supply system. In Ifa Daba a big jump in additional benefits is made with the upgrading of the water services to include domestic use, with an increase in health and additional time saving benefits.

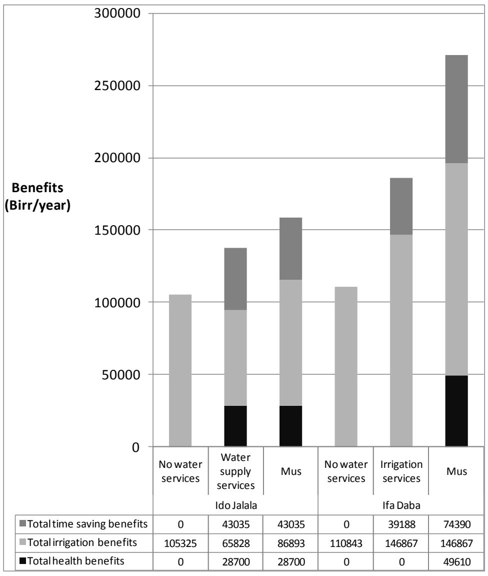

Figure 6: Annual benefits of water services

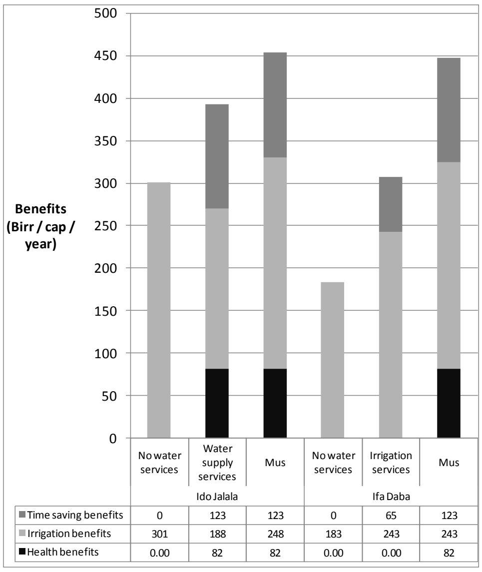

Figure 7: Annual benefits of water services per capita

It should be noted that not everyone benefits equally from irrigated agriculture, be it traditional or improved, whereas all community members benefit from improvements in water supply, both through improved health as well as through time saving.

Comparing costs and benefits

When the annual benefits are compared with the annual costs, as shown in figure 8, it becomes very clear that in the studied cases the benefits of water use easily outweigh the costs related to providing water services, whether these services cater for single use or for multiple uses.

The graph in figure 9 illustrated the additional annual costs and benefits for each of the steps towards multiple use water services. It shows that the additional benefits of going from single use water services to multiple use water services and smaller than the additional benefits of going from no formal water services to single use water services. However, the additional costs in this step are also smaller.

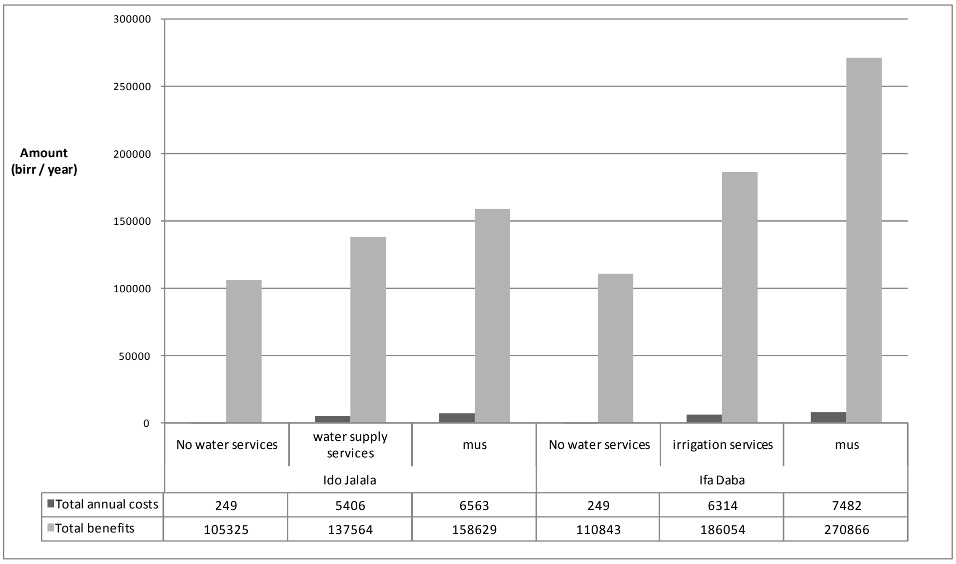

Figure 8. Total annual costs and benefits

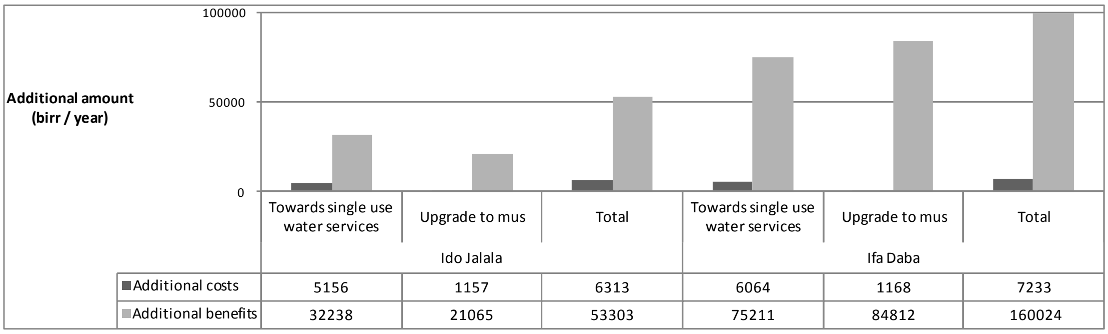

Figure 9. Total additional annual costs and benefits

The table below gives an overview of the Benefit/Cost ratios and the rations of the additional benefits / additional costs.

Table 1. Benefits/ Cost and Additional Benefit/Cost ratios

	Ido Jalala			Ifa Daba		
		Domestic water supply services	Multiple use services		Irrigation services	Multiple use services
B/C		25	24		29	36
	Towards water supply services	Upgrade to mus	Total	Towards irrigation services	Upgrade to mus	Total
Additional B/C	6	18	8	12	73	22

In the Ido Jalala case, the benefits outweigh the costs slightly more when domestic water supply services are provided than when multiple use water services are provided, as shown by the slightly higher B/C ration.

In the Ifa Daba case, the B/C ratio for multiple use services is higher than the B/C ratio for irrigation services, which suggests that adding a domestic water component to an irrigation system is a very good investment. It could be argued that the reason for this is that the system is a developed spring system, which means that very little extra CapIn and Opex have to be made to supply water of suitable quality for domestic purposes, which brings health and time saving benefits.

In both cases, the additional B/C ratio is higher for the upgrade to mus, than for the step towards single use water services. This shows that indeed high additional benefits can be obtained with relatively small additional costs when a single use system is upgraded to cater for multiple uses.

Conclusions and recommendations

The study has shown that introducing single use water services can have impact on the different uses of water, not only the type of use that the services cater for. Especially in the case of limited availability of water resources, it is essential that implementers and policy makers understand the multiple demands of communities and commit themselves to meeting these demands as well as possible by providing multiple use water services, in a sustainable and equitable way. Integrated planning and management, taking into account water demands for different uses, and how these may develop over time, is key in providing sustainable multiple use services. Enabling multiple uses of water by providing multiple use water services results in high benefits, as shown by this study.

Acknowledgements

The authors would like to extend thanks to other RiPPLE MUS research team members: Mr Zemede Abebe, Mr Samuel Chaka, Mr Adissu Delelenge, Mr Jaleta Gebru, Mr Zelalem Lema and Mr Demeksa Tamiru. Furthermore, the authors thank the people of Ido Jalala and Ifa Daba for their contributions to this research.

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Note/s

All amounts in this paper are given in Birr^{year2000} (based on the GDP deflator of the World Economic Outlook Database (IMF 2007)). 1 US^{year2000} = 8.15 Birr^{year2000}

[1] RiPPLE: Research Inspired Policy and Practice Learning in Ethiopia and the Nile Region (www.rippleethiopia.org)

[2] HCS: Hararghe Catholic Secretariat

Keywords

Costs, benefits, Ethiopia, multiple use of water, multiple use system, RiPPLE

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Experiences on Multiple Use Dams in Sissala West District, Ghana

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Plan Ghana works in the Sissala West district in north-western Ghana. The main livelihood of indigenes is rain-fed farming and livestock rearing. Northern Ghana experiences an 8-month long dry season each year, during which farming and livestock watering become extremely difficult. Food shortages occur and people lose their animals. Moreover, rainfall patterns are irregular, causing young crops to wither in incidental prolonged dry periods, a situation aggravated by climate changes. Plan partner communities requested support for the construction of dam facilities to support dry season farming and livestock watering. After feasibility studies, 8 dams were constructed with the aim of improving livelihoods and health of people through sale and consumption of produce from the following intended uses; Irrigation, Fish farming and Livestock watering. Over 1000 households are benefiting from the dams. A total of 95 hectares of land has been put under irrigation growing mainly vegetables. Leafy vegetables are now available on the market in the dam communities. Income levels have increased through the sale of surplus produce. Some community members have taken up fishing whilst livestock have sufficient water.

Apart from the intended uses of the dams, they are serving other practical water needs which were not catered for in the design, and bring in additional sources of income; Moulding bricks, Watering dirt-roads and Household cleaning. Data collection on use demands and patterns, especially on the unexpected additional activities, needs to be continued to guide future multiple use of water projects in Plan's MUS programme.

Introduction

Plan is an international, humanitarian, non-governmental organisation with a vision of a world where all children realise their full potentials. Plan supports communities in the areas of health, education, water and sanitation, livelihoods and child rights. In Ghana, Plan works in some of the most deprived districts across 5 out of 10 administrative regions. Amongst the districts that Plan Ghana works in is the Sissala West District which is located in the northern most part of Ghana on its border with Burkina Faso. The populace is among the most deprived in the country. Over 90 percent of the populace are farmers while other income generating activities include livestock rearing, "pito" (local beer) brewing, petty trading, charcoal burning and Shea butter preparation (Holix Consult, 2003). With the exception of charcoal burning and petty trading, all the income generating activities rely heavily on availability of water especially farming which is their main source of livelihood.

Water sources in the communities are normally hand dug wells and boreholes which are usually inadequate to meet all the communities' water needs. Most of the communities' income generating activities including farming is therefore conducted in the rainy season when water is in abundance. Rain water is utilised by either harvesting as run-off water or by direct precipitation. Rainfall pattern in the area is however irregular and the season last for approximately 4 months within the year. Because of this, farming activities can only be undertaken for this period out of the whole year. Families depend mainly on their farm produce for food and income for all their other needs. The crops mainly cultivated are maize, millet, sorghum, rice, beans, yam, groundnut and cotton. With the exception of cotton which is produced for commercial purposes, the crops are mainly for household consumption.

The harvest during the farming season is expected to sustain a family throughout the year hence part of the produce from the farming season is stored for later consumption. As a result of general poverty in the area, farmers are unable to employ mechanized and improved agricultural technologies to cultivate large plots of land. The food produced is hardly sufficient to sustain families throughout the year as expected. This results in chronic hunger and malnutrition most part of the year making the indigenes susceptible to various diseases.

Also during the dry season, indigenes idle about with nothing to do. Some travel to distant places in southern Ghana in search of rare jobs and end up undertaking menial jobs to cater for their families. Without adequate shelter and protection, some girls and women who find themselves in such positions end up in prostitution with an increased risk of teenage pregnancies and STIs including HIV/AIDS.

Intervention

In view of the aforementioned problems, Plan Ghana's partner communities in the Sissala West district in their community development plans identified dams and dugouts as a priority. Plan Ghana commissioned a feasibility study in 2003 to assess the communities and ascertain the possibility of constructing dams or dugouts in the communities. After the feasibility studies, 8 sites were selected for the construction of dam facilities. Contractors were procured to undertake the works under the supervision of a consultant. Most of the materials used were obtained locally from the communities with the exception of cement, pipes and appurtenant structures and fencing material. Community members supported the construction by providing land for the project, mobilising materials like boulders for riprap on the upstream face of the embankment to prevent crocodiles burrowing into the embankment. They also provided labour for the construction of fencing around the irrigable areas. The District Assembly supported by obtaining the required environmental permits for the project and through project monitoring.

Earthen embankments were constructed across natural watercourses to form a reservoir, with a spillway located at one end of the embankment. 2 intake points are situated within the reservoir connected to conduits underneath the embankment that transports water from the reservoir. To these main conduit pipes are connected lateral pipes that distribute water to the irrigable areas and drinking troughs. On the irrigable area, water is collected in tanks distributed uniformly from which farmers fetch to irrigate their crops. Flow of water through the pipe network is regulated by a number of control valves within the pipe network. The first phase of the project consisting of 4 dams was completed by mid 2006 whilst the second phase also of 4 dams was completed by mid 2007. The reservoir capacities are between 113,400 to 702,350 cubic meters. (Plan Ghana Irrigation Fact Sheet, 2007)

By design, the dams were intended for irrigated farming, provision of water for livestock watering and fish cultivation. Each dam therefore had a fenced irrigable area between 5 to 20 hectares, 2 animal drinking troughs and all the reservoirs were stocked with fish upon completion of construction works. These were expected to improve the nutrition of community members and provide additional income for them through the consumption of produce and sale of surplus produce respectively.

Management and Sustainability

To ensure proper management and sustainability of the dam facilities, communities were supported to form Water Users Associations (WUAs). These were trained in management, operation and maintenance of the dam facilities and tasked with drawing up constitutions governing the use of facilities as well as day to day management of the facilities. Some community members were trained in fish farming and processing. Others received training on proper agricultural practices and animal husbandry practices. Trainings were undertaken with the support of the Ministries of Fisheries and Agriculture who continue to support the communities through provision of extension services and routine monitoring. Plan Ghana frontline staff also provide support to WUAs when the need arise.

Communities drew up criteria for allocating land since the irrigable areas were not sufficient for all community members to have plots. Current plot sizes range from 20 to 60 square meters per individual and farmers pay a levy for a plot per year. Each animal within the community is also charged a specified amount per year for drinking from the facility. A community member also has to obtain a licence from the WUA to operate as a fisherman by satisfying some set criteria and the payment of an appropriate fee. Also, the use of water from the reservoir for commercial purposes attracts a fee. Monies accrued from the charges and levies are kept in a community account and used for maintenance activities on the dams. Currently, over 1,000 individuals are utilising the facilities.

Utilisation

For the first phase projects, the first 2 years of utilisation met with challenges due to the inability of the barbed wire fence to keep animals away from crops cultivated in the irrigable areas. However, about 20% of the irrigable areas were put under vegetable cultivation for household consumption after communities had tried fencing with tree branches. Livestock in these communities and beyond had abundant water to drink. The experience with the fencing in the 1st phase informed the change in design of the fence in the 2nd phase to chain link fencing which has been successful in keeping out animals. This year, the fencing in the 1st phase has also been changed to chain link. The first year of the 2nd phase projects was more successful as communities put over 60% of the irrigable area under cultivation of mainly vegetables during the dry season. Vegetables cultivated include local leafy vegetables, tomatoes, onions, cabbage and okra.

Results, intended uses

During this year's rainy season, the communities cultivated grains on the irrigable areas which are yet to be harvested. Dry season gardening is mostly for vegetable growing. During the last dry season, in 2 communities, farmers were able to produce vegetables in excess of the community needs and sold the surplus to people from surrounding communities. Some community members reported incomes ranging from $70 to $600 from the sale of excess vegetables produced during the dry season. The other communities mainly consumed their produce without any surplus.

Photograph 1. Sorghum cultivation on irrigable area

Photograph 2. Cattle at drinking trough

Moreover, all livestock in the communities had water to drink and livestock from other communities also travelled to the dam communities for water. Serious fishing activities have not commenced because most of the fingerling stock had not matured and the communities have been asked to start fishing after the 2nd year of stocking. However, some amateur fisher folk, especially children, undertake fishing activities using hooks and lines mainly for pleasure and household consumption.

Results, unplanned uses

It has been observed that some of the communities are using water from the dams for other activities that were not originally planned for. These include household activities like washing of pots and pans, washing of clothing which they sometimes do at the dam sites and even at times for drinking and cooking even though they have been educated on the harmful effects of consuming water from the reservoirs

Houses in the communities are usually built from bricks moulded from mud. During the heavy rains, parts of some houses collapse and therefore the dry season is always a time for renovations on houses. Communities utilise water from the dams for their construction activities such as moulding bricks and brick-laying. Also construction contractors working in the area fetch water from the dams with water tankers for their construction activities at a fee.

Other intangible benefits of the dams include the recreational and ecological benefits. Upon a visit to the dam sites, especially in the dry season, one is always struck with the coolness of the breeze at the sites and the variety of flora and fauna. Some villagers have been observed swimming in the reservoir especially during the hot dry season. The sites also hold a potential for tourism as some of the dams house crocodiles and several other animal species.

Photograph 3. Clothes washing at dam site

Photograph 4. Brick moulding at dam site

Lessons learnt

From initial observations, the following lessons have been learnt;

- Due to proximity of projects to communities and presence of small ruminants, appropriate fencing would have improved initial utilisation of first phase projects considerably
- Adequate provision (washing bays, treatment of water for drinking, bricks moulding bays, etc) should have been made for unplanned uses through detailed assessment of water needs at onset of project
- Projects are very capital intensive (An average of $400,000/dam) and also certain maintenance activities are beyond communities' capacities necessitating external support
- Involvement of government agencies like the Ministries of Agriculture and Fisheries has impacted positively on the projects through support provided to communities
- Proactive leadership at the community level is necessary to ensure sustainability (Apathy and low capacity of some WUAs affects maintenance activities)

Conclusion and Next Steps

The dam projects form a part of Plana Ghana's livelihood program strategy and has demonstrated that if properly planned, water projects have a potential of improving the livelihoods of people considerably. It has been observed that virtually all aspects of a person's life, both domestic and occupational, in a community such as the dam communities are influenced by availability of water. Plan Ghana intends to carry out continual data collection on dams' utilisation and will explore the possibility of treating some water from the reservoirs for consumption of farmers at the dam site.

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Addressing health through multiple use water services

E. Boelee [Ethiopia]

Multiple use water services can bring more health benefits than separate water supplies for domestic and productive uses – if health is explicitly and properly addressed. That means that in the planning phase due attention has to be given to adequate water allocation for various purposes as well as to providing safe sanitation and offering complementary health and hygiene education. These elements can also be useful in step-wise upgrading single purpose systems to multiple use water services. Sufficient water of good quality is needed for drinking water and hygiene. If the system cannot supply adequate water quality, then additional facilities such as home water treatment can be a good solution, provided the users understand and can operate the treatment themselves. The (re-) use of water for home gardens with a variety of vegetables and fruits is important for balanced nutrition. Proper design, construction, operation and maintenance of water systems can avoid the creation of breeding sites for vectors of diseases such as malaria mosquitoes and schistosomiasis snails. Environmental sanitation, including construction and safe use of latrines, but also protection of water resources from pollution by runoff and animals, reduces the demand for water treatment as well as risks of water use (exposure to pathogens and toxic chemicals) for productive and domestic purposes. Upgrading of water services often reduces water collection efforts for women and children, leading to a whole range of additional socio-economic benefits that in turn may bring health benefits, while poverty reduction in itself also leads to improved health.

Photograph 1. Rehabilitated irrigation canal in Uda Walawe, Sri Lanka, offers clean and comfortable bathing sites (Boelee et al. 2006).

Source: Ronald Loeve

Photograph 2. People often perceive clear water as being clean and turbid water as dirty as here in South-Central Ethiopia.

Source: Peter McCornick (pending permission)

Photograph 3. Open reservoir filled with water from irrigation canals in Hakra 6R, Punjab, Pakistan. The water is heavily polluted during transport and storage in the tank that often serves as solid waste collector as well (Ensink et al. 2002; van der Hoek et al. 2002). The pipes lead to individual houses where an electric pump provides the pressure necessary to serve the entire house. The water flowing from the tap looks clear and gives a false impression of good quality.

Source: Eline Boelee

Photograph 4. By taking drinking water from an irrigation canal, this boy makes a clever decision; the groundwater from wells in the Rift Valley in Ethiopia is highly contaminated by fluoride with levels up to 9 mg/l. Hence surface water is actually the healthier alternative here (see also Jensen et al. 2001).

Source: Eline Boelee

Photograph 5. In arid regions of South Asia and North Africa, pumps and wells are often dug near unlined irrigation canals to benefit from the local groundwater recharge. While seepage from canals reduces irrigation efficiency, this indirect multiple use of water may have health benefits, such as here in Hakra 6R in Punjab, Pakistan, where the groundwater is too saline for consumption. The horizontal filtration through the soil generally improves the canal water (Boelee et al. 2007; Ensink et al. 2002; Meijer et al. 2006; Shortt et al. 2003, 2006).

Source: Eline Boelee

Photograph 6. Even when clean water is provided from a good distribution network, practices of water collection and storage may contaminate the water and make it as polluted as surface water (Ayalew et al. 2008; Guchi 2007; Jensen et al. 2002; Scheelbeek 2005). Photo from Gorobiyo, Eastern Ethiopia.

Source: Michiko Ebato

Photograph 7. Multipurpose water system in Adidaero, Tigray Region, Ethiopia: left an irrigation canal, right a horizontal filtration gallery for clean drinking water (Ebato and van Koppen 2005). It took several months before the community accepted the water as clean water for consumption – the convincing argument being a field worker who drank the filtered water instead of buying bottled water.

Source: Eline Boelee

Photograph 8. Home water treatment in locally made earthen pots with a sand filter inside removes 91-99% of bacteria, parasites and turbidity (Guchi 2007). The water is sufficient for daily drinking water requirements, serving a household of 6 people, and a year after introduction, most pots were still used properly in Yubdo-Legebatu, West-Central Ethiopia (Cousins 2007).

Source: Ephrem Guchi

Photograph 9. Simple facility for hand washing in South-Central Ethiopia, keeping the water clean.

Source: Peter McCornick (pending permission)

Photograph 10. Using a perforated can for drip irrigation, daily wastewater from bathing or washing utensils can provide sufficient water for one papaya tree, safeguarding the entire household from blindness due to vitamin A deficiency (Scheelbeek 2005). Ajo village, Legedini Peasant Association, Dire Dawa District, Ethiopia.

Source: Eline Boelee

Photograph 11. In many large-scale irrigation systems, steps have been built on large canals to facilitate access to the water for domestic purposes such as bathing and laundry. While this reduces the drudgery of water collection, it may also expose people, especially women and children, to schistosomiasis, such as here in Office du Niger irrigation system in Mali (Boelee and Madsen 2006).

Source: Henry Madsen (pending permission)

Photograph 12. Communal tank, old stone structure rehabilitated with cement in Tessaout Amont irrigation system in central Morocco (Laamrani et al. 2000). Farmers use part of their irrigation water allocations to fill it. What looks like a door is the intake and the manholes on top are used to haul water out. Before it gets into the tank, the water is transported over some 15 kilometres: first from the reservoir through the old riverbed, then into cement-lined main canals and elevated concrete secondary canals system all the way to the site. The last 10 meters it flows over the ground by the side of the road and gets polluted by animal droppings and other waste.

Source: Eline Boelee

Photograph 13. These boys in the Tessaout Amont irrigation system in Central Morocco explained that they have to go to an upstream canal further away to get cleaner water. In the rubber bags on the donkey they can take some 30 litres but would still need to go at least twice a day and therefore could not attend school (Boelee et al. 1999).

Source: Eline Boelee

Photograph 14. Children hazardously collecting water from large irrigation canal in Tessaout Amont, Morocco. Several children and even adults drown in this canal every year. Though it doesn't show on this particular day, the water can flow very fast and wipe you away easily while it is very difficult to get out.

Source: Menno Houtstra

Photograph 15. Catchment management is important for springs, wells and rain water harvesting structures such as this small reservoir Mai Negus in Tigray Region, northern Ethiopia, to reduce erosion and siltation as well as pollution by grazing livestock and runoff. Such measures can improve the water quality and reduce the need for treatment (Million 2008).

Source: Eline Boelee

Photograph 16. In arid mountainous areas, water collection can be a physically risky undertaking, as shown in Sesella well, Eastern Ethiopia. In villages like this, the development of water services closer to homes can drastically reduce the number of broken legs, arms and hips. In these isolated areas where health services are far away, fractured bones often lead to lifelong disability.

Source: Pauline Scheelbeek

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Incorporating Productive Use into Water Systems In Urban Nigeria

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Given the importance of the urban water system to low income productive water users, a functional and efficient utility as well as an appropriate policy framework has been identified as being imperative in order to maximize income and employment benefits for urban productive water users. This is true in Nigeria where water supplies to households by the water utilities have traditionally been confined within what is known as domestic water needs. The quantity of water supplied has often been meant to cover basic needs such as drinking, cooking and personal sanitation needs etc. However this has not been a true reflection of the use of this limited amount of water supplied. Recent studies in other parts of the world have however shown that millions of low-income households now, more than ever before are using their limited water supplies for activities such as productive uses. Such productive uses of water may not really thrive or even take off unless the required quantity of water is available. Such activities often generate numerous benefits to households involved. An understanding of how productive uses of water could successfully be mainstreamed into urban water systems in Nigeria was studied. This involved a social survey of households and institutions in Owerri, Nigeria; where productive uses of water is already real, particularly in activities such as home gardening, horticulture and livestock rearing etc. In view of the persisting problem in water supplies in Nigeria, where water utilities such as the Imo State Water Corporation (ISWC) is still enmeshed in intermittent supplies; the implications for households, especially the productive water users; alternative water suppliers and the government is explored in the paper in order to identify how supply sustainability for these activities could be maximized as a veritable tool vital in the fight against poverty.

Introduction

As the world becomes more urbanized and poverty becomes an increasingly urban phenomenon, it also, becomes pertinent to understand the role of water as a key contributing factor to the incidence of poverty or otherwise in urban centers. The link between poverty and water in urban centers often seems misunderstood. The reality is indeed startling as the global urban population without access to improved water services rises from 107 million in 1990, to 170 million in 2004 Owen (2006; 7). Many of the inhabitants of these big cities have no or inadequate access to running water. This is particularly true for cities in Africa where government and its utilities often do not only have limited means with which to expand the water, and maintain the quality but they also need to expand water supply services to meet the ever increasing needs of industry and to support growing population with varying distribution of economic activities and settlement patterns. The result is that dwindling household incomes have necessitated the rise in various informal small-scale entrepreneurial activities in urban centers around the world, especially the third world. The effect of all these on urban water supply can no longer be ignored or glossed over. The biggest challenge therefore, is evolving a new way of managing the city to enable it tap the potential inherent in the size and innovation that drive the urban population. The reality of this is particularly more evident in water use.

Understanding the term 'Productive Use of Water'

Moriarty et al (2004:21); describe 'Productive Use of Water' as the water used for small scale, often informal activities whose primary purpose is improved nutrition or income generation. It was therefore defined as a quantity of water over and above domestic 'basic needs' that is used for small scale productive uses. Bustanmante et al (2004:144); defined domestic water as commonly understood to include the water needs of families for drinking, cooking, washing and sanitation/hygiene. This definition covertly offers accommodation to sundry economic activities such as vegetable gardening, fruit trees, beer brewing, tea shops, road side eating shops, hair dressing, livestock rearing, ice block making, grass-mat weaving, smearing and plastering of walls and floors, medication and religious rituals, baking, poultry, pig rearing, fish pond, recreation (e.g. Watering of lawns and swimming pools) etc. No doubt these coteries of activities are productive because they engage (time, effort and money) the individuals involved in them and at times serve as an income generating activity for them. An appreciation of the huge potential benefits realizable from these activities often leads for demands that they be specifically catered for particularly in the design of urban water systems as one important tool to check urban poverty.

Defining the borders of domestic water

According to Moriarty et al (2004;27) systems that are designed to provide minimal domestic 'basic water' supplies and that do not take account of productive uses can be expected to fail if people actually want to use its water for productive activities (often through illegal connections). Further to the foregoing UNECA (1999;29) states that the provision of water supply in human settlements involves tapping the most suitable source of water, ensuring that the water is fit for domestic consumption and supplying it in adequate quantities. Perhaps adequate quantity here supports the position Moriarty et al.

But the UNICEF/WHO Joint Monitoring Programme defines an improved drinking water source as being more likely to provide safe drinking water than a not- improved drinking water source, by nature of its construction, which protects the water source from external contamination particularly with fecal matter (WWDR2; 2006 pg.225). This definition however did not consider quantity and access hence necessitating the need for a broader definition. It was, however realized that it was not just water quality but also water quantity which mattered in achieving health improvements, and that quantity in turn was dependent on accessibility as documented by Robinson et al (2004, 174). It was based on this particular premise that Howard and Bartram (2003) proposed four access categories. This was based on the relationship between accessibility (expressed in time or distance) and the likely quantities of water collected and used. From Table 1, the four categories are: no access, basic access, intermediate access and optimal access.

Table 1. Requirements for water service levels and health implications

Service Level	Access Measure (Distance or time)	Needs Met	Level of health concern
No access: quantity collected often below 5litres (L) per capita per day.	More than 1,000 meters (m) or 30 minutes total collection time.	Consumption cannot be assured. Hygiene not possible (unless practiced at the source)	Very High
Basic access: average quantity unlikely to exceed 20L per capita per day.	Between 100 and 1,000m or 5 to 30minutes total collection time.	Consumption should be assured. Hand-washing and basic food hygiene possible; laundry and bathing difficult to assure unless carried out at source.	High
Intermediate access: average quantity about 50L per capita per day	Water delivered through one tap on plot or within 100m or 5 minutes total collection time.	Consumption assured. All basic personal and food hygiene assured; laundry and bathing should also be assured.	Low
Optimal access: average quantity 100L per capita per day.	Water supplied through multiple taps continuously.	Consumption assured. All needs met. Hygiene need all met.	Very low.

Source: Howard and Bartram (2003).

Howard and Bartram (2003) argued that an improved water supply source should provide adequate quantities for bathing and clothes washing as well, but recognize that the quantity per person required corresponds only to the level of basic access. It should be recalled that basic access is the current global standard for access. Moriarty et al (2004; 23) therefore suggests that it is essential that development of water resources and services be based on a clear understanding of the full range of uses to which people put (or might put) the water provided. This in a nutshell demands the need to listen to people and putting their needs first. Moriarty et al (2004; 40) insists that water used for small-scale productive purposes, with its potential to make limited but measurable improvements in the lives of billions of people should be added to this 'domestic' supply when making rights-based allocations of water resources. They proposed the term 'household' water to encompass this combination of domestic and small-scale productive supplies.

Methodology

A social survey of households and institutions in Owerri city was carried out to obtain the people's views, and observe their daily economic activities as it relates to the way and manner they use their drinking water supplies for economic and productive enterprises. Particular attention was focused on the water supplied by the Imo State Water Corporation and the alternative water suppliers. Research tools used in doing this study included Questionnaires, Focus group discussions and Observations. Further information was scooped from local newspapers, personal discussions and review of institutional documents. A total of 61 questionnaires were prepared and distributed; however a total of 41 of these questionnaires were returned by respondents representing a total of 67.2% of the total. A break down into the two groups showed a representation of 56.66% for institutions and 77.41% for households. Quota sampling technique was used in selecting respondents.

Findings

Owerri is the capital city of Imo State, Nigeria. The geographical area of Imo State is located in the South Eastern zone of Nigeria. Owerri is predominantly an urban community with a population of about 1.5million people. The annual growth rate of the population is put at 4.5% (NPC, 2007). This is equivalent to a population density of over 400 persons per square kilometer. The Imo State Water Corporation (ISWC) has the mandate to supply water to the urban and semi-urban areas of Imo State especially Owerri. Table 2 below shows the percentage consumption by the major consumers.

Table 2. Percentage Estimate of Users of ISWC Supplied Water

Category of Water User	% of consumption
Domestic	35
Commercial	20
Industrial	45

Source: Okereke et al (2000).

Presently ISWC has an effective coverage of 31% of the city's population of 1.5million and usually supplies are intermittent. Most people in Owerri city are generally poorly served and hence complement their limited ISWC supplies from surface sources (e.g. car washers and brick/block molders etc); commercial boreholes (Horticulture; household gardens and Ice block makers); and water vendors (e.g. Restaurants etc). Due to the intermittent nature of the ISWC supplies and the high cost of water from these alternative sources the average consumption per household of six people in Owerri has shrunk to between 80-100L per day since 1997. The percentage volume of Unaccounted For Water (Non Revenue Water) is estimated at 50-69% of current supplies. Water supplies to consumers or ISWC customers are based on fixed tariff that is payable on household bases as no single meter is in use anywhere in the city.

The implication is that household productive water users such as those making Ice blocks, Home gardens, commercial car washers; Horticulture; Bricks/Block makers and Restaurants etc have the potential of using more water than is accounted for. Associated with this is the realization that some of these potentials are either "covert" or "overt" in most cases. The efficiency of bill collection by ISWC that is based on fixed tariff that is payable without metering has been estimated by Okereke et al (2000; 171) to be less than 30%.The result is that ISWC loses one of the most important benefits of water metering which is the revenue it provides for water operations. The Imo State Water Corporation in Owerri is well aware that some residents are currently using the limited water supplies for sundry activities like home gardening, commercial flower gardening, watering of lawns and commercial washing of cars as well as for brick/block making. The harvesting and use of rain water in these activities is not really optimized.

However amongst the 6 productive water user groups identified in the study, the Willingness to Pay (WTP) for ISWC water was higher among the Restaurant and Ice Block groups. This was assessed based on their overwhelming subscription to the introduction of meters. Currently these two groups use 250 and 50-100 l/p/d of water respectively which they source 50 and 75% respectively from water carte vendors. They operate basically within their households. Both activities are dominated by women and represent the highest number of productive users surveyed. There activities are more water efficient than the other groups. Already, the Horticulture, Car Wash, Bricks/Block Making and Home Garden groups have been on the searchlight of ISWC because of the poor reputation of using and wasting so much water. Despite the fact that they currently use higher quantities of water per day, they are often hesitant to pay anything near commensurate charges. They are notorious for many cases of illegal connection and disruption of water flows. They strongly oppose the introduction of meters because of the latent fear that it will not only expose their high level of water wastage but impose higher bills on them. They are rather contented with the existing status quo which tends to favor them because they currently underpay.

Table 3: Estimate of Average Income from Productive Uses of Water in Owerri City

User/Activity	Average daily quantity of water used (litres)	Monthly tariff payable to Water Utility (Naira)	Average monthly cost of water if purchased from the vendor (Naira)	Average monthly land/plot/space rent (Naira)	Average monthly income (Naira)
Horticulture	250-450	5000	12000	3000	45000
Car Wash	500-1000	7000	20000	2500	55000
Brick/Block	1000-3000	15000	40000	10000	90000
Ice Block	50-100	1000	2500	5000	7000
Home garden	250-450	2500	3000	10000	15000
Restaurant	250	1500	3200	4000	20000

Source: Author (2007). Note: All stated figures concerning payments and income are rough estimates because they are very variable as they are based on variable factors such as rate of patronage and use of service. Only the tariff from ISWC and land/property rent is constant. (1US$ equals 115Naira)

Discussion

Considering the regular, though small income (as shown in Table 3 above) being generated from productive water uses in Owerri, it would be proper to effective provide for their water needs in urban water budgets. This has become imperative in order to effectively manage the accompanying threats to system sustainability and mitigate poverty. Moreover, prioritizing the water needs of productive users should be blended with traditional domestic supplies to dynamically achieve optimal sustainable development. This is true for Owerri where for example, many home-based informal enterprises like restaurants and bricks/block making activities are earning income from their distribution links with formal enterprises in the global chain of production. However this remains dicey as a lot of factors come into play. Metering of utility supplied water is one such factor. It should be noted that water meters are necessary for implementing full-cost pricing. Full cost pricing is based on the economic principle that utilities should charge water rates that reflect the total costs of replacing and upgrading infrastructure.

However, it has been noted that water metering can be detrimental if water prices are set too high by utilities. An unaffordable rate structure can threaten the health and welfare of economically disadvantaged populations such as the urban poor and those of them involved in productive water uses particularly if they cannot afford to pay for a necessary amount of water.

It has been suggested by Sansom (undated) that one way to try to avoid this problem is to calculate an average monthly consumption rate needed to cover key human needs and then charge a basic rate for this amount and a higher price for any consumption above that amount. The implication of this to productive water use in urban areas such Owerri is yet to be explored. The failure to meter water supplies in Owerri has caused more confusion than order. This is so because the arrangement involving metering and billing per household links human behavior to economic resources and the assumption is that an increase in water price reduces use (Lallana et al.2001) as quoted by Helena Krantz (2005). This creates an incentive to reduce the low-value use; its use is not considered being worth the money.

For the ISWC to restore a lead to consumers on water efficiency, it must amongst other factors get on top of its leakage problems. Other enabling indicators for a viable utility are according to Sansom et al (undated; 7) the Working Ratio; and the Staff per 1000 Connections. These indicators often serve as yardsticks for measuring utility performance and the possibilities of a formal productive use in urban water systems. A working ratio (i.e. operation and maintenance expenditure divided by the total revenue) should be around a value of 0.5 for a utility to generate sufficient revenue to fund effective service provision including future investment. Therefore more water supplies will exert operation and maintenance (O&M) on the utility. A rise in O&M that is higher than the revenue may not support productive use. A ratio of a utility staff per 1000 connections is an indication of productivity and efficiency. It also marks good service performance level.

From the study most viable option for productive water users in Owerri is to secure access to water through a range of alternative approaches such as rain water harvesting and household level waste-water reuse etc. However, militating against this is housing insecurity. According to Moser (1996, 23), housing insecurity, such as when households lack formal legal title, increases the vulnerability of the poor. In Owerri, most of these productive water users live or operate on rented plots; this together with huge capital costs hinders the option of any sustainable rainfall harvesting. This is in the face of the reality that the city records an average of 2000mm of rainfall per annum. Earlier findings such as those of Skinner (undated) shows that rainwater costs about five times as much as metered water supplies in Sri Lanka, and that it takes 20-25 years to recover the capital cost of such investment in Namibia. The apparent inertia and apathy in utilizing rainwater as an option in Owerri by these groups could therefore be appreciated from this standpoint. But when the poor have some secure ownership of their housing, they often use this asset with particular resourcefulness when other sources of income are reduced. Home owners use their homesteads as a base for productive activities e.g. vegetable gardening; horticulture and livestock etc (which may not be permissible if the occupier is on rent).Therefore the importance of land and housing in combination to water as productive assets in the urban context has become evident especially in poverty alleviation.

Owerri, unlike Yaoundé city, Cameroon is yet to come to terms with the reality of waste water reuse. A study by Raschid-Sally et al (2004; 95-116) in Yaoundé had x-rayed 3 urban and peri-urban sites where the use of waste water in productive activities in agriculture was already a norm. Vegetables, especially the indigenous leafy variety as well as salad, leeks and lady's finger etc and horticulture were commonly irrigated with waste water. In Yaoundé 96% of farmers were producing vegetables and flowers for commercial purposes while only 4% produced for exclusive family consumption. Household waste water reflects what the residents consume, and therefore changes over time. In the current consumer society and chemical society it contains a wide range of substances, and wastewater today may contain as many as 30000 different chemical substances (Palmquist, 2001) as quoted by Helena Krantz (2005). Household wastewater is a mix of nutrients (e.g. phosphorus, nitrogen and potassium), other chemicals (e.g. metals and anthropogenic organic substances), various solids and pathogens (e.g. bacteria and viruses). The nutrients originate mainly from food, and some of the phosphorus from detergents. Metals originate from several sources such as food, tobacco and snuff (cadmium), amalgam tooth fillings (mercury), wear and tear of objects (cutlery, zippers, casseroles etc) and pipes, etc.(Naturvardsverket 1995) as quoted by Helena Krantz (2005). In addition, residents dispose of a wide range of products and substances in toilets and drains.

In Owerri houses, these are normally mixed and piped together into drains or septic tanks connected to soak-away pits. The total volume of water used in households is about $59m^3$ per household of 5 persons and year. If all these waste water is re-circulated to agriculture, between 75% and 85% of the nitrogen, phosphorus and potassium from the households will be used as a resource instead of being a potential pollutant to the environment.

Conclusion

Given the importance of the urban water system to low income productive water users, a functional and efficient utility; and an appropriate policy framework is imperative in order to maximize income and employment benefits for urban productive water users. Water Utilities, Urban planners and Municipal officials should acknowledge that productive water uses are here to stay, and that they contribute to the city economy in many ways. It is germane to underscore that reducing urban poverty is not possible without supporting these productive water users. The government should promote inclusive urban planning, that includes participatory planning processes which addresses the key constraints and needs of different categories of productive water users. However, top on the difficulties constraining the ISWC is its inability to provide investment for maintaining the condition and performance of their water assets. It needs to focus more on assets management and putting funds aside for depreciation, if it wants to achieve reliable services. To overcome these constraints, ISWC will need to design strategies to; improve current service levels for all consumer groups; and provide for the rapid increase in the urban population.

Achieving these would possibly enable productive use, and this means the provision of quantity of water that is over and above those required for mere domestic needs. Legislative framework by the governments should concentrate on ensuring productive water users are well served through the timely provision of relevant infrastructure and support services to support like 24 hour water supply. It is germane to note that some productive water uses are more water efficient than the others. The study has amongst other issues in this context revealed that the desired Willingness to Pay (WTP) for water services is higher among the Restaurant and Ice Block groups. Their overwhelming subscription to the introduction of meters indicates so, together with the possible realization that ISWC supplies could be cheaper than those from alternative sources. An average small restaurant uses 250 l/p/d of water while an average ice block maker uses 50-100 l/p/d of water. Unlike other productive uses, very limited or insignificant amount of water is wasted on these activities. Waters used here were discovered to be sourced 50 and 75% respectively from alternative sources. In other words utility supplies make up less than 40% of these supplies. Another feature common to these two groups are that they operate basically within their households levels and are practiced dominantly by women (housewives); they also represented the highest number of productive users surveyed. On the contrary, activities like Horticulture, Car Wash, Bricks/Block Making and Home Garden group have the poor reputation of wasting so much water. Despite the fact that they currently use much higher quantities of water than the average urban consumer, they are often hesitant to pay commensurate charges. They are notorious for many cases of illegal connection and disruption of water flows. They strongly opposed the introduction of meters because of the fear that it will expose their high rate of water wastage and its appropriate charges.

To sustain the positive gains of these activities there is need to ensure and enhance sustainable urban water service delivery and waste water treatment and reuse in Owerri, Nigeria; there is an urgent need to address the overall challenges which include: the creation of stable economic environment and institution of good governance at all levels of governance; improving planning, allocation and regulation; achieving economic and financial sustainability of utility investments/assets; building the capacity of stakeholders e.g. productive water users and therefore improving their socio-economic life as well as those of many others.

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

A livelihood approach to water interventions in rural areas and implications for Multiple Use Systems

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Audrey Nepveu de Villemarceau [Italy]

Among all constraints to development, water has been systematically highlighted as one of the most important challenges to rural poverty reduction in sub-Saharan Africa. Highly variable and erratic precipitations, poor development of hydraulic infrastructure and markets, and lack of access to water for domestic and productive uses, all contribute to maintaining high the vulnerability of rural people in the region. Through a recent study, FAO and IFAD have been investigating the linkage between water and rural poverty in sub-Saharan Africa. The study argues that there are ample opportunities to invest in water in support to rural livelihoods in the region, but that interventions must be targeted adequately. The key word is "context-specificity", and the main challenge is to understand where and how to invest. A comprehensive approach is needed, where investments in infrastructure are matched with interventions in institutions, knowledge and finance in ways that offer an opportunity to get the best return in terms of poverty reduction, and taking into account the extreme heterogeneity of situations faced by rural people over the region. Multiple use systems (MUS) are important in this context as infrastructure systems better address people's need than sectoral water development programmes. The paper presents the main results of the study with special emphasis on the potential of investments in multiple use systems in the different livelihood zones of sub-Saharan Africa.

Introduction

For many people, especially in rural areas where agriculture is at the core of livelihoods, water represents both a basic need and an important production asset. The roles of water, its availability in time and space, in quantity and quality, its accessibility, its control and management vary from one place to another and between users. In many cases, the vulnerability of rural people is considerable, owing to a combination of highly variable precipitations, poor development of infrastructure, lack of access to markets, credits and farm inputs and non-conducive water governance.

In order to help planning more effective water investments in sub-Saharan Africa, FAO and IFAD have joined forces to analyze the conditions required to ensure successful interventions in water in rural areas (FAO and IFAD, 2008). Basing its analysis on information available at regional level and a series of objective criteria, the study proposed a livelihood-based approach, and assessed the potential for poverty reduction through water interventions in the region. The paper presents the approach and main findings of the study, with specific emphasis on multiple use systems (MUS) that corresponds to the multiple needs for rural people to lead a healthy, fruitful life.

Guiding questions

In order to answer the question on how water-related interventions can best contribute to boost livelihoods in rural areas, the study was organized along three main questions:

- **What** is the linkage between access to water and poverty?
- **Where** is water a constraint to agricultural productivity and a priority for sustainable rural livelihoods?

- **Who** are the target beneficiaries of proposed interventions?

The first question is related to the role water plays in rural livelihoods, its relative importance compared to other issues, to questions of access, control and management. The second question implies that the importance of water is not perceived by people in a similar way everywhere. In rural areas of sub-Saharan Africa, where agricultural activities still represent the basis of peoples' livelihoods, water is perceived as a constraint in different ways in different places, in large part driven by climatic conditions, the availability of water, mainly for domestic and agricultural uses, and its importance for agricultural production. The third question recognizes the need to analyze different social and gender categories in a given community, and adapt programmes in ways that they satisfy the needs of the various target groups while contributing to greater equity and improvement of the conditions of living of the most vulnerable people.

Adopting a livelihoods approach to water interventions in rural areas

The study has adopted a livelihoods approach to development. A livelihoods approach puts people in the centre of the development process, considering the full range of ways in which people ensure their living. Contrarily to supply-driven approaches, the livelihoods approach put household demand in the forefront (Nicol, 2000). The livelihoods approach also challenges the usual sector driven approaches to consider issues in more comprehensive terms, as they are perceived by people, putting the household at the centre of the development process, and considering all the assets (or capitals) needed by the households to ensure their living. Table 1 shows issues and possible interventions in water as they relate to the five livelihoods capitals: physical, social, natural, financial and human.

Table 1. A livelihood approach to rural water development

Capital	Issues	Interventions
Physical	Availability of affordable and accessible water of good quality for drinking and other purposes, crop failure risks, access to markets.	Infrastructure for: irrigation, drinking water infrastructure, sanitation, animal watering points, wastewater treatment infrastructure. Roads and markets.
Social	Water sharing in watersheds and irrigation schemes, equity in access, need for community based asset management in irrigation and drinking water.	Improvement of community water point management, community irrigation management through water users associations, development of adequate right systems and legislation addressing specifically the needs of poor households within communities.
Natural	Land and water availability.	Enhanced through catchment's protection, maintenance of natural environment and soil fertility, pollution control.
Financial	Access to cash, credit and savings, for investment and operation and maintenance of hydraulic infrastructure.	Adapted financial services, including term loans, micro-finance, cooperatives, seasonal loans, micro-credit, subsidies and grants.
Human	Skills, knowledge, health.	Training in asset management, water resources issues, responsive approaches, community self-assessment of needs, participatory monitoring, gender mainstreaming, nutrition, hygiene.

Another advantage of the livelihoods approach is that it shows how physical (*hard*) investments, often considered as the first relevant intervention needed to address water-related development issues, are only part of a broader range of necessary actions, most of which being of an institutional or social nature (*soft* interventions).

Options for water interventions

While water control and access is not the only factor influencing livelihoods in rural areas, it often plays an important role. In agriculture, it offers security and allows farmers to plan their investments without fear of crop failure. Clean and affordable access to domestic water relieves the burden from women and girls who have to spend a considerable amount of time in fetching water. Access to a source of water to water animals or for small productive activities can have an important impact on the economy of the household, in places where water is scarce.

Adapting interventions to local conditions

Effective investments in water in rural areas require a good understanding of the range of different livelihood realities. Large differences can exist between regions in a country in terms of the way secure their livelihood, rainfall and water resources endowment, access to water, conflicts on water, market opportunities, education and knowledge levels and working opportunities for the rural poor. Such differences need to be taken into account in developing water investment strategies that match the needs and capacities of local population. The key word is "context-specificity".

Identifying target groups

The study recognises the variety of situation in which rural people operate in sub-Saharan Africa. Yet, considering that farming remains the main source of livelihood for most rural people in the region, it has focussed its attention on four main categories of people making their living mostly from farming: highly vulnerable population; traditional smallholders; emerging smallholders and large scale, commercial farmers. While arbitrary by nature, such a typology reflects quite well the situation in many countries of sub-Saharan Africa. Each of these categories contributes in different ways to the country's economy and has specific needs, summarised in Figure 1, where the level of poverty increases from top to bottom.

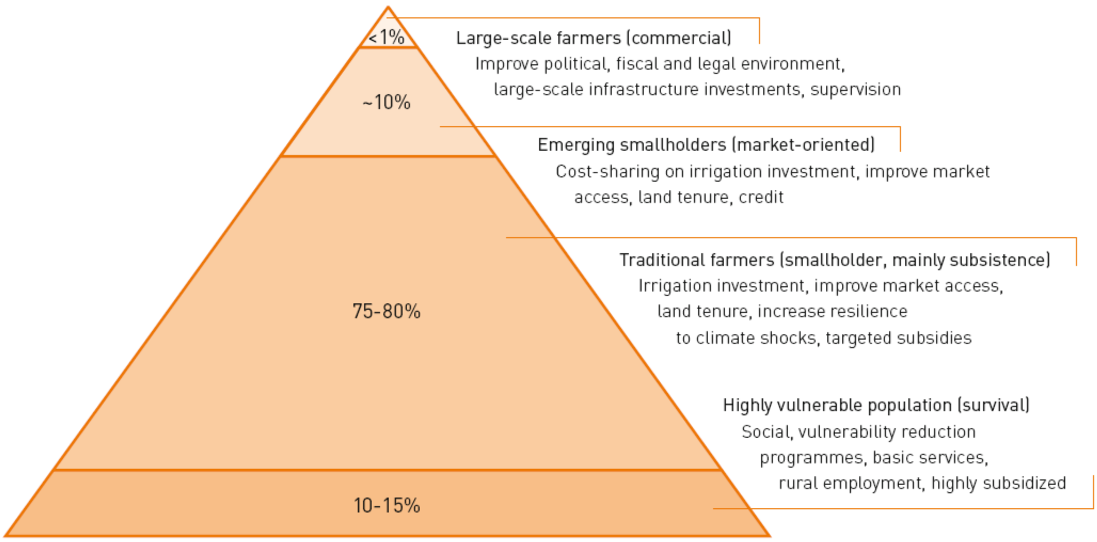


Figure 1. Adapting support strategies for farmers in SSA

Source: FAO and IFAD (2008)

Such needs can be detailed in terms of investment, financial support, policy and legislation, capacity building etc. Traditional smallholders, producing mainly staple food for their own consumption and with relatively marginal connexions to markets are thought to represent the majority of rural farmers. The study has estimated them to represent 80 percent of a rural population of about 420 million. Together with the highly vulnerable people, they represent the bulk of rural population requiring poverty reduction interventions. Half way between the traditional smallholders and emerging farmers are the very small scale producers with some connection to markets, practicing gardening, raising some livestock and having some non-agricultural home processing activities. These people are usually poor and access to a secured source of safe water often represents a major issue for them.

Adapting investments to the needs of beneficiaries

Improving water access and control includes a range of investment options to support crops, livestock, forestry, aquaculture, domestic and other productive activities. The study analyses a series a water control technologies in terms of their uses. Four categories of technologies are discussed: water capture, storage, lifting and (field) application. Table 2 (adapted from FAO, 1998) presents examples of such technologies well adapted to smallholders and the variety of possible uses.Criteria for adaptation of technologies to smallholders' conditions include operational simplicity, reduced number of users, no need for external support for operation, low maintenance requirements, limited physical and financial capital requirements. Such criteria imply that in many cases the preferred options will not be those showing the best benefit/cost ratio. Typically, simple and robust investments will have better chances of success than more sophisticated, complex systems.

Table 2. Examples of water control and water use technologies adapted to smallholders

<table>
<tr><th rowspan="2">Types of uses</th><th colspan="4">Technologies</th></tr>
<tr><th>Water capture</th><th>Water storage</th><th>Water lifting</th><th>Water use/application</th></tr>
<tr><td rowspan="2">Domestic water use (safe drinking-water, water for cooking, bathing, laundry, cleaning, etc.)
Irrigated crops, including vegetable gardening, fruit trees, etc.
Enhanced water management for rainfed agriculture
Aquaculture and inland fisheries
Livestock watering
Small industries like beer-brewing, brick making, hairdressing, or ice-block making</td><td>Shallow tubewells:
• dug wells
• drilled wells
Spring diversion
Run off the river diversion
Deep tubewells</td><td>Small dams, reservoirs
Excavated ponds (incl. integrated paddy and fish production)
Rooftop tank
Cisterns
Underground dams</td><td rowspan="2">Human powered pumps:
• hand pulleys and buckets
• hand pumps
• treadle pumps
Animal-powered pumps:
• mohte
• Persian wheel
Motorpumps
• petrol
• diesel
Solar pumps</td><td rowspan="2">Above ground:
• shallow trenches
• drip systems
• hose
• water can
Below ground:
• porous ceramic jars
• porous and sectioned pipe
Water purification methods:
• filters
• boilers
• chlorination</td></tr>
<tr><td colspan="2">Runoff farming (in-situ water conservation, incl. stone bunds, ridges, broad beds, furrows, no-tillage, infiltration pits, contour bunds, vegetative bunds, terraces, mulching)
Water harvesting (off-site water conservation: Catchment area + reservoir)
Groundwater recharge</td></tr>
</table>

Source: adapted from FAO and IFAD (2008)

Of particular interest is the range of options available to improve water control for crop production. CA (2007) has described in details the "continuum" from purely rainfed to purely irrigated agriculture, and the range of possible interventions in water control for soil moisture management. Among possible types of interventions, the study selected seven broad categories which are considered to have large potential in terms of poverty reduction. They are: soil moisture management in rainfed agriculture, small scale water harvesting infrastructure, promotion of community-based small scale irrigation, improvement of existing irrigation systems, water control for peri-urban producers, investment in water for livestock production, and promotion of multiple uses of water. Evidence shows that, when well designed, such programmes can substantially contribute to poverty reduction.

Essential conditions for success

While focussing on water control, the study acknowledged the fact that in most cases the success of water investments in terms of poverty reduction depends on a series of conditions and complementary investments in human, physical, financial, social and natural capital. Seven major conditions for success have been identified and discussed in the report. They are: enabling governance and policies; secured access to market (including good access to market information, favourable terms of trade, and access to inputs); physical infrastructure (including roads, markets, storage, processing and refrigeration facilities, affordable and reliable energy supply); equitable and secure land tenure and water rights; soil fertility management; adapted financial support packages (including, where justified, subsidies and weather insurance); and investment in human capital (in which gender considerations are of prime importance). Such conditions are considered to be as important as the water-related interventions they support.

Mapping rural poverty and livelihoods in sub-Saharan Africa

In order to analyse and understand the spatial distribution of rural livelihoods and their implications for water programmes, the study has adopted an approach increasingly used in food economy and early warning programmes (USAID, 2008). Livelihood mapping consists in identifying areas presenting some homogeneity in terms of the main sources of living for rural people. Extensively used in combination with vulnerability mapping, such maps help understanding possible sources of vulnerability among rural populations and adapt interventions in the most effective way.

By nature, livelihood mapping is not specific to any sector. However, in view of the particular importance of water, as discussed above, both for domestic and productive uses, in rural areas, such maps can be interpreted with a water focus and help adapting water interventions. Typically, *livelihood zones* are area showing homogenous and well distinguished biophysical and socio-economic determinants. Biophysical determinants include climate, water resources endowment, soils, etc. Socio-economic determinants include population structure and dynamics, culture and ethnic groupings, distance from markets, institutions and laws.

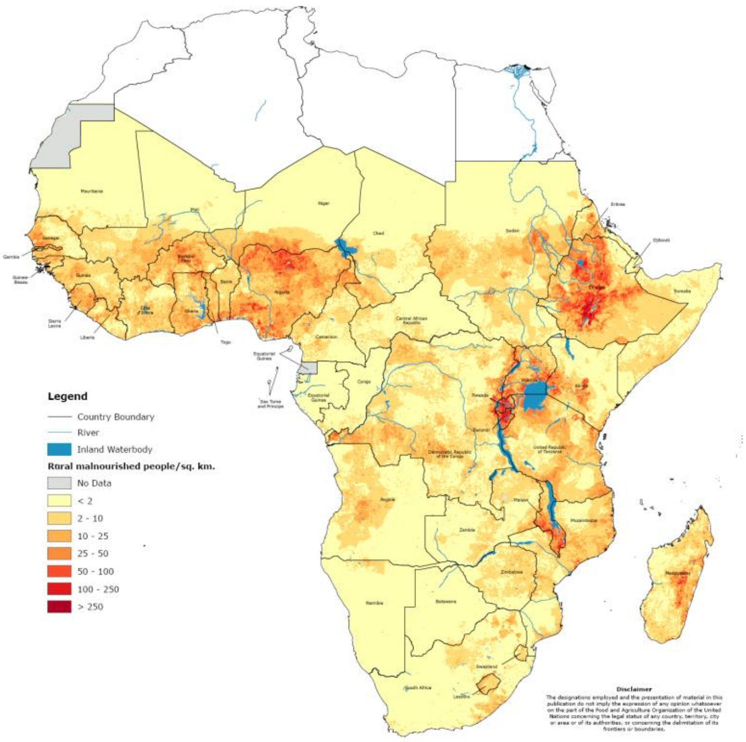


Figure 2. Distribution of rural poverty in sub-Saharan Africa

Source: FAO and IFAD (2008)

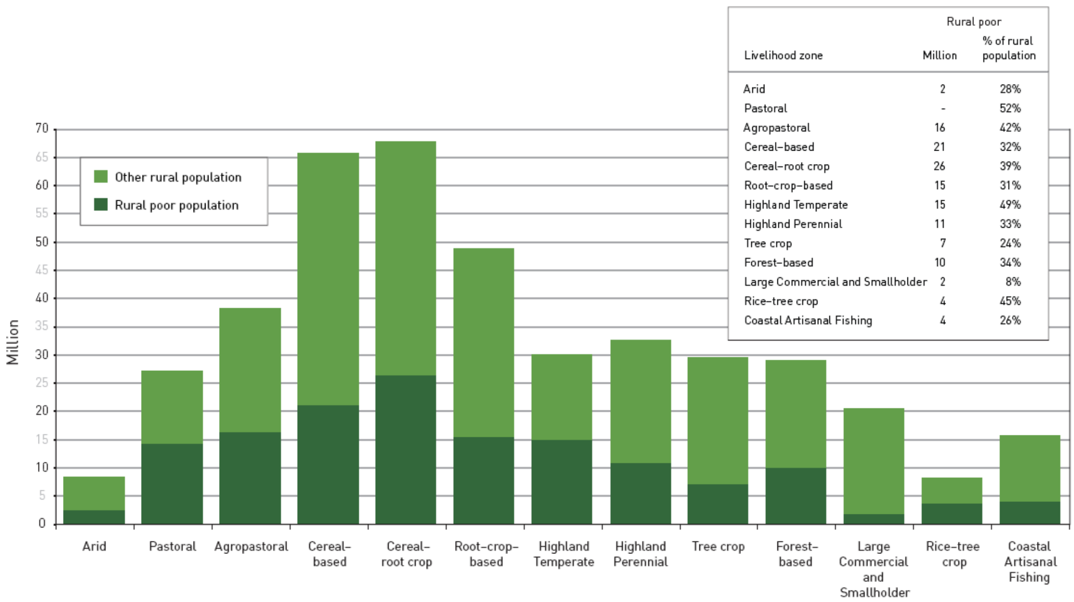
One important and relatively well known socio-economic factor is that related to population distribution and prevalence of poverty. Taking into account available information on distribution of rural population (FAO-FGGD, 2008) and district-based information on prevalence of food insecurity and child malnutrition (CIESIN, 2008; DHS, 2008), the study prepared a map of showing the distribution of rural poverty in the region (Figure 2). The map shows the particular concentration of poverty in Eastern African highlands of Ethiopia and the Lake Victoria basin as well as Madagascar, and in the Gulf of Guinea, with particular emphasis on Nigeria.

Identifying the main livelihood zones

Similarly, the study produced a map showing the main livelihood zones for the region. Based mainly on agro-climatic conditions, as indicated above, the map shows thirteen main zones, described mainly by the type of farming system they sustain (FAO and World Bank, 2001). While it is recognised that at such scale only very broad categories can be identified, and that the complexity and diversity of local situations remain, the map allows for a first analysis of water-related issues in the different zones. In addition to these 13 zones, two local but highly relevant zones have been identified. They do not appear on the map, because of their local nature, but are relevant both in terms of sources of livelihood and water issues.

Relationship between livelihoods, water and poverty

The 15 livelihood zones are described in details in FAO and IFAD (2008). For each zone, a detailed description of the importance of water is provided. Clearly, the role of water changes with climate and aridity conditions, and population density. Large parts of the continent are characterised by high vulnerability to climate variability and droughts, and water control plays an important role. In densely populated areas, the need to intensify agricultural production also calls for better control of farm inputs, including water. Figure 3 shows the distribution of rural population and prevalence of poverty in the different zones, both in absolute and relative terms.



Livelihood zone	Rural poor Million	Rural poor % of rural population
Arid	2	28%
Pastoral	-	52%
Agropastoral	16	42%
Cereal-based	21	32%
Cereal-root crop	26	39%
Root-crop-based	15	31%
Highland Temperate	15	49%
Highland Perennial	11	33%
Tree crop	7	24%
Forest-based	10	34%
Large Commercial and Smallholder	2	8%
Rice-tree crop	4	45%
Coastal Artisanal Fishing	4	26%

Figure 3. Prevalence of poverty in livelihood zones of SSA

Source: FAO and IFAD (2008)

Assessing the poverty-reduction potential of water interventions

Criteria used for the regional analysis

The study proposes a qualitative approach to assessing the potential of water-related interventions for poverty reduction in sub-Saharan Africa. Based on the context-specificity principle, and on the concept of livelihood zoning described above, it identified three levels of potential for poverty reduction: “low”, “medium” and “high”. The potential in each livelihood zone has been assessed on the basis of three criteria: prevalence of poverty (both in absolute and relative terms); water as a limiting factor for rural livelihoods (related mainly to agro-climatic conditions); and potential for water intervention (based on the potential for further development of water resources and irrigation potential). Priority for action is then obtained through a combination of the three criteria. For example, in a zone where prevalence of poverty in high and water is clearly a limiting factor, if there is enough water available for new interventions, then the zone represents a high level of priority. At the other extreme, zones with low poverty rates, areas where water is not perceived as a limiting factor and areas where there is no more potential for additional water control present few opportunities for poverty reduction through water interventions. The results indicate that the areas with major potential for poverty reduction according to the three criteria are agro-pastoral, cereal-based, and cereal-root crop-based zones, together with the highland temperate zone, host to a large share of the region’s rural poor. Areas with abundant precipitation and water resources show low potential for poverty reduction through water control investments, while other regions are classified as “moderate”.

Assessing investment potential for MUS

In its final stage, the study assessed investment potential for the seven types of possible interventions described above. After having assessed the relevance of each intervention for each livelihood zone, a simple and transparent calculation was performed to assess, by zone, the potential for investment in these seven types of interventions. The potential was expressed in hectares for rainfed soil moisture management, small scale irrigation, irrigation improvement, and peri-urban water control, in heads of livestock for livestock watering, in Mm^3 of storage for water harvesting infrastructure and in number of households for multiple use systems. Average unit costs were assigned to each type of intervention, and the potential, later expressed in number of beneficiaries, was calculated using the three criteria described above. Details of the computation method are presented in Annex 2 of FAO and IFAD (2008).

Multiple Use Systems (MUS) play an important role in livelihoods of sub-Saharan African households (IFAD 2007). When possible, investments that provide water for more than one household purpose are likely to be more effective than single-purpose investments in improving livelihoods (Renwick, 2001). Different typologies of MUS that meet the livelihood needs and conditions of rural people in sub-Saharan Africa have been described by Boelee, Laamrani and van der Hoek (2007):

- agriculture-related purposes, such as irrigating home gardens, watering livestock, washing agricultural equipment, and soaking fodder;
- domestic purposes, such as laundry, bathing, washing household utensils, soaking grains, cooking, drinking, house cleaning, and sanitation;
- commercial purposes, usually small-scale activities or home industries, such as brick making, butcher’s or other shops, washing vehicles, pottery, and mat weaving;
- productive purposes, usually non-consumptive, such as fisheries and water mills;
- recreation.

Clearly, MUS are expected to have more potential in the pastoral and agropastoral livelihood contexts where water is scarce and unevenly distributed in time and space. In these areas, all activities, including irrigation, livestock watering, domestic and other productive activities are constrained by water scarcity. MUS also offer positive opportunities in terms of enhanced equity, as it tend to benefit women, girls and vulnerable people more directly than better-off farmers (IFAD 2007).

Assessing the potential for multiple use systems in sub-Saharan Africa was particularly difficult. The study relied on estimates provided by Renwick et al. (2007), where several levels of multiple uses systems are proposed. Unit cost was assessed on the basis of regional investment estimate for “Domestic+” systems as estimated by Renwick et al. (2007) for sub-Saharan Africa, and considering one system per household. An average unit cost of 75 US$ per household was obtained for MUS. In total, it is estimated that about 44 million households or 220 million persons could benefit from investments in MUS in rural areas, which corresponds to 52 percent of the rural population of the region. Investments in MUS would require 3.3 billion US$, about 4 percent of the total investments of the seven types of interventions. The livelihoods zones where MUS investments would be highest are 1) cereal-root crop-based, 2) agro-pastoral, and 3) cereal-based zones, characterised by a combination of poor access to water, high population density and prevalence of poverty, and where it could potentially reach 90 percent of the rural population (Figure 4). Instead, in well water-endowed areas, the potential of MUS is thought to be less than 10% of rural population, given the availability of alternative sources of water for most activities. It should be clear that such figures must be considered only as indicative, and as an order of magnitude of the potential for investments in MUS in support to rural poverty in the region.

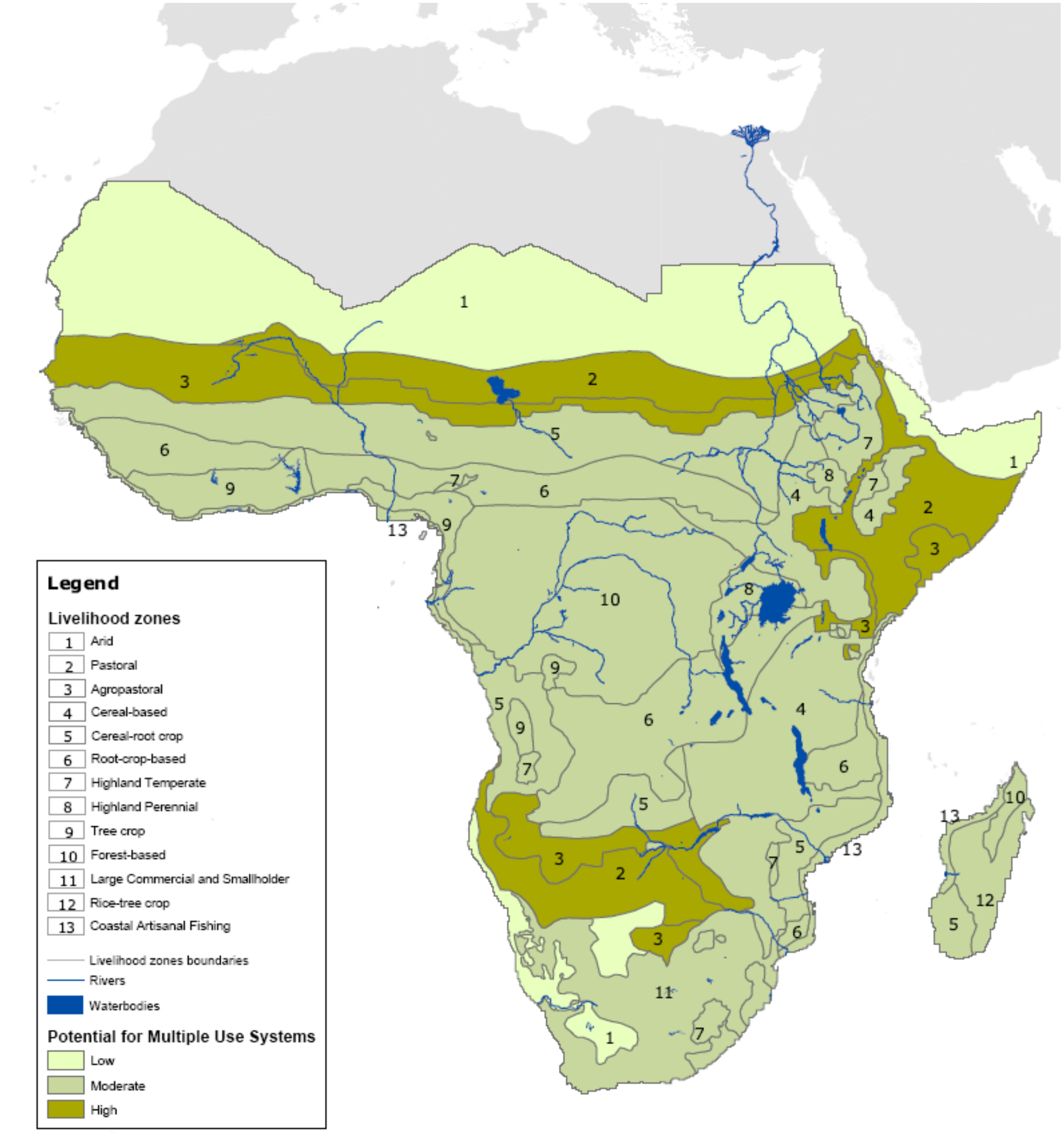


Figure 4. Potential for Multiple Uses Systems across livelihood zones in sub-Saharan Africa

Conclusions

For many rural poor in sub-Saharan Africa water remains an important element of livelihood. Reliable and affordable access to sufficient domestic water supply and to sanitation satisfies basic household needs, helps improving health and hygiene, and reduces the drudgery of female household members. For crop production, the main source of livelihood for most rural people in the region, a better control of soil moisture is often the first condition for enhanced productivity, and it is an effective way to reduce vulnerability to climate variability. Animals, small and large, play an important role in household economy, food security and improved nutrition, and access to water for them is therefore important. Along rivers and lakes, people make a living out of inland fishery, the importance of which is usually largely underestimated. Local economies in rural areas are not made only of farming, and many people need water to satisfy the needs of their small industries, whether agro-processing or not.

Water-related programmes tend to be sectoral, with water supply and sanitation as a major MDG-related target on one side, and water control for agriculture (mostly irrigation) in support to food security and poverty alleviation on the other side. In agriculture, in particular, regional programmes focus on the achievement of a physical potential, with the objective of doubling irrigation in the region (NEPAD, 2002; Commission for Africa, 2005), but with little connexion with the demand, be it in terms of agricultural products or in broader terms of poverty alleviation. This study has attempted to consider water-related investments from the user's perspective, using the livelihood approach to address water issues in all its dimensions.

A demand-driven approach to water investments in rural areas of sub-Saharan Africa has been developed, where population number, and in particular the rural poor, is combined with freshwater endowment (precipitation, water resources) to assess the demand for interventions that enhance access, control and management of water resources. In so doing, the study emphasises the necessary context-specific aspect of water programmes, and shows how demand varies across livelihood zones. While recognising the importance of water, the study also stresses the importance of enabling environment to ensure the success of water interventions. It stresses the need and importance of "soft" measures, as a condition for success of "hard" investments, including governance, policy, institutional and capacity-building environment. It also stresses the need to match investments in water with investments in other infrastructure, including markets and roads, in order to generate added value locally and increase the impact; and, for the agriculture sector, the need to combine investments in water control with investments in soil fertility enhancement, a problem of major importance in sub-Saharan Africa.

Multiple use systems, in particular those that build on domestic water supply systems and developed to serve other uses ("Domestic +" systems), play an important role in promoting household-level income-generating activities. Likewise, "Irrigation +" systems, because they mobilize important quantities of water, have the potential to develop and serve additional water needs that comparatively represent a small amount of water. Both types are perfectly in line with a livelihood approach which offers a comprehensive approach to water programmes at household level. Like for other investments, the demand for MUS depends on local conditions, and in particular alternative sources of water available to households (springs, rivers, lakes).

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Multiple Functions of Water Management in Paddy Fields

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Water for agriculture in the paddy area of Asia monsoon regions is not just considered as an economic resource of individual farmers, but is thought to be a common resource shared by a whole rural community and a part of the people's lives. Paddy field irrigation has characteristics not only of negative externalities but also of positive externalities, such as flood prevention and ground water recharge. This paper introduces the multiple uses and functions of water for agriculture in the paddy area of Asia monsoon regions. It maps the high value generated from paddy farming in Asian countries and how this is critical for many communities in addressing the challenges of "Food security and Poverty Alleviation" and "Sustainable Water Use".

Asian Rice Based Systems and World water issues

In the Asian monsoon regions, populations have been dramatically increasing and a consequent increase infood production is urgent and important. Rice is the staple food in the region and has supported the population for long years. However, since available fresh water for the increase of rice production is limited by competition for water with other sectors, sustainable water use should be promoted and more efficient management with better governance introduced at local level.

It is now widely recognized that paddy fields are fully part of the wetland realm. In the Ramsar Convention classification they are classified as human-made wetlands (Ramsar, 2006). This recognises that the beneficial outputs generated by rice based aqua-ecosystems go much beyond crop production (Renault and Facon, 2004) to providing various functions including other productive function such as fisheries and perennial home stead vegetation, support to the environment, flood mitigation, recharge of groundwater, purification of water and conservation biodiversity. In the Asian monsoon regions, paddy farming and its water use not only contribute to food production but also provides broad-based services for communities, traditions and culture and environment.

These multiple roles of paddy farming should be properly recognized and appreciated. Moreover, it should not be overlooked that paddy farming is mutually dependent with local communities, culture and environment. Those features should be naturally taken into account in managing and developing water resources. These recognitions and considerations should lead to the sustainable development in agriculture and rural areas.

Ways of farming and irrigation in the world are diverse. However, there are always common features; that is, an established farming style is closely associated with the indigenous climate, nature, communities and culture in each region. Therefore, it is important to understand the features and the background of the irrigation style in each region when we discuss water issues.

Multiplicity and complexity of uses in rice-based system

Past international water debates on paddy farming have often been loaded with incomprehension, many pointing out the high water withdrawals of rice systems without taking into consideration the return-flows of the paddy cascade system and the dimension of multiple services in rice-based system. A fundamental of rice systems is that out of the withdrawal the fraction which is really consumed by the crop through evapotranspiration is minimum, figures as low as 25 % are not unusual which means that a large part of the withdrawal goes to uses other than the crop including of course drainage return to natural streams.

Thus the use of water in rice based system is diverse and complex. Of course these specificities complicate the introduction of any modern managerial methods such as water pricing. Questions such as what services to what users at what cost, are not as straightforward as compared to single use systems. The issues of characterization of all water uses, of identifying proper representatives of all users and putting in place effective approaches for participative governance of such complex systems needs to be considered seriously at both national and local levels.

Addressing externalities

As with many other human activities the process of paddy farming generates both positive and negative externalities which need to be fully identified and seized (Boisvert et al, 2003). The multiple uses and functions associated to paddy farming are the positive externalities of the process. Negative externalities can be specific to paddy farming or relevant to agriculture practices in general: indiscriminate use of pesticides, inefficient use of fertilizers, clearing of flooded forests and destructive fishing gear, emissions of carbon dioxide, methane, nitrous oxide and ammonia.

As far as food security is concerned rice development must be approached as an ecosystem that provides the habitat with a variety of organisms (e.g. fish and insects) often used by indigenous people. This multi-product dimension is no doubt an important opportunity to alleviate rural malnutrition and poverty.

In the debate on externalities, talking in general of “paddy farming” is somehow too much a simplifying process, many things depends on local practices and contexts. There are situations where paddy farming causes major problems which need to receive proper treatments (e.g. ‘water pollution caused by Rice Farming in Thailand’ see INWEPF 4th Steering Meeting and Symposium, 2007). There are other contexts where the overall balance is much more on the positive side and that needs to be accounted for when it comes to decision on agriculture and water management.

Paths for water management improvements in rice-based systems

Discovering and recognizing the diversified values of rice ecosystems is no reason for complacency. There is room for improving water management in both technical and economic terms. In fact, MUS is a very important opportunity for most rice-based systems to find various ways of valuing water and to come up with acceptable solutions for bearing the cost of the operation and maintenance of water management.

As mentioned previously, however, the systems of paddy farming are complex and very diversified and thus do not require the same path of modernization. In simple terms, a modern water management service is one adapted to users' demands and to their willingness to pay. Thus the first step in embarking toward modernization is to acknowledge or identify the various functions or services that the rice system already provides or is expected to provide and corresponding users.

The second step would be to improve the capacity of stakeholders in valuing and planning techniques; defining the management objectives related to the various roles and values of water; setting water management strategies; operating rules; management arrangements (including contributions by various stake-holders); and design features.

In a sense, the recognition of these different values of water in the rice systems is a pre-requisite for moving towards integrated water resources management.

Features of Asian monsoon regions

Important features of Asia monsoon regions and rice cultivation are summarised below.

High precipitation

The top ten rice-producing countries in the Asian monsoon regions have more than 1500-mm of annual precipitation while many of the Western countries and upland farming regions have less than 800-mm. The rainfall in the Asian monsoon regions is not constant throughout the year but extremely fluctuating seasonally.In these regions, the season is clearly divided into rainy and dry. Excessive rainfall and runoff in the rainy season brings about flooding and a broad swath of inundation, which recharges groundwater and river flow and thus forms distinctive and sound water cycles of the regions.

High rice production

With the above-mentioned features of rainfall and flood, paddy farming has been dominant agriculture in the regions. The ratio of rice producing area is very high and the area occupies 75 percent of the total grain producing area in the fourteen countries of the regions. Rice production in Asia amounts to 600 million tons and occupies 91 percent of the total rice production of the world. Paddy farming has been historically maintaining the water cycles which were originally formed by inundation under the natural conditions through seasonal flooding. It has coincidentally sustained the rich aquatic environment of the regions.

High population

The population of the fourteen INWEPF member countries in the Asian monsoon regions is about 2.1 billion and occupies about 30 percent of the world. Meanwhile, the cultivated area per capita of Asia is only 0.15 ha while that of the world average is 0.25 ha. These figures show that the paddy farming has good capacity in supporting population.

Multiple functions of paddy farming

Multiple functions of paddy farming which has been made by the climate, nature, communities and culture are as the follows.

Rice production

The primary task of the paddy field is, naturally, rice production. In other words, paddy fields have sustained high productivity for thousands of years. In order to maintain this high productivity, farmers have tactfully utilized rainfall which varies short to excess throughout the growing season of rice. Stored water in the paddy field also prevents salinization and accelerates fixing nitrogen from the air.

Fisheries production

Many rice based system are associated with fish production either in the field itself or in the water infrastructure (reservoir and ponds). This additional production represents in some cases a significant source of protein for the population and complement well the nutrition inputs from the rice (Halwart and Gupta, 2004), as well as a source of incomes for fishermen. In one of the well referenced rice based system in Sri Lanka (Kirindi Oya) fish activity represents about 20 % of the rice production gross value (Renwick, 2001).

Domestic water

In many rural areas of Asian developing countries there is no domestic water network, and thus irrigation canal water or shallow groundwater are the only sources of domestic water for people living in the area. Clearly in these contexts, irrigation water and paddy farming contribute to support population access to domestic water. In this contexts the closure of canals generates deterioration of the sanitary conditions of the population.

Sustaining homestead garden

Some irrigated rice based systems have progressively allow the development of a very rich perennial vegetation in natural landscape as well as in homestead garden within the command area which would not being possible with rainfall only. Although not often converted into monetary terms, the associated values are of high importance for the population (cool air – medicinal trees – construction material – food – biodiversity- etc.) (Renault et al, 2000).

Flood mitigation

A large amount of rainfall and the runoff caused by the heavy rains in the upstream is trapped in the paddy fields downstream and run down very slowly from them. Stored water in paddy fields could mitigate damages caused by flood and protect human lives and properties in the downstream act as a dam.

Prevention of soil erosion and slope failure

Since the surface of paddy field is quite even and covered with the stored water, soil erosion scarcely occurs in paddy fields, which is usually caused by rainfall or shallow flows on the field surfaces. The paddy fields of which ridges and slopes are well taken care prevented from soil erosion and slope failure.

Recharge of river flow and groundwater

Stored water in the paddy fields gradually permeates into ground or through out to the river. Thus, stored water in the paddy fields functionally recharges groundwater and stabilizes river flow, resulting in sound water cycles.

Formation of aquatic environment

Paddy fields, surrounding reservoirs and canals should be considered to form "wetlands" as aquatic environment, linked with rivers, lakes and ponds. These wetlands formed by the paddy fields provides rich habitats for the living things concerned, such as freshwater fish, insects and birds, together with the adjacent forests and country areas.

Formation of culture and traditional events

Farmers living in the same paddy farming area have historically had to cooperate with each other, effectively using irrigation water from the paddy field upstream to downstream for transplanting, harvesting and so on. Their water management, such as allocation of water and maintenance of irrigation structures, has inevitably formed their own communities. The water management has also brought about the traditional events and ceremonies through which farmers pay great respect to or worship the nature bringing rain and floods. In some villages, the rules of the society and/or the roles of farmers in the society have been established through those customs of water management. Thus, the paddy farming not only established modern paddy farming but also formed communities and cultures in the regions.

The economic evaluation of those multiple functions of paddy fields in Japan

Part of the result is shown inn the table, which was under consideration by a special committee of Science Council of Japan. The evaluation shows that it seems to be huge economic value in the multiple functions of paddy fields. It is important to evaluate the multiple functions of paddy fields, therefore, we think that it should be considered more detail from now on.

Function category	Annual cash value (billions of yen)	Evaluation method
Flood mitigation	3,498.8	Evaluation of cost of flood mitigation dams to achieve same effect(substitution method)
Prevention of soil erosion	331.8	Evaluation of cost of Sabo mitigation dams to achieve same effect(substitution method)
Prevention of slope failure	478.2	Evaluation by the amount of damage prevented by cultivation (direct method)
Recharge of groundwater	53.7	Evaluation of cost of water relative to ground water (substitution method)
Restoration of body and mind	2,375.8	Evaluation of expenditure from household budgets for travelling to, from the city, other locations (substitution method)

Source: Science Council of Japan

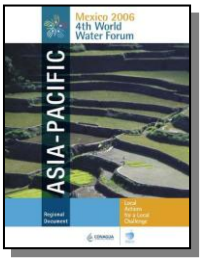
Activities of INWEPF

Finally, we introduce the International Network for Water and Ecosystem in Paddy Field (INWEPF) established in 2004 in Asia region. INWEPF has provided International forum to realize the three challenges of the Ministerial Recommendation on Water for Food and Agriculture in WWF3 by promoting dialogue, exchanging knowledge and experiences, creating synergy among existing forums and strengthening capacity building in agricultural water management in paddy fields with due consideration for environmental aspect.

Specifically INWEPF attended international conference such as 4th World Water Forum, 1st Asia-Pacific Water Summit, and has done transmission of information to all over the world.

4th World Water Forum in Mexico

INWEPF participated in the forum convening topic session titled “Sustainable paddy water use and its multi-functionality with better governance” held at March 20 of 2006, 4th day of the forum, chaired by Dr. Keizrul bin Abdullah. And the message from INWEPF to 4th World Water Forum was reported.



> Protecting zones at the land-water interface like mangroves, paddy fields, wetlands, and forests not only increases ecosystem health, but may also provide extra protection against some disasters and saline intrusion, help groundwater recharge, and improves quality of life.

A part of report on 4th World Water Forum

1st Asia-Pacific Water Summit

INWEPF participated in the forum at the priority theme C "Water for Development and Ecosystem," over the last decade, more emphasis has been placed on establishing sustainable water management practices. The delegate of INWEPF published the message from INWEPF at the forum.

Policy brief which is the result of summit includes the importance of multiple functions of paddy fields.

Delegates published the message from INWEPF

> 70. Recognizing and managing the multiple roles of irrigation water. In addition to food, irrigation systems in the region also provide water for farmhouses, habitats for fish and other aquatic resources, rural enterprise water supplies, domestic water, hydroelectric power, and navigation. It also supports important cultural values that are essential for local wellbeing and livelihoods. Ecological benefits include flood control, groundwater recharge, water purification, biodiversity conservation, and climate adjustment. Policies that recognize and promote the multi-functionality of irrigation water can improve food security, health and sanitation of local communities, and benefits to society as a whole.

A part of Policy brief

Conclusions

Positive multi-functions of paddy farming are introduced in the paper while also recognition is made of possible negative impacts to the environment. The important point is to recognize and appreciate these externalities both positive and negative, and to enhance to preserve the sustainability of paddy farming by achieving sustainable, effective, and equitable water allocation.

Improving the performance of these rice based system is often possible as long as we consider the full dimension and complexity of multiple uses. The paradigm shift is from “Crop per Drop” to “Multiple Values per Drop”. This certainly does not simplify the task of the decision makers and developers confronted to investment in water and natural resources, but obviously the high efficiency of these multiple uses of water system has to be fully considered. The challenge is how to put these sometimes quite long history sustainable practices into a world of competition on natural resources and environmental concerns and to serve properly and in the most cost effective way an ever increasing population.

INWEPF created in 2004, will keep trying to collect and disseminate the information needed for sustainability of paddy farming, modern management approach as well as good governance of such multiples uses systems. INWEPF will continue to emphasize the multiple values of paddy farming in particular for rural poor contexts where generating all the values provided by paddy farming by other means would be by far too costly and thus out of reach. INWEPF believes that MUS in rice based system is a chance for the most vulnerable people of rural areas and for modern countries to preserve a system that provides usually a positive balance of services.

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Keywords

Asian monsoon regions, Rice based systems, Wetlands, INWEPF.

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Poverty impacts of improved access to water and sanitation in Ethiopia

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It is often argued that investments in water supply and sanitation (WSS) generate wide-ranging economic benefits. At the household level improved access to WSS is expected to lead to significant improvements not only in human health and welfare but also in levels of production and productivity. Investments in WSS are therefore considered important instruments for poverty reduction, but empirical evidence to support this remains quite limited. This study presents micro-evidence from a survey of 1500 households in Ethiopia on the economic impacts of improved access to WSS. We found that access to improved WSS has a strong statistical association with increased household water consumption and decreased average time spent to fetch water. Because of this time saving, household members with access to improved sources were also found to be more likely to participate in off-farm/non-farm employment. We also found strong evidence of positive impacts of improved access to WSS on health; although there are indications some type of illnesses may also have increased (e.g. water borne diseases). This evidence clearly shows that improving access to water supply infrastructure alone is not sufficient to bring about desired public health benefits. Interestingly, households with access to improved water supply and agricultural water were found to have significantly lower overall and food poverty levels in terms of incidence, depth and severity of poverty. Therefore, the pathways through which improved access to water supply has impacted poverty reduction in the study areas had to do with direct improved health benefits and through time-saving benefits induced increased participation of households in off/non-farm employment and irrigation. Determinants of off/non-farm employment and poverty were systematically analysed and factors identified and recommendations made to enhance these poverty impacts of water supply improvements.

Introduction

At the macro level, water sector investments can be an engine for accelerated economic growth, sustainable development, improved health and reduced poverty. Improved water resources management and water supply and sanitation contribute significantly to increased production and productivity, and recent studies indicate that poor countries with access to improved water and sanitation services have enjoyed annual average growth of 3.7% of GDP, while those without adequate investment saw their GDP grow at just 0.1% annually (SIWI, 2005). Furthermore, investments in the water sector can generate economic benefits that considerably outweigh costs and contribute to human development (Ibid.). Hence, interventions to reduce poverty and bolster economic growth will be more effective if they explicitly include measures to improve people's health and livelihood systems.

At the micro level, improved WSS leads to considerable time savings and increased livelihood opportunities for the poor, as well as education and health gains (Slaymaker, et al., 2007, Howard & Bartram, 2003). More time and better health reduce poverty because of the greater opportunity for employment, and increased productivity of labour. The opportunity costs of time spent accessing water may be considerable not just in terms of income generation or school attendance, but also reproductive tasks such as caring for children and the elderly, all of which affect the overall health, welfare and productivity of the household (Magrath & Tesfu, 2006). However the potential poverty impact of improved WSS access seems to depend heavily on the availability of other livelihood assets e.g. land, labour, livestock, credit, and local markets (Moriarty, et al., 2004).

While the expected poverty impacts of investments in WSS on poverty are considerable, there is still limited empirical evidence in the current literature. At the macro level, a positive relationship is seen across countries between per capita income and access to WSS (e.g. UNDP 2006: 35-36). This may in part reflect a causal effect of better access to WSS on productivity and income. This theory has been largely untested, but indirect support is found in studies which find a positive relationship between initial levels of health, and subsequent rates of economic growth across countries (e.g. Sachs and Warner 1997; Barro and Sala-i-Martin 2005). For more direct evidence, we must turn to studies at the country or regional level.

There is strong evidence that collecting water limits the amount of time spent by women in productive employment (see for example Ilami and Grimard, 2000 on Pakistan). Improving the quality of water sources may also be important for raising productive employment. Across villages in rural Tanzania, Mduma and Wobst (2005) find a positive and statistically significant relationship between the proportion of households supplying labour to the labour market and the proportion that have access to safe water. There is also evidence from a countries in Africa, Asia and Latin America that access to WSS reduces child mortality (Fuentes *et al*, 2006; Guillot and Gupta, 2004; Abou-Ali, 2003). Finally, several studies on demand for water at the household level have explored the effect of access to water on household welfare. These studies are generally grounded in standard microeconomic theory, adapted to reflect the special features of water as a consumer commodity.

Objectives of the study

The objectives of this study were to characterise existing WSS coverage and factors influencing access to improved services; and to understand the effects of improved WSS access on different aspects of poverty. This study goes beyond assessing the impacts WSS on health to examine: the incidence of water-related diseases among households with and without access to improved WSS; the relationship between household WSS access and participation in off/non-farm employment opportunities; and whether improved access to WS and access to irrigation has led to a significant reduction in overall levels of poverty.

Data and methodology

Data and sampling strategy

The household survey was conducted during October- December 2007 on 1500 households in 2 woredas (districts) in Eastern Hararghe zone, Oromia Regional National State, Ethiopia[2]. Stratified random sampling by agro-ecology, distance to market and presence of improved WSS was used to select 20 kebeles (villages) from these woredas. 75 households were randomly selected for surveying in each kebele. Detailed data was collected on WSS facilities and access, household demographics, household assets, income from diverse sources, consumption expenditure, incidence of different illnesses and village-level factors such as access to market and other services. This study is part of a comprehensive study by the project, the WSS-poverty nexus is just one aspect of the study whose results are reported here.

Estimation approaches

A variety of approaches from descriptive statistics to regression analysis were used to describe the current situation and establish the links between WS and different welfare outcomes. To model the probability of a household member being ill as a function of various covariates we used a binary choice model, where the dependent variable is whether a household member is reported sick or not and the explanatory variables included individual characteristics (age and sex of the individual), household related variables (such as family size, number of children under five, number of seniors), access to improved water supplies, sanitation behavior (e.g. ownership and use of pit latrines), and village level factors representing access to health and other services. Similarly, we modeled the level of health expenditure incurred by a household, using variants of censored regression models. The rationale is that the health expenditure variable is a censored variable requiring another estimation strategy than the usual ordinary least squares (Verbeek, 2000). The vector of explanatory variables influencing the level of expenditure include patient characteristics (such as age, sex, etc.), type of illness1, household's ability to pay (measured by its asset endowments such as average land and livestock holdings and average household income), and access to health services as measured by distance to health centre and all weather roads. To overcome the structural restriction imposed by the Tobit model (see Verbeek, 2000), we also estimated a truncated regression model by taking only the positive expenditures and identified the determinants of positive expenditure.

To estimate poverty, in this paper we used expenditure adjusted for differences in household characteristics. We used the Foster-Greer-Thorbecke (FGT) class of poverty measures to calculate poverty indices as these indices are said to have some desirable properties (such as additive decomposability), and include some widely used poverty indices such as head-count poverty gap and severity measures (Foster et al., 1984); Duclos et al., 2006). We calculated these indices using STATA 9.0 and tested for differences in the poverty profiles of households with and without access to an improved water source, as proposed by Kwakani (1993). The consumption poverty line was set at ETB 1821.05 (Ethiopian birr) (US$1=ETB9.2), an inflation-adjusted poverty line based on the official poverty line of ETB 1075 set in 1995/96 by the Ethiopian government (MOFED, 2006). An inflation-adjusted poverty line of 1096.03 was also used as an absolute food poverty line, based on the corresponding 1995/96 official food poverty line.

An analysis of poverty would not be complete without explaining why people are poor or remain poor over time. In microeconomics, the simplest way to analyse the correlates of poverty is by a regression analysis against various factors (see Coudouel et al., 2002; Wodon, 1999). In this regression, the logarithm of consumption expenditure (divided by the poverty line) is used as the left-hand side variable. The right hand side variables in the regressions include: (a) household characteristics household head, including sex, level of education (read and write or not, arithmetic skills), age and number of dependents; (b); asset holding: livestock size (in Tropical Livestock Unit) and farm size, adult labour (by sex); (c) access to different services and markets: credit, non-farm employment, improved water supply and health. Access to market was proxied by distance to woreda (local) market, distance to all weather roads. Access to WS was measured by whether the household reported improvement in WS during the last five years (0/1); and (d) village level characteristics mainly kebelle dummies to control for village level covariates.

The estimated coefficients of the poverty regression are partial correlation coefficients that reflect the degree of association between the variables and levels of welfare and not necessarily their causal relationship. The parameter estimates could be interpreted as returns of poverty to a given characteristic (Coudouel et al., 2002; Wodon, 1999) while controlling for other covariates. We used survey regression techniques to account for the stratified sampling technique and, hence, adjusted the standard errors to both stratification and clustering effects (Deaton; 1997; Wooldrige, 2002) and thereby dealt with the problem of heteroskedasticity. We also tested for other possible misspecifications (e.g. multicollinearity) using routine diagnostic measures. Furthermore, while poverty could be influenced by the state of health of members within the household, including such a variable in the poverty equation risked causing an endogeneity problem. To correct for this we used an instrumental regression model, using the predicators of health expenditure to control for health effects.

Results and discussions

Access to improved WSS

The data show that households in both woredas obtain water from protected and unprotected sources, and typically rely on multiple water sources for different uses (see Table 1). It is interesting to note that a significant proportion of water drawn is for non-household use. These non-domestic uses are rarely factored into scheme design, and have important implications for sustainability. They also suggest that the benefits of improved access extend far beyond human health, the main traditional justification for WSS interventions.

44 % of the respondents in Babile and 35% in Gorogutu indicated that they had experienced major changes in water supply over the last 5 years. The new systems were widely perceived as having resulted in increased supply of water, improved water quality, shorter distances and increased awareness of sanitation and hygiene, and were considered to provide good quality water on a reasonably reliable and accessible basis. At the same time, we note that continuous service is achieved in only 60-69% of systems, reflecting the challenges of delivering effective services on a sustainable basis in this area, and that use of unprotected

[1] Type of treatment was excluded from the list of explanatory variables as we found it to be highly correlated with type of illness and type of health facilities visited.

sources still predominates in both woredas. We also found that investments in new water points were more likely in relatively well-connected kebeles, while kebeles far from roads were less likely to get water points. Moreover, communities located in highlands were more likely to be targeted that communities in lowland altitudes, where water shortage is more severe. This may show a problem in targeting.

Table 1. No of users from different types of sources (By use type)

System	Drinking and other household uses		Non-household uses	
	Babile (n= 1,608)	Gorogutu (n= 4,199)	Babile (n= 1,577)	Gorogutu (n= 5,838)
Household connection	0	21	1	39
Public stand pipe	106	669	73	704
Community borehole	914	359	590	263
Household boreholes	3	25	5	17
Protected community well	22	30	26	41
Unprotected community wells	460	145	609	205
Protected household well	0	0		2
Unprotected household well	6	0	11	6
Stream	56	0	150	662
Community pond	11	123	46	400
Dam		13		26
Household pond	0	7	14	20
Others	30	2806	52	3453
Pearson chi2	**39.2968 *****			

Note: *, **, *** significant at 10, 5 and 1% respectively.

We examined access to sanitation by looking at changes in sanitation services and waste management strategies. About 40% of households in Babile and 30% in Gorogutu have their own latrines but considerable proportions do not use them and continue to defecate outdoors. This has important implications for sanitation policy and programming and suggests that access to infrastructure alone is not sufficient to bring desired improvements in public health.

We also explored the major health problems in the two woredas. Diarrhoea (including its acute form, dysentery) accounted for 49% of health problems and malaria for 27%; together with respiratory diseases water-related illnesses make up the bulk of illnesses reported. These findings are important and suggest that isolated efforts to improve access to WSS infrastructure are not sufficient to reduce water-related diseases.

Statistical association between improved water supply and welfare indicators

We explored the statistical association between access to improved water supply and different welfare indicators (see Table 2). This gives indicative insights into how improved access to water supply could influence household welfare, before systematic analysis is done to establish cause -effect relationships.

Improvements in access to water supply were found to have a strong statistical association with increase in volume of water collected (7 litres per day) per household and decrease in average distance travelled to a water source. Both are expected to lead to significant time savings (about 3 minutes per trip), which are expected to increase household members' participation in productive engagement. Indeed, we find a strong association between improved access to water and participation in off/non-farm, although the average number of days engagement is higher in households without access to improved source.

Interestingly, we found that households with access to improved water sources have significantly higher consumption expenditure per adult equivalent than those without access, and are less likely to have faced food shortages, and likely to have experienced them less frequently, during the last five years. Furthermore, income from livestock sales was found to have a significant association with improved access although agricultural income was not significantly associated with access to water from protected source. We also found significant association between improved access and illness and missing jobs/school because of illness. The pathways through which improved access may impact on household welfare thus seem to relate a combination of direct health benefits, time-saving induced increased participation in off/non-farm employment and livestock income than to crop productivity.

Table 2. Association between improved water supply and some socio-economic variables

Variable name	Protected source (n = 720)	Unprotected source (n= 1,234)	p-value*
	Mean	Mean	
Average distance (in minutes single trip)	20.34	23.86	0.0006***
Quantity of water fetched (in litres per day)	55.82	48.71	0.0000***
Illness (0/1)	0.526	0.546	0.029**
Participation in productive engagement	0.44	0.41	0.007***
Miss job because of illness (last year)	0.389	0.366	0.010***
Miss school because of illness (last year)	0.097	0.118	0.000***
Per capita income (in ETB)	943.97	1827.54	0.2049
Per capita crop income (in ETB)	749.9	1681.12	0.1815
Per capita livestock income (in ETB)	128.89	152.66	0.0522**
Per capita agricultural income (in ETB)	620.54	1527.48	0.1930
Per capita non-farm income (in ETB)	193.64	145.88	0.0158**
Number of working days engagement in a year	128.32	147.23	0.0143**
Number of working days missed because of illness in a year	68	80.91	0.1379
Income loss due to illness (in ETB)	389.93	494.51	0.3112
Number of school days missed because of illness in a year	46.32143	58.54	0.2791
Medical expenditure (in ETB)	197.67	200.62	0.9062
Annual consumption expenditure per adult equivalent (in ETB)	2272.59	1262.102	0.0029***
Faced food shortage (no of households)	270	726	0.000***
Frequency of food shortage	2.31	2.348011	0.0102***

* Two-sided test of equality of means/proportions, ETB= Ethiopian Birr.

Exploring linkages

Improved water supply and health

We ran three separate regressions for what we called water related illnesses, non-water related illnesses and all kinds of illness, in the latter case we pooled the data for water and non-water related illnesses. We found that the probability of being reported ill in any kind of illness decreased with access to improved source showing that households that have access to water from an improved source were less likely to fall ill. The probability of illness, on the other hand, increased with distance to the source. When we disaggregated illnesses into water related and non-water related ones, the results are mixed. In this case, probability of falling ill in water related diseases increased with access to improved source and decreases with distance to water source. On the other hand, the probability of a person falling ill in non-water related illnesses decreased with access to water from a protected source and increases with distance. The possible explanation may have to do with the fact that the effect of distance to a water source on the incidence of water borne diseases (e.g. malaria) is through its proximity while its effect on water related diseases (e.g. diarrhoea) is because of its quality. The distance variable is perhaps picking up the effect of distance on the incidence of water borne diseases, particularly malaria.

Improved water access and participation in off/non-farm employment

We systematically assessed the determinants of participation in off/non-farm employment, controlling for a host of explanatory variables including improved access to water supply. We found a strong association between improved access to water supply and participation in off/non-farm employment, after controlling for other covariates. This could be attributed to the time saving associated with increased availability of water and shorter fetching distances leading to increased availability of labour at household level[3] and reinforces the conjecture that one of the most important pathways through which improved access to water supply will impact on poverty is through increased participation of households in off/non-farm employment.

Having access to credit, and skills of some sort (non-farm), are also found to have a very significant effect on participation. Household characteristics also play a role. Households with older or female heads were less likely to take part in off/non-farm employment. On the other hand, we also found that as the number of male adults in given household increases, the probability of the household's participation in off/non-farm employment decreases. This may point to the high level of rural unemployment in the study sites and in Ethiopia in general. These results clearly show that improved access to water supply can enable increased participation in off/non-farm employment. The fact that we see such strong effects even in an area with high rates of unemployment suggests that access to water may be a significant binding constraint to seeking and participating in off/non-farm employment in rural areas.

Poverty impact of access to improved water supply

As discussed above, we used a two-pronged approach to assess the impact of improved water access on poverty: estimating the poverty profiles of households using standard poverty measurement approaches and identifying determinants of poverty.

Households with access to improved water supply were found to have significantly lower overall and food poverty levels in terms of incidence, depth and severity. Accordingly, 87% of the population without access were found to live below the absolute poverty line of ETB 1821 compared with about 67% of the population with access (see Table 3). Using the food poverty line of ETB 1096 we found that about 79% of the population without access live below the food poverty line compared with 55% of the population with access (see Table 4).

Table 3. Incidence, depth and severity of poverty of households with and without access (poverty line = ETB1821.05)

Category	Incidence ($\alpha = 0$)		Depth ($\alpha = 1$)		Severity ($\alpha = 2$)	
	Value	SE	Value	SE	Value	SE
With access (n=876)	0.67	0.017	0.509	0.016	0.437	0.015
Without access (n=641)	0.87	0.009	0.717	0.009	0.637	0.010
z-statistic	-934.96***		-799.65***		-705.94***	

Table 4. Incidence, depth and severity of food poverty of households with and without access (poverty line = ETB1096.02)

Category	Incidence ($\alpha = 0$)		Depth ($\alpha = 1$)		Severity ($\alpha = 2$)	
	Value	SE	Value	SE	Value	SE
With access (n=876)	0.554	0.018	0.437	0.015	0.554	0.018
Without access (n=641)	0.792	0.011	0.643	0.010	0.792	0.011
z-statistic	-759.06***		-712.60***		-635.58***	

We further explored levels of poverty between households which have access to irrigation and those without, as productive irrigation is a potential route by which water could contribute to poverty reduction. Irrigation in the region is primarily small-scale, where households operate a small holding averaging about 0.2 of hectare and grow cereals and vegetables. Households with access to irrigation were indeed found to have significantly lower overall poverty and food poverty levels in terms of incidence, depth and severity.

We next estimated determinants of poverty. Our regression results showed that access to an improved water source does not have a significant direct effect on household wellbeing. However, a host of household and village level variables were found to be significant in explaining household welfare. Most notably, asset ownership in the form of land and livestock were found to have a significant positive effect on household welfare. However, labour endowment (measured as the number of male and female adult members in the household) was found to have a negative effect on wellbeing. This may imply that the marginal contribution of each additional unit of labour to wellbeing in the communities is negative, reflecting the poor functioning of the labour market and high rural unemployment. Participation in off/non-farm employment was found to have a significant effect on household welfare. This reinforces our earlier hypothesis that an important effect of access to improved water supply on poverty could be through time savings allowing greater participation in off/non-farm employment. The amount of loan taken by the household has a negative effect on household wellbeing. This shows that the marginal return in terms of poverty reduction from a given amount of loan taken was negative, which may point to sub-optimal use of loans.

Some household factors are also significant. Female-headed households are found to have significantly lower wellbeing than male-headed, and as the number of dependants (consumer-worker ratio) increases the wellbeing of the household decreases. Other explanatory variables which are significant in determining wellbeing include distance to all-weather road and to local woreda market. As expected, households that are located close to all-weather roads were found to be better-off than those further away. However, households located far from the woreda market were found to be better-off than those nearer, suggesting that distance is less important than the presence of good roads. Our findings thus provide empirical evidence to support earlier studies which have concluded that the potential poverty impact of improved WSS access depends on the availability of other livelihood assets e.g. land, labour, livestock, credit, local markets which can be combined to generate increased income (SecureWater, 2003, Moriarty et al., 2004).

The results of the Instrumental Variables Regression model provide additional insight on the impact of improved water supply on poverty through improved health. This was used to control for the effect of water supply on poverty through improvements in health, using health expenditure as a proxy for household health status. Households with greater health expenditures, hence poor health status, are found to have lower wellbeing. This captures the indirect effect of water supply on poverty through health.

To summarize there is strong evidence on the impact of improved water supply on poverty. The mechanism through which this impact seems to work is (1) direct through productive use of water in agriculture and (2) indirectly through improved time saving and increased participation in off/non-farm employment and through improved health by reducing health expenditure of households and probably, increased labour productivity. This study does not provide empirical evidence on the labour productivity gains of improved water supply and this need to be explored further.

Conclusions and policy implications

While the expected benefits from investments in water supply and sanitation (WSS) on poverty are considerable, there is still limited empirical evidence in the current literature. Our findings indicated that there were important changes in water supply during the last five years where access to water from protected sources such as public stand pipe, hand pump and protected springs has increased. The new introduced water systems were also appraised as reliable, providing good quality water, and relatively accessible. The most important changes witnessed as a result of the introduction of new water supply systems include: increased supply of water, improved water quality, shorter distance (time saving) and increased awareness in sanitation and hygiene. The overall trend is therefore quite positive.

However detailed analysis of the distribution of services in the two focus weredas showed that investments in new water points were more likely in relatively well connected Kebeles. Kebeles which are located far from all weather roads had a much lower likelihood of getting new water points during the last five years. This highlights the difficulties of targeting the unserved in remote rural areas and raises important questions for policy makers committed to making clean water accessible to all on an equitable basis.

Notwithstanding the significant improvements in water supply, water from unprotected sources still provides the major source of water for about 60 percent or more of the households in both weredas, more so in Gorogutu. In this case, the bulk of households obtain water for domestic and non-domestic use from unprotected community wells, stream, community pond and unprotected springs. This may have implications on health and other community wellbeing. Not surprisingly, diarrhoea (including its acute form), respiratory problems and malaria are still the most important health problems reported by 49%, 38% and 27 percent of the households. Hence, water-based and water borne diseases account for the bulk of the illnesses in both woredas, more so in Babile. These results highlight the fact that people in rural areas typically rely on multiple water sources for different water uses. The factors underlying these patterns of water use behaviour and source preference are poorly understood are generally overlooked in mainstream sector policy and programming approaches but have important implications for sustainability. The evidence presented here challenges the traditional narrow sector focus on health benefits and points to a wide range of livelihood benefits which have hitherto remained ‘invisible’ in sector monitoring and evaluation.

Looking into linkages between improved access to water supply and health, our results show that access to improved water source significantly reduced the probability of illnesses and even more so if it is the source is close. On the other hand, it also seemed to have a positive association with water related illnesses calling perhaps for mitigative measures to reduce incidence of water related diseases. This evidence clearly shows that improving access to water supply infrastructure alone is not sufficient to bring about desired public health benefits. Increased availability and perceived high quality of water are found to have significantly reduced incidence of illnesses.

The probability of participation in off/non-farm employment was found to have significantly increased with access to improved water supply. In fact, households that have access to water from improved source were found 14% more likely to participate compared to those without access. This could be attributed to the time saving benefits of increased availability of water in shorter distance so that more labour time is available to the household. This is an important new finding and suggests that lack of access to improved water supplies may act as a significant binding constraint to the participation of poor rural households in off/non farm employment. This is a particular problem for labour constrained households and has important implications for the effectiveness of labour intensive works (food for work etc) designed to benefit vulnerable households.

Regarding, the impact of improved water supply (both domestic and productive) on poverty households with access to improved water supply were found to have significantly lower overall and food poverty levels in terms of incidence, depth and severity of poverty. These findings provide strong empirical evidence of the contribution of water supply sector investment to poverty reduction.

But is not only access to improved water supply or productive water that reduces poverty. A host of household and village level variables came out significant in explaining household welfare. Most notably, asset ownership in the form of land and livestock were found to have significant positive effect on household welfare. Participation in off/non-farm employment was found also to have a significant effect on household welfare. This reinforces our earlier hypothesis that the effect of improved water supply on poverty could be time saving benefits by making more time available for participation in off/non-farm employment. Female-headed households were found to have significantly lower wellbeing compared to male-headed households. The results also show that the benefits of water supply sector investment are often unevenly distributed and suggest the need for greater attention to issues of equity in sector policy and programming. Furthermore, access to public infrastructure such as all weather roads are found to have a significant impact on poverty reduction as households that are located close to all weather roads were found to better-off compared to households far off. In summary, our findings confirm that the potential poverty impact of improved water supply access also depends on the availability of other livelihood assets. There is, hence, the need to devise mechanisms to build such community and household assets. Enhancing the asset base of households through credit program or otherwise is an important entry point to enhance the impact of improved water supply on household poverty. Moreover, building of community assets such as roads could serve two purposes: enabling access to water supply and enhancing the impact of improved water supply on poverty. This could also be another entry point for policy interventions to ensure poverty reduction and equitable development.

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Note/s

[1] According to the latter study for example, a rise in life expectancy at age one from 50 to 55 years would raise subsequent growth by 0.9 per cent per year.

[2] This study forms part of the RiPPLE research programme which aims to promote improved understanding among policy makers and practitioners of key challenges faced in delivering effective WSS services in Ethiopia and the wider Nile Region (www.rippleethiopia.org).

[3] Based on the assumption that improved sources are indeed closer and/or more productive resulting in a reduction in the amount of time spent collecting water to satisfy household needs.

Keywords

Water supply & sanitation, access, impact, poverty, Ethiopia

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Inland Fishery as an Additional Source of Income and Protein in Minor Tanks in Sri Lanka

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In the past, village irrigation-tank based fisheries have played an important role in the Dry Zone of Sri Lanka. However, currently, its contribution to the economy is far below expectation (Ministry of fisheries & ocean resources – 2002). This is mainly due to the poor condition of minor irrigation systems and lack of multiple use approach in the planning and development of these schemes. The Minor Irrigation Tank Rehabilitation project implemented by Plan Sri Lanka supports the development of small irrigation systems in the Anuradhapura district in an integrated manner, taking peoples' multiple water needs into consideration. Project interventions include infrastructure improvements, capacity building of farmers and partners, integrated watershed management, crop diversification and an inland fishery program to improve livelihoods and food security. Under this project, Twelve of the rehabilitated schemes were identified by the National Aquaculture Development Authority as suitable for inland fisheries and in 2006 /2007, 6 of the 12 tanks were stocked with fingerlings. The economic returns in some tanks have far outweighed the costs incurred. The paper discusses Plan Sri Lanka's experiences in integrating inland fisheries within its tank rehabilitation project as part of Plan's MUS programe for poverty alleviation. It will explain demonstrated benefits in income generation, provision of a supplementary protein source for improvement of nutritional status and improved institutional stability. It will highlight best practices in institutional and resource management and appropriate technological practices for increasing benefits and effectiveness in multiple water use.

Introduction

Small tanks in Sri Lanka are defined as those with an irrigated cultivation area of 80 ha or less. Such small tanks are located in the Dry Zone of Sri Lanka that receives a mean annual rainfall of less than 1,250 mm. Small tanks or reservoirs therefore, are the pivot of the village economies and rural life as they are of multiple uses (Agricultural, Domestic and Environmental) and support human settlements in vicinity of tanks. It is estimated that small tank technology dates back to the pre Aryan settlements (6^{th} Century B.C), in Sri Lanka. The tanks are also part of an integrated system that is known as a cascade defined as a "connected series of tanks organized within the meso-catchments of the dry zone landscape, storing, conveying and utilizing water from an ephemeral rivulet" (Madduma Bandara, 1995). So the cascade is a collection of tanks in an identified geographical area.

The Project

Plan has worked in Sri Lanka for over 27 years. For operational purposes the program areas are grouped into four main geographical zones out of which the Northwestern program area comprising of the Polpithigama Divisional secretariat in the Kurunegala District and Mahawilachchiya, Anuradhapura Central and Medawachiya divisional secretariat are the areas in Anuradhapura district. Through a technical feasibility study, Plan identified 40 minor irrigation tanks that are hydrologically feasible within 12 hydrological feasible cascades in Mahawilachchiya, Anuradhapura Central and Medawachchiya Divisional Secretariat areas in Plan North west program unit. With the financial support of Plan Netherlands, Plan Sri Lanka is in the process of developing 5 cascades in Anuradhapura Central (MANUPA), Medawachiya and Mahawillachiya Divisional Secretary areas. The rehabilitation activities are being carried out with 29 irrigation tanks located under selected five selected cascades and fingerlings were stocked in six rehabilitated tanks listed in table 1& 2 in 2006 and 2007.

Project Approach and Methodology

Project is implemented in an approach that encompasses physical improvement of minor tanks in cascades, conservation of watershed areas improving income generating activities by introducing agriculture related livelihood options of the tanks within the respective cascades emphasizing the multiple usage of water, for optimal productivity.

Community Mobilization

Although there is policy and legislative support for Farmer Organizations, effective mechanisms for service delivery was lacking in the project location and most of farmer organizations who manage and look after operational and maintenance of minor tanks were dysfunctional. As the main service delivery mechanism Plan sought to address the issues that affect the functionality of the Farmer Organizations. Some of the key interventions were conducting a series of capacity building trainings for the farmer organizations on different aspects such as minor tanks development, operation and maintenance, integrated watershed management and multiple uses of cascade systems in Sri Lanka. At the same time Plan initiated coordination with the officers of the National Aquaculture Development Authority and Department of Agrarian Development to change the attitudes of Farmer Organizations to introduce the inland fishery program. Traditionally inland fisheries addressed the nutrition needs of these communities and it was imperative to re-introduce these sources of food intake to address poverty and food insecurity. Consequently inland fishery committees were formed as a subcommittee in farmer organization to implement activities related to fisheries in 6 minor tanks in two cascades which were rehabilitated by the project.

Partnering with Related Stakeholders

Minor tanks (Cascade) development requires a multifaceted approach that needs effective involvement of all relevant line agencies such as the Department of Irrigations, Agriculture, Agrarian Services, Forestry, and Fishery related institutes and Divisional Secretariats. So at the beginning of project, a Project Steering Committee (PSC) was formed with the chairmanship of Government Agent (District Head of the Gvt. Departments) of Anuradhapura District. The presence of all the relevant government agencies at the PSC meeting played a vital role acting as a coordinating body at district level to develop multiple uses of irrigation systems. After community mobilization and networking with partners' physical improvement of the tanks was initiated. The forest reservations just above the tanks were demarcated and some reservations were reforested to provide favorable conditions for the tank systems. Members of Farmer Organizations were instructed to reduce human activity in watersheds to reduce the turbidity of the water.

How Tank Rehabilitation Supports Food Production and Other Community activities?

Rehabilitation of minor tanks located in cascades gives multiple benefits such as providing adequate water for agriculture and aquaculture, Increment of water table at the vicinity of tank(drought mitigation) and ensure water for bathing and washing for village communities. After implementing Minor tank rehabilitation project of Plan Sri Lanka many results could be achieved.

Capacity improvement and renovation of canal systems have led to the reduction in water losses in the tanks and has ensured availability of water throughout the year. Increased levels groundwater enabled survival of trees in home-gardens located below the tank bed elevations during the dry periods. This is evident in Ethdathkalla tank where 5 acres are being irrigated by agro wells. The water availability of wells in the periphery of rehabilitated tanks has increased with reducing fetching time for water. A 15% increase of paddy yield has occurred due to the rehabilitation of the tank and a value was added to water spread area of tank by introducing inland fish into tanks. With balance water in dry periods Cultivation of Other Field Crops such as maize, chili, Mung bean etc in paddy lands assured the food security in dry season. Multiplicity of services from tanks such as cultivation through out the year, availability of fish, credit facilities being implemented through fund raising activities attracted and absorbed community members to the farmer organizations making them functional and effective through out the year . This has influenced to institutional strength and stability with multiple services which could be obtained from farmer organizations. Earlier services from farmer organization could be obtained for a limited period of time and gathered only to organize their cultivations in rainy season. Due to the project interventions, membership and participation for farmer meetings has increased significantly. At present, 328 families in the project area where the inland fishery program implemented receive direct economic benefits from inland fisheries and are assured water for the cultivation of 405 acres of paddy.

Inland Fishery with the availability of water

In order to provide additional income generation activities and also to meet the protein requirement of villages, the project, in consultation with Project Steering Committee decided to implement an inland fishery program with the technical support of the National Aquaculture Development Authority and this has become a best practice introduced by Plan Sri Lanka as some Farmer Organizations achieved significant results with proper management of their minor irrigation systems. Out of the rehabilitated irrigation schemes, 12 systems were identified as suitable for inland fisheries by the National Aquaculture Development Authority and in 2006 fingerlings were stocked in two tanks. The value of the harvested fish amounted to US$1,814 against the cost incurred US$685. In 2007, investment for fingerlings in 5 minor irrigation tanks was US$1,449 and value of harvested fish was US$7,008. Rohu, Big head carp, Catla and Common carp were the varieties introduced to the tanks that have no competition and predation on local/indigenous varieties.

Table 1. Harvesting data in 2006

Tank Name	Number of fingerling stocked	Cost for fingerlings (US$)	Number of Kgs harvested	Income(US$)
Ethdathkalla	30,000	450	1,215 Kg	790
Kiulekada	12,620	235	1,711 Kg	1024
Total	42,620	**685**	**2,926**	**1,814**

Source: Farmer Organization records

Table 2. Harvesting data in 2007

Name of the tank	No of fingerlings	Cost for Fingerlings(US$)	Harvest (Kg)	Income(US$)
Millawetiya	7,200	105	476.5 Kg	309
Ethdathkalla	40,000	600	7,786 Kg	6034
Loku katukeliyawa	7,000	104	555 Kg	492
Mahahalambewewa	10,000	100	195 Kg	126
Katukeliyawa	36,000	540	69 Kg	47
Total	**100,200**	**1,449**	**9,012**	**7,008**

Source: Farmer Organization records

In these regions which are far away from sea, inland fish represent an essential, often irreplaceable source of high quality and cheap animal protein crucial to the balance of diets in marginally food secure communities. The fish harvest that could be obtained from tanks meets the protein requirement of immediate beneficiaries of tanks while providing rice as the staple food. Most inland fish produced in tanks is being consumed locally and sells at a half rate which is affordable to the other communities.

Lessons Learnt

Key elements for success are coordinated and collaborative efforts of all agrarian and agriculture related organizations and early participation in planning for development and management. Introducing Multiple and integrated services from minor tanks enhance the effective participation of respective communities for management of water resources than to a single use approach (Cultivation oriented). With that different type of needy people gets together with community organizations where they can discuss meet and built consent on their requirement and needs. Having realized tangible and intangible benefits that could be obtained from minor tanks rather than crop cultivation would endure the organizational stability and sustainable usages of tanks. As meeting of protein requirement for rural poor is difficult, inland fishery at least in one or two hydrological well endowed tanks per cascade is well accepted by communities. Following key challenges are still prevailing to maintaining and enhancing inland fish production and need policy level influences to make a positive different in dry zone of Sri Lanka.

- Un-integrated approach for minor tank development works and poor coordination among line agencies
- Degradation of aquatic resources and environments due to bad and intensive agronomic practices
- Insufficient institutional and political recognition
- Seasonality of tanks which hider the provision of fish through out the year

Photograph 1. Harvested fish ,Ethdathkalla Tank

Photograph 2. Fishing at EthdathkallaTank

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Keywords

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Reducing the cost of water using smart technologies

H. Holtslag [Netherlands] & W. Mgina

Background

To increase rural water supply in Africa, hand piston pumps were widely disseminated in the 1980s. After technical improvements, the focus shifted from technology to the so called VLOM approach (Village Level Operation and Maintenance management) but still 20 - 50% of the hand pumps in sub-Saharan countries are not working at any given time. A major reason seems the lack of capacity of the users to manage the maintenance, and although hand piston pumps are relatively simple it seems that in many cases they are still "hi tech" for the target group. "Lo-Tech" pumps or so called Appropriate Technologies (AT) also often fail because they are not efficient or not accepted because of their "stone age" image. Another reason is the lack of the involvement of the local private enterprises in production, sales and maintenance. When the projects finish, the activities often stop because local production, quality control, sales and marketing (supply chain) are not developed.

Making improvements

In many situations the sustainability of water supply could be improved and the cost could be drastically reduced by shifting from conventional hand pumps that are often imported, to simpler and locally produced options. An example is the rope pump which was known as a "string and bamboo" option. With new design inputs it now is a very effective pump for boreholes or hand dug wells as deep as 60 meters. Worldwide some 3 million people now use rope pumps of which some 1.4 million are in Africa and it is probably the fastest growing hand pump worldwide. It is fit for family use but also supplies water to communities of 250 people. Because of its high pump capacity it is very effective for MUS (Multiple Use Services) from both shallow wells and deep wells. For the same depth, the rope pump is 5 to 10 times cheaper than piston pumps. Under experiences with rope pumps in 3 countries.

Smart technologies

The rope pump is not "Hi tech" but also not "Low tech" so it can be considered as a Smart technology (smart tecs) and is just one example of innovations that took place in the last 10 – 20 years. Other Smart tecs are there in the field of wells, storage irrigation, treatment, sanitation and hygiene. Smart tecs can be defined as innovative, simple and affordable water- and sanitation solutions that in general can be produced and managed with locally available skills and materials. Smart tecs have proven to be sustainable and reduce cost by 50% or more compared to conventional options. Some Smart tecs for Multiple Use Services are:

Box 1. Rope pump experiences

Nicaragua. Some 70.000 rope-pumps have been installed since 1990. The shift from imported piston pumps of 600$ to locally produced rope pumps of 70$ has doubled rural water supply in ten years, much faster than countries that apply piston pumps. Users do the maintenance and over 95% of the pumps remain in operation (IRC, 1995).

Zimbabwe. This Rope pump model was introduced by the organisation Pump aid in 1990. Now some 3000 pumps serve 950.000 people and more pumps will be installed before 2015 and reach 3 million more people. With this approach Zimbabwe may reach the water MDG!

Ghana. First experiences with rope pumps have been discouraging. In a World Bank funded project 80% did not function after one year because of lack of user involvement and errors in design, production and installation. The "wrong" introduction of the rope pump hampered the acceptance of this option by the government for a long time and it took organisations as Water aid a long time to repair the "image damage" with better pumps and more user involvement.

- Upgraded wells: Simple lining systems to deepen the well in dry periods, well cover combined with EMAS pump or a Rope pump Windlass model
- Manual drilling (Step auger, Rota sludge, Baptist drilling). The drilling options are based on the Indian sludge method and can drill in semi hard ground layers of resp. 50 and 80 meters deep. In Tanzania a combination of a manually drilled borehole and locally produced rope pump costs 600$ compared to 3000$ for a machine drilled borehole and a piston pump. The Baptist drilling is cheaper than the Rota sludge. In Bolivia, over 2300 family wells have been drilled and combined with a simple PVC pump, for a cost of 3$/m. A water point for 100$!
- Wire cement tanks: These tanks use wire instead of construction steel for reinforcement and locally available support material as bricks, bamboo or wood. Compared to Ferro cement tanks the cost of wire cement tanks are 30-50% lower and tanks up to 60 cubic meter have been made with this technique.
- Easy drip. A low pressure drip irrigation system consisting of local poly pipe and imported lay flat hose. It can directly be coupled to a treadle pump or rope pump without the need for a water storage tank and irrigate in one time some 400 m2 meters of tomatoes from a 10 meter deep well. Time needed, 0.5 to 1 hour per day. Cost of material for 400 square meters is 35 – 50 US$
- Tube recharge: A simple option to recharge the aquifer with rainwater that otherwise would flow away. It consists of a hand augered hole of 5 to 10 meter deep filled up with gravel and closed at the top with a sand filter. Experiences in Zambia indicate that hand dug wells that before went dry at the end of the dry season, now had water all year round. After training, these systems can be made by families themselves at a cost of 2- 5 US$ for materials
- Siphon filter. A small and effective water filter that produces 30-60 litres of safe drinking water per day and costs 8-12$. (see "Marketing safe water systems" www.poverty.ch)

Cost -benefits of (new) water options for donors

In general it is very cost effective to invest in improvements in water ane sanitation: 5$ to 28$ returns for every dollar spent (WHO/ SIWI 2004). Treatment of water at the household level can even lead to a benefit of up to US$60 for every US$1 invested (SIWI/WHO, 2004; WHO, 2007). An example is Nicaragua. Dutch aid invested 1 million US$ in improvements and first dissemination of the rope pump. The resulting increase of family incomes has led to an increase of the yearly BNP of Nicaragua by 10 million US$!

Cost - benefit of (new) water options for users

Surveys in Nicaragua indicate that rural families with a well generate twice as much income than families without a well and a 70$ rope pump on a water well generates 220$ extra income per year (Zee, undated). The low cost and simplicity make rope pumps also affordable at family level (NWP, Undated). Treadle pumps or rope pumps reduce can make very low cost irrigation possible for small farmers could increase (double) food production and reduce poverty if combined with agricultural inputs and access to market (Polak, pers. Comm.). The introduction of wells and pumps has to go hand in hand with actions on water conservation.

Photograph 1. Hand Digging a small diameter well of 20 m deep, using a "well ventilator"

Photograph 2. Manual drilling a 30 m borehole using Baptist drilling (Soil: compact clay, time taken: 3 days)

Photograph 3. An example of MUS: A rope pump used for 10 families and irrigation of 200 m^2 vegetables

Photograph 4. Easy drip irrigation, directly coupled to a Rope pump (Material cost 35-50US$ per 0.1 acre)

Photograph 5. Tube recharge system: This family has water in their hand dug well at the end of the dry season.

Photograph 2. Smart tec center Tanzania for demonstrations: training in production and maintenance

Box 2. Examples of smart technologies for MUS

The Money-maker in Kenya : a pedal pump called "Money-maker" is used for small-scale irrigation. This treadle pump costs $70-120 and can generate $200-500 per year extra net income per family. More than 40,000 pumps are presently in use (Heierli , undated)

The Rope pump in Zambia: After training by Connect international, the local organisation DAPP now trains other NGOs and local workshops in production and installation. Since 2006, some 500 pumps have been produced and of which some 50% are used for both domestic use and small scale irrigation of vegetables. Cost of a pump and well improvement are US$150 – 250 and families pay back credits for this investment in 6 to 12 months by selling vegetables to the local market. Similar activities are now starting in Tanzania, Mozambique and Malawi

Dissemination of Smart technologies

One could observe that if these technologies are so promising why aren't there many more in use in rural Africa? There are many reasons but two major ones seem to be:

- **Lack of awareness.** An estimated 90% of rural families in Africa have never heard or seen the new options. Although some options have been demonstrated on water events and are available on the internet, it takes much more marketing and promotion to make policy makers, NGOs and end users aware. This needs funding that until now is difficult to get .Also there are many wrong assumptions made regarding the rope pump. Some people remember the rope pump from 30 years ago when it was introduced in Africa as a low lift pump only fit for family wells. Others think that the rope pump does not count as an improved water source since it is partly open and the well can be contaminated. Experiences indicate that both assumptions are not correct.
- **Simple is not easy.** A major problem with options like rope pumps and hand drilling is that they are "too simple". If people see it, they think they can make it. Although they are indeed easy to make, some basic design rules are needed in order to avoid damage. For instance the wrong clearance in a bushing can cause the handle to break within two months and if it is right, a bushing lasts for 15 years. As with maintenance of other technologies , users need to be involved, families or pump caretakers need to be trained etc.

Lessons learned

Some aspects that successes have in common are:

- Aid was is essential for introduction, training, quality control, awareness creation, marketing.
- Involvement of local private sector and profit for are essential for profit based sustainability.
- It is essential to create supply chains where all actors make a profit
- "Reparability" of a technology is more important than the "reliability".
- To reach water related MDGs, low cost and locally produced hand pumps can be more effective than hi quality imported pumps. (for wells, boreholes up to 60 m deep)
- Over 95% of the rope pumps function at any given time (if well introduced)
- Simple is not easy. The development and dissemination of simple technologies require professional knowledge transfer both on technical and social aspects.
- A large scale dissemination of small scale options can make a huge impact on the MDGs.

Recommendations

- More development aid for water and sanitation for two reasons. Firstly, water and sanitation are essential to reach 6 out of 8 MDG's. Secondly, Improvements in WASH have a "guaranteed" benefit of 5 -60 US$ for every dollar invested.
- Give people choices! If rural communities get a new water supply, give them the choice between a piston pump or a rope pump! (Let them pay a % of the real price)
- Invest money where it is most effective. Money can only be spend once and maybe shifting investments for urban to rural can be effective for reasons as 84% of the MDG poverty and water target group lives in rural areas (UNICEF /WHO 2008) and furthermore access to water in rural areas may reduce migration to cities

- Use existing subsidies for water to stimulate family wells. With the new low cost options, a hand drilled borehole and rope pump may be affordable for middle and lower income families (eventually with credit)
- Replace (part of the) broken piston pumps by locally produced rope pumps.
- “Create awareness” with a Coca Cola approach: all stake holders should at least be aware of new options, than they can choose themselves.
- Create ”Smart Tec centres”. In every region or even better in every community there should be demonstrations of new proven Smart tecs with real examples of different wells, drilling options, hand pumps, storage tanks, irrigation, filters, latrines/ hygiene ideas as Tipp taps etc.

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Note

The first author is since 1987 active in some 16 countries in the development and supply chain of rope pumps and other Smart tecs. He is initiator and main author of Smart Water Solutions published by the Netherlands Water Partnership. Other smart series are on sanitation and water harvesting (see www.IRC.nl and information on rope pumps at www.ropepumps.org as well information on smart tecs at www.AKVO.org and www.connectinternational.nl). The second author is technical Director of SHIPO which has a Smart centre in Njombe, Tanzania.

Keywords

Innovative technologies, affordability, repairability, profit based sustainability, smart technologies, rope pumps

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Impact of Multiple Use Water Services in Tori Danda Community, Nepal

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This paper draws upon research conducted in the Malewa Basne Multiple-Use Services (MUS) system developed in Tori Danda village of Syangja District in Nepal with support from the Smallholder Irrigation and Marketing Initiative (SIMI) project, the Central Department of Rural Development, Tribhuvan University, and International Development Enterprises (IDE) Nepal. The paper describes how the MUS-by-design process and application of related micro irrigation technologies impacted a community in the middle hills of Nepal. Analysis of project impacts was conducted through selection of a random sample of participant households and data collection through a Participatory Rural Appraisal approach. As one of the first gravity-fed double tank, two line distribution systems designed in the middle hills by the SIMI project, this study of Malewa Basne represents typical MUS implementation challenges and community outcomes. The impact analysis includes increase in vegetable production, marketing aspects, and shifts in intra-household roles. Discussion of the process of MUS development also includes the mitigation of community conflict that arose due to caste dynamics and socio-economic disparities.

IDE-Nepal has implemented over 80 multiple-use water services projects in the middle hills of Nepal in the past five years. As one of the first systems built, there are interesting impact lessons that can be drawn from the experience of Tori Danda village. The richness of the experience and outcomes of the Malewa Basne MUS system are due to many factors including caste conflict and linkages with micro irrigation and marketing.

This paper is based on survey research conducted in November, 2006 with smallholders in Tori Danda village. Eleven users (6 women and 5 men) of the multiple-use water system implemented by International Development Enterprises (IDE) through the Smallholder Irrigation and Marketing Initiative (SIMI)[1] were interviewed first in a group and then individually. Interviews were also conducted with SIMI staff.

Photograph 1. Tori Danda village (Source: Narayan Singh Khawas)

Background

Tori Danda village is the residence of 29 households in Sworek VDC of Syangja District, Nepal. Sworek VDC lies in the western part of Syangja, about 15 km from the district headquarter. Siddhartha highway passes through the adjoining VDC (Dahathum) and a two-kilometer trail leads from the highway (at the Gairathok trailhead) across the Andhi Khola River up to the village. The villagers are almost completely dependent on agriculture, although some are able to earn additional income from service work or as daily laborers. Landholdings average only half a hectare and prior to the SIMI project, production was largely for subsistence. The major staple crops in the area include rice, maize, wheat and millet, and most households raise some animals including buffaloes, cows, goats, and poultry. Temperatures range from 10-38 degrees Celsius throughout the year. Village literacy is high and all children go to a nearby school.

Due to its location in the middle hills, land in the village is sloped (Photograph 1). The 29 households of Tori Danda are comprised of three different castes at three bands of elevation. The upper band is Giris (8 households), the middle is Brahmins (16 households), and the lower is Thakuris (5 households). Brahmins are a higher level caste whereas Giris and Thakuris are both lower castes than Brahmins, but equivalent to one another. The Malewa Basne multiple-use system supplies the 21 Brahmin and Thakuri households, totaling 121current users.

Development of the MUS system

SIMI staff originally approached Tori Danda villagers in 2003 to encourage the use of micro irrigation for production of high value vegetables to increase income. Despite having little water available, households were already using up to one-third of their domestic water for productive purposes (livestock and irrigation.) Since there was no spring source at an elevation above all three clusters large enough to supply the whole village, the village had two different domestic water systems that had been built by the local government in 1988. The Giri cluster's system used a very small spring source to supply two taps for their eight households. The Brahmin and Thakuri clusters shared a larger spring source (Malewa Basne – "pigeon cry" - spring) that supplied five shared taps. While the Giri domestic supply remained sufficient for their needs, the system shared by the Brahmins and Thakuris was insufficient - only the Brahmin households were actually receiving adequate water.

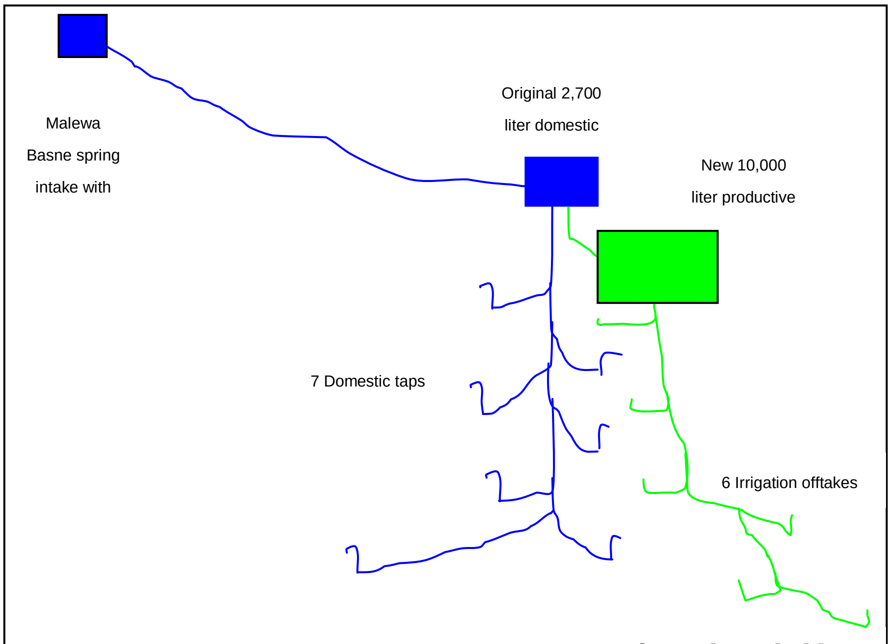

Figure 1. Schematic of Malewa Basne MUS system for 21 households

Since social custom allows Brahmins to take water first from communal taps, and they had the relative advantage of having access to the taps at higher elevations, not enough water was left for the lower level taps. Thus, the Thakuri households were only receiving water one out of every two days. At the original community meeting with all three clusters, the Giri cluster decided that they did not need to be part of a larger multiple-use system because they had their own source and system. Therefore, SIMI began working with just the Brahmin and Thakuri clusters to rehabilitate their old domestic system. SIMI proposed additional taps for Thakuri households and new irrigation offtakes[2] to be shared by field neighbors. However, due to the previous mistrust generated between the two clusters, the Thakuri households originally refused to share the system. At the same time, the land that SIMI suggested be used for construction of the productive use tank belonged to a Brahmin household that refused to give up their land.

These two conflicts persisted through six months of negotiation and system construction sat pending. In order to resolve the conflict between the two clusters, SIMI met with the households in each cluster, had community level meetings, and requested the help of the Water User Committee (WUC) that had been established for system construction and management. SIMI explained that they would ensure equitable distribution of water by installing flow regulators at each tap and offtake to mitigate problems caused by elevation differences. SIMI also had the Brahmin cluster make a public declaration of agreement to equal water allocation. Although SIMI had requested one community member to be elected for training as a plumber/mason, the community elected one Brahmin and one Thakuri to have representation from each cluster. To solve the other conflict, the chair of the WUC held side meetings with the Brahmin landowner, who happened to be his brother, and was able to convince him to agree in writing to give the land free of cost to the community.

Upon resolution of the conflicts, system construction began. SIMI staff estimated the domestic and productive water demand for a 10-year projected population of 137, using 45 liters/capita/day for domestic purpose and 650 liters/household/day[3] for drip irrigation. A new larger pipe was attached to the intake of the spring but still fed the original domestic tank. A new productive use tank was built to capture the overflow from the domestic tank. The five original taps serve 15 households and two new domestic taps were built to serve the remaining six households. Six irrigation offtakes were built to distribute the water from the productive use tank for application using drip irrigation kits (see Figure 1.) The trained plumber/masons provided skilled labor for system construction while the remaining households contributed unskilled labor and local materials. SIMI provided materials needed from outside the village, engineering survey and design, social mobilization, and training. The total cost of the scheme came to NPR 135,890 (US $1,941) including the estimated cost of the existing pipe (NPR 15,741) and existing domestic water tank (NPR 8,500). SIMI provided 48% of the remaining costs; the villagers contributed 34%. Thus, the cost per household not including existing infrastructure was about US $76. Including the cost of SIMI/IDE overhead and agricultural interventions, the average cost of a MUS scheme is US $196-226/household (Mikhail and Yoder, 2009).

Photograph 2. A farmer fills up his micro irrigation header tank from the offtake (Source: Narayan Singh Khawas)

Photograph 3. Villagers weigh vegetables at the cooperative (Source: Narayan Singh Khawas)

Important linkages: micro irrigation and marketing

Each household purchased their own micro irrigation kit (Photograph 2) and were trained on vegetable cultivation, use of micro irrigation, and post harvest processing. The village also elected members to represent them in the Namuna Agriculture Production Marketing Cooperative, a combination of marketing committees from SIMI projects throughout Sworek VDC and two neighboring VDCs. SIMI helped the

Cooperative establish a collection center at the Gairathok trailhead on the Siddhartha highway to collect produce from the three VDCs (Photograph 3).

The Cooperative manages the collection center, provides seasonal cropping calendars, and supply of fertilizer and seeds. The Cooperative also bargains with nearby traders for higher prices or takes their produce for sale in the larger markets of Pokhara and Butwal, retaining 3% of the sales and paying the farmers according to the daily rate and amount of produce. Produce is brought to the collection center two market days each week.

Outcomes

Domestic water and sanitation

As shown in Table 1, with an average household size of 6 members, the water available pre-project was less than the standard 45 liters/capita/day[4]. Even so, households chose to use one-third of their water for productive purposes. Since a greater supply was available post-project, water usage for all needs increased, and households used roughly two-thirds of their water for productive purposes. However, households have opted to use less than the 650 liters/day for irrigation. On the other hand, water use for livestock has almost doubled and includes livestock watering and cleaning of sheds. This has resulted in healthier, more productive animals. A few households have even been able to purchase additional livestock.

Table 1. Quantity of water used pre- and post-MUS construction

Use	Prior to MUS construction (liters/household/day)	After MUS construction (liters/household/day)
Drinking	60	105
Cooking	15	35
Bathing & Washing	90	150
Livestock	75	135
Irrigation	15	500
Total	255	925

Source: This table is based on recall data during interviews with 11 of the 21 households using the Malewa Basne MUS system.

Prior to the project, half of all village households had their own toilets. As part of the project a demonstration toilet was constructed and sanitation education given to the community. Due to greater water availability post-project, project awareness activities and demonstration of a low-cost toilet option, and increased income, the remaining households constructed pit latrines on their own.

Increased income

While rice production remained the same[5], eight out of the eleven interviewees shifted some of their land from millet and maize to vegetable production. Cereal production subsequently decreased, but they were able to purchase replacement cereals with their increased income. While most households grew a handful of rainfed vegetables for home consumption prior to the project, none of them had enough vegetables to sell. Production of the traditional vegetables of potatoes, pumpkins, beans, and lady fingers remained roughly the same, but farmers cultivated much more of the high value crops of cauliflower, cucumber, cabbage, and tomato. For the 11 farmers interviewed, vegetable production increased by 72%. Due to micro irrigation, the farmers can now produce vegetables both on- and off-season for a total of three seasons in one year. According to the Cooperative's records, this led to an income increase/household/year of Rs. 15,000 - 150,000 (US $214 - $2,143).

Table 2. Average change in vegetable crop production per household per year (three seasons in one year)

Types of Crops	Before MUS (kg/year)	After MUS (kg/year)
Cauliflower	16	415
Cucumber	5	102
Cabbage	47	83
Tomato	564	591
Potato	144	150
Pumpkins	5	3
Beans	2	1
Lady finger	0.90	0.72
Total	784	1346

Source: This table is based on recall data during interviews with 11 of the 21 households using the Malewa Basne MUS system.

Change in roles

One important outcome was a change in intra-household decision-making. Because women are traditionally the cultivators of vegetables in Nepal, the increased importance of vegetable sales for household income was important for increasing women's decision-making power and financial independence. The eleven interviewees were asked what agricultural decisions men and women within the household were responsible for before and after project implementation. They stated that prior to the project women mostly contributed labor on the farm including fertilizer management, weeding, harvesting, and storing. Nine of the eleven households stated that women were now involved in making decisions about land preparation, variety selection, and hiring of labor. The other two responded that women were now involved in vegetable sales, irrigation, and pest management. All households stated that the men had become more involved in roles previously considered as "female". Eight households said that women had been empowered through their raised income and had started to handle the daily expenses without requiring permission from their husbands.

Conclusions

The outcomes of MUS implementation in Tori Danda village were similar to many other MUS projects in the Nepal middle hills. Most households displayed their need to access water for both domestic and productive purposes and saw an increase in vegetable consumption and income. And, as most MUS projects, there was some change of gender roles due to the increase in water availability and encouragement of kitchen gardens, causing a subsequent decrease in water collection time and increase in time spent in cultivation. Several key factors would help in replicating the Tori Danda MUS experience: inclusion of the community throughout the implementation process, resolution of caste conflicts through negotiation, setting up a viable water user committee for operation and maintenance of the system, training in use of micro irrigation and vegetable cultivation, and setting up a marketing committee to help villagers market their produce.

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Notes

[1] SIMI is a USAID funded project being implemented by Winrock International as the lead organization with International Development Enterprises (IDE) and local partners: the Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED), the NGO Support Activities for the Rural Poor (SAPROS) and the Agricultural Enterprise Center (AEC).

[2] Irrigation offtakes are taps that are low to the ground with two spouts so that field neighbors can access water at the same time. A flexible hose is attached to a spout and used to fill up a drip irrigation "header" tanks. Or, a sprinkler can be attached directly to the offtake.

[3] The water demand calculation for drip irrigation in the middle hills varies from 400-800 liters/household/day, depending on the discharge of the spring. For micro sprinkler irrigation the demand is 1120 liters/household/day. The Malewa Basne spring has a discharge of 0.3 liter per second which is large enough to supply 650 litser/household/day for drip irrigation.

[4] In Nepal, the 45 liters per capita per day allotment for domestic purpose includes livestock watering.

[5] In the middle hills of Nepal, farmers usually have terraced land away from the village where they cultivate rice. This land is often fed by farmer managed canal irrigation systems. The rest of their crops they grow on the lower quality land nearer to their homes.

Keywords

multiple-use water systems, micro irrigation, marketing, water user committee, intra-household, vegetable production

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Evolving mechanisms to implement a range of small and large scale water supply infrastructure for households' multiple water uses in South Africa

S. Mashicila [South Africa]

South Africa's renewed commitment to poverty eradication is voiced in the water sector through the new Strategic Framework for Water for Sustainable Growth and Development. It recognises the catalytic role that water can play in poverty eradication through home- and village-based economic activity of poor households. This sets the table for the implementation of a range of conventional and less conventional infrastructure solutions of all sizes, to respond to people's need for water for productive uses, and to the diversity of situations found in the South African context. Current institutional arrangements for water supply and management provides a basic framework within which such a range of infrastructure solutions could be implemented, provided some adaptations are made to consultation processes, design criteria and performance measurement. Sufficient attention to operation and maintenance of infrastructure is proving to be a key challenge.

Introduction

The concept of 'multiple use systems' arose from a recognition that as humans, our water needs are multi-faceted, and that water can play a catalytic role in helping people step out of poverty. The well-known finding by AWARD in Bushbuckridge in Mpumalanga Province, recorded that double the economic activity was evident in villages with 'more water' than the 25 lpd required by the Reconstruction and Development Plan (RDP) of post-apartheid South Africa. Further work confirmed that many water-based economic activities do not require purified water, which opened up a host of possibilities to exploit a range of water sources and systems to supply water for multiple uses.

These findings have helped to shape South Africa's new Strategic Framework for Water for Sustainable Growth and Development, whose vision is of a robust, accountable and people-centred water sector, which ensures that water security supports social transformation and economic growth without compromising environmental integrity. The strategy states that decisions regarding the use of water must focus particularly on poverty eradication and social justice, and places much emphasis on the provision of water for productive uses by poor households.

South Africa is highly diverse: annual rainfall varies from approximately 900mm on the Eastern seaboard to desert conditions along the Western seaboard, socio-economic conditions range from ultra-poor to wealthy, operating in parallel 'first' and 'second' economies, often occupying the same geographic space; population is highly dense in places, and settlement patterns were hardly ever determined by the proximity of a good water source.

In the UN World Water Assessment Programme (WWAP) discussion document in 2008, one of the points for debate posed a 'choice between small or large-scale infrastructure'. However, the complexity of the South African geographic, economic and social landscape – which has consequently often been called 'the world in one country' – demands a range of infrastructure solutions to address water supply backlogs, operation and maintenance challenges and an ever-evolving set of institutional questions.

Sustainability

Infrastructure is a means to an end. It supports quality of life and the economy, as long as it delivers the service that individuals and institutions need, in a way that ensures access, affordability and reliability. Service providers can only know what level of service to provide by consulting people about their needs, preferences and levels of affordability. Sustainability is therefore possible only through proper planning, which is dealt with in the next section.

The Water Services Sector in South Africa has infrastructure assets of a replacement value of several hundred billion Rand (1 USD=R8.50). Water Services Authorities (WSAs) are responsible for the development, management and maintenance of this infrastructure. During the next decade a lot more infrastructure will be provided, yet many WSAs do very little to ensure that the correct type of infrastructure is provided for specific circumstances and do very little infrastructure asset management and also do not budget sufficiently for it. Money "saved" on management of assets is not a saving at all. This is a short-term outlook, often said to be due to political short-term imperatives and lack of capacity and know-how within the municipality. It becomes a vicious cycle once infrastructure is allowed to deteriorate as a result of a lack of maintenance. Expensive refurbishment then becomes necessary and there is even less money for ongoing maintenance. In addition, deteriorating infrastructure leads to poor service delivery and reduced payment by consumers, exacerbating the lack of cost recovery.

A poor state of infrastructure can be due to various reasons including amongst others, inadequate level of service, inappropriate design, inappropriate technology, unskilled operators, inappropriate operating rules/systems, inadequate funding, and non-availability of chemicals, lack of equipment and tools or logistical problems.

Access to a tap and toilet is of no use to the community if the water stops flowing or the toilet no longer works. The need to find the correct balance between the type of infrastructure that is provided and the sustainability of services is of utmost importance. It impacts directly on the affordability of the service and the sustainability of a Water Services Authority or Water Services Provider.

Key issues from consultations

The following key issues identified during consultations for the drafting of the Water for Growth and Development Strategy, emphasises the need for a range of interventions to ensure sustainability and appropriateness of water supply infrastructure (extract from draft working documents):

Issue 1: Ensure the upkeep of current infrastructure to continue to provide economic, social and environmental functions of water infrastructure. Absolutely ensure adequate O&M – the skills, capacity, management; siltation, flood protection, environmental releases; need to respond to changed requirements due to climate change and global warming;

Issue 2: Enable 6% economic growth. Need to respond/prepare timely (long advance times for investigation, design & construction of large infrastructure) and spatially (water infrastructure needs to be complemented by other infrastructure development in response to economic development opportunities); essential to ensure effective water access [for basic AND productive water needs] of all strata within society; therefore need for range of types and sizes of infrastructure (from tiny RWH dams to large dams… the global debate about large vs small is nonsensical in our situation, we need a range as appropriate to different circumstances);

Issue 3: Enable the use of alternative strategies (in addition to conventional infrastructure) – WCDM, RWH, etc. Recognise that to implement alternative strategies like WCDM and broad-ranging RWH, we need capacity (skills, people, systems, management, institutions) similar to the capacity developed over generations for the planning, design and construction of conventional infrastructure. We need to start developing these capacities long in advance of a crisis, because in a crisis situation there will no time to do it properly.

Some of the key organisations currently involved in water services provision in South Africa and tasked to ensure that the correct type of infrastructure is provided for specific circumstances are as follows:

- The *Department of Water Affairs and Forestry (DWAF)* is responsible for sector policy, support and regulation. In the past, DWAF did have some water services assets but these assets are currently in the process of being transferred to various WSAs.
- *Water Services Authorities* (metropolitan municipalities, some district municipalities and authorised local municipalities) are responsible for ensuring provision of water services within their area of jurisdiction.
- *Municipalities* operate some local water resource infrastructure (such as dams and boreholes) and bulk water supply schemes, supply water and sanitation to consumers (households, businesses and industries) and operate wastewater collection and treatment systems.

Planning for small and large infrastructure

Water legislation in South Africa distinguishes between water resources, governed by the National Water Act (Act 36 of 1998) and water services, governed by the Water Services Act (Act xx of 1997).

Although South Africa is a water scarce country with a highly skewed rainfall distribution pattern and subject to droughts, water resources planning systems are strong and look at future water needs. Water in South Africa is supplied on a regional basis, therefore drought conditions and low dam levels in one part of the country may result in water restrictions in that area, however, dams in another part of the country may be full as a result of good rainfall. Temporary and geographic imbalances are compensated through strict water allocation processes, and extensive networks of infrastructure that transfer water from different parts of the country to where it is needed.

Water should be a concern for all South Africans, and a consistent campaign is underway to remind our citizens to be water wise by using water sparingly.

From a water resources perspective, there is enough water in our rivers, dams and underground to supply water for socio-economic growth and development, and there are programmes in place to enable timely development of bulk infrastructure for future supply of water to the growing economy and to address the imbalances of the past in regard to access to water for drinking purposes and productive use.

Since 1994, South Africa has been driving an aggressive infrastructure rollout programme to address the backlog in water supply to poor communities across the country. Between 2004 and 2006 nine water resources capital projects were completed at a cost of R1,3 Billion. Another R8,8 Billion is being spent on six major water resources infrastructure projects to be completed between 2008 and 2012. The scope and pace achieved has been possible by focusing on fairly standardised bulk and reticulated supply systems. Two main challenges have since arisen in the water supply sector in South Africa:

- Firstly, it has been virtually impossible to keep up with this pace in the development of institutional capacity for management and maintenance of the infrastructure created through the rollout programme, to the extent that the reliability of even newly created systems are deteriorating;
- Secondly, the remaining population to be served are generally more remote and difficult to reach than those already served.

Both these factors demand a fresh look at alternative options for water supply and institutional arrangements for planning, operation and maintenance. In water services, the primary instrument for planning is the Water Services Development Plan (WSDP) and the primary purpose of the WSDP is to assist WSAs to carry out their mandate effectively. From a Local Authority or WSA perspective, wherever practical, infrastructure should be designed to accommodate mixed levels of service within communities, allowing consumers to select a level of service which suits their needs, is affordable to them and can be upgraded over time. Also, wherever practical, financially viable and sustainable, preference should be given to water supply services which make available at least 50 litres per person per day in close proximity to domestic dwellings (preferably in the yard). Where housing densities are low, low pressure yard tanks could prove to be the most cost-effective means of achieving this.

When it comes to sanitation, and housing densities are low, on-site sanitation systems are likely to be most appropriate. Some form of waterborne sanitation system is likely to be most appropriate where housing densities are high, for example, in urban areas.

Unauthorised and informal settlements where people are living on land without permission of the owner of the land, the provision of services poses a challenge to WSA’s. Interim basic water and sanitation services should be provided as appropriate, affordable, and practical in accordance with a progressive plan that addresses both land tenure and basic services. The DWAF provide best practice guidelines to assist WSAs with regard hereto.

To do justice to the implementation of multiple use systems to enable a larger percentage of poor households to become economically active where they live, two adjustments are necessary:

- First, the basic guidelines mentioned above, as well as the WSDP standard framework, need to be reviewed and expanded to provide for multiple use systems, including rainwater harvesting and water conservation and demand management measures; and
- Secondly, the use of participatory planning methods such as SWELL, needs to be adopted by WSAs for better tailored development of the WSDPs.

Financing mechanisms to implement an appropriate range of small and large infrastructure

The two main financing mechanisms for implementation of small and large water supply infrastructure, are the Municipal Infrastructure Grant (MIG) and the newly established Regional Bulk Infrastructure Grant.

MIG was created to enable WSAs to do proper planning and construction of their local water supply networks and systems. Adjustments are currently under discussion to adapt the conditions and criteria for MIG funding to enable, and indeed encourage, municipailties to implement multiple use systems where appropriate. A specific challenge is to foster close collaboration between affected units within the municipality, for instance between the water supply and local economic development (LED) units. Collaboration may be inadvertently discouraged if the implementation of multiple use systems detract form the performance assessment of participating units. A remaining problem with MIG funding is that it is normally used for the provision of new infrastructure and not for the maintenance of existing infrastructure.

Further major challenges of WSAs in South Africa are that large regional water services infrastructure developments cannot be initiated with current funding available to individual municipalities. These regional schemes are also not always financially viable, because of the vast distance over which water needs to be supplied to various scattered communities (Kwa Zulu Natal, Eastern Cape, Limpopo, etc). The nature of regional bulk infrastructure also requires that various municipalities and economic sectors need to be involved in the planning, financing and operation of such large schemes. Substantial water resources, water user requirements and economic factors need to be considered, requiring complex and comprehensive planning and implementation management requirements.

To help the WSA's to provide the bulk infrastructure that they require, DWAF established the Regional Bulk Infrastructure Grant to assist with the provision of bulk infrastructure. The fund aims to support Government's development targets (e.g. eradication of basic water supply backlogs by 2008 and basic sanitation backlogs by 2010) as well as socio-economic priorities such as the 2010 Soccer World Cup, growth and development initiatives, as well as addressing specific water risks (e.g. water availability, water quality and environmental challenges). The implementation and management of regional bulk water services infrastructure is guided, impacted and driven by various factors, including the following:

- *Socio-economic development:* Regional bulk infrastructure serves both a social and economic component of services. The development and management of such infrastructure is thus dependent on the interaction and cooperation from both sectors. This implies integrated and comprehensive development planning, co-funding and financing mechanisms.
- *Water availability and scarcity:* Water availability and the scarcity thereof dictate the need for and scope of bulk services. In many situations the solution demands that water must be transported over vast distances to serve communities in an integrated manner. Without bulk infrastructure, internal services are often not possible or not sustainable.
- *Integrated water management:* Water resources have to be shared across institutional boundaries and between competing water users. DWAF's role, as national custodian, planner and regulator is of critical importance in guiding and overseeing this process. It involves extensive water resources planning, strategic analysis and prioritization.
- *Benefit of scale:* Regional bulk schemes promote benefit of scale which can reduce development and operating costs for local services through improved efficiency, cost sharing and cross subsidization. Limited funding demands cost optimization.
- *Institutional arrangements:* The fact that water resources must be shared amongst numerous communities demands integrated cooperative management at a scheme level. It implies joint interests and

responsibilities between local authorities and other sector institutions, which is best managed at regional or partnership level.

- *Financial aspects and viability:* Many municipalities are not able to finance and operate large schemes, which imply that many regional infrastructure schemes are either not implemented or are poorly managed. To implement and operate such projects requires alternative funding mechanisms and specific institutional arrangements.
- *Extended implementation options:* Regional bulk services are often better suited for alternative implementation mechanisms such as engineer-procure-construct (EPC), Public Private Partnership (PPP) or build-operate-train-and-transfer (BOTT) contracts, which can introduce cost savings through economy of scale and implementation efficiencies.
- *Sustainable management:* Regional bulk infrastructure development goes beyond the immediate drive and focus of the basic services needs. It also includes sustainable management of bulk infrastructure and service quality through operating efficiency and sustainable water services provisioning. The scale of operations allows for procurement of suitable skills and capacity or the introduction of institutional support through outsourcing.
- *Risk management:* Regional sharing of water resources increases the assurance of water supply. Improved management and operation can further reduce the risk of service interruptions and increase quality of service (e.g. drinking water quality) subject to proper institutional arrangements and management.

Conclusions

It has been shown that in South Africa, in order to provide water and sanitation services which are responsive to the needs of its people, there is a need to implement an appropriate range of small and large infrastructure. The time has arrived to move beyond a narrow focus on large bulk water supply schemes which provide the water to the WSAs who then distribute it in the communities.

Consultation techniques like SWELL have been developed with the specific purpose to enable municipalities to work out, with households in the villages, what their full range of water needs are in terms of quantity, quality and reliability of supply for the different uses. What is needed now, is the adjustment of existing planning tools, guidelines and financing mechanisms to encourage the uptake and implementation of an appropriate range of water supply solutions.

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Keywords

Water supply, sanitation, infrastructure provision

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Analysis of the MUS learning alliance process in Nepal

Monique Mikhail [USA] and Robert Yoder

This paper draws on research conducted by International Development Enterprises (IDE) in Nepal as part of a multi-country action-research project on Multiple-Use Water Services (MUS) approaches. As one component of the action-research project, IDE-Nepal fostered a MUS learning alliance of government and non-government organizational partners to share the multiple-use concept, obtain support for project implementation, and explore methods for scale-up of the approach within Nepal. The paper analyzes the two-pronged learning alliance method used at the community, district, and national levels including the successful linkages and critical gaps. The genesis of partner thought throughout the learning alliance process is outlined and the various outcomes and drawbacks at the community, district, and national levels explored. Various barriers to scale-up of the MUS approach are catalogued, and strategies suggested by partners discussed. In addition, the paper includes an internal reflection of the experience of employing the learning alliance approach, future directions of IDE's involvement, and the constraints faced.

The learning alliance in Nepal was initiated by IDE as part of the CP-MUS action research project on methods for expanding awareness of multiple-use water services (MUS) and examining up-scaling methods. The learning alliance in Nepal attempted to bring together all stakeholders at both the district and national levels to obtain support for MUS project implementation and disseminate the idea of multiple-use water services throughout the country.

Methodology

Information in this document is based largely on personal and group interviews conducted by Monique Mikhail during February to May, 2007 as part of the CP-MUS project. The CP-MUS project was funded by a grant from the Challenge Program on Water and Food with the International Water Management Institute as the lead organization.[1] The CP-MUS project implementation in Nepal largely occurred through the Smallholder Irrigation and Market Initiative (SIMI).[2] Various SIMI staff were interviewed along with NGO and government partners. The individuals chosen were those within each government organization and NGO partner that had been the most involved in either MUS project implementation at the district level or the Learning Alliance at the national level. The SIMI and related IDE/Winrock MUS experience is documented in "Mikhail, M., Yoder, R. (2009). *Multiple Use Water Service Implementation in Nepal and India: Experience and Lessons for Scale-up*. In Press." More information on the CP-MUS project can be found at www.musproject.net.

Beginnings of MUS-by-design in Nepal

IDE has historically worked with individual households to access appropriate technologies for increased income. In line with this technique, SIMI worked with smallholder farmers to use micro irrigation technologies, grow high value crops, and connect with local markets. However, IDE had not previously been involved in developing water sources for farmers. Instead, those farmers who purchased micro irrigation kits were predominantly using water from their existing domestic water systems for irrigation of kitchen gardens. SIMI staff recognized that use of domestic systems was limiting because the systems were not designed to provide enough water for irrigation in addition to domestic supply. It was also difficult to carry sufficient water for irrigation from the domestic taps. Additionally, some communities did not have a water system at all, but were required to carry water from the nearest spring or stream. Others had old systems that were no longer sufficient for even their basic domestic needs.

Some technical staff realized that if they built a hybrid domestic-irrigation system, not only would they provide much-needed domestic water, but also enable the expansion of micro irrigation technology use, and save precious water collection time that could be used for vegetable cultivation. Thus, a meeting with the entire SIMI technical team was held in July 2003 to discuss the best way to develop water resources for irrigation. They decided to design the new multiple-use systems based on the model of gravity flow domestic water systems in the hills. Two designs emerged from these first few systems and are explained in Mikhail and Yoder, 2009.

These new multiple-use systems received high praise from the communities and resulted in better outcomes than where SIMI had worked only on micro irrigation without developing the water source. Due to the success, they were incorporated into several IDE/Winrock programs.

Two-tiered approach – practical and conceptual advocacy

Although IDE worked to develop a formal learning alliance, particularly at the national level, the expansion of the MUS concept occurred far more organically. Because IDE had not originally planned on water source development as part of the SIMI project, there were insufficient project funds to construct MUS systems. Thus, SIMI decided to put a cap on the amount provided to each community and required each community to search for matching funds to secure their project. With the help of SIMI staff, communities approached their local and district governments, the Village Development Committee (VDC) and District Development Committee (DDC), respectively, as well as NGOs working in their area and district level line agencies. It sometimes took multiple meetings with the same official to secure their support. If it proved overly difficult for the community to secure local level funding, SIMI staff sought funding at the national level. The search for matching funds built rapport between the communities and their funding partners and improved the communities' ability to advocate for itself. The search also developed partnerships between SIMI and other organizations operating in the same districts. As the program progressed, these partners would refer new communities to SIMI for MUS projects. The communities also extended invitations to partners to attend village level meetings, consultation meetings, and trainings throughout the process. Partners became a part of the implementation process, building linkages between all stakeholders. Exposure visits were held including visits of one community to another, of potential partner NGOs and GOs, and of national-level officials and international visitors. These site visits proved to be a powerful practical advocacy technique.

SIMI recognized that in addition to the practical advocacy occurring at the district level, there was a need for broader knowledge sharing of the concept and exploration of ways to move policy forward in support of MUS. This conceptual advocacy began with the creation of a MUS brochure for outreach activities. SIMI staff met bilaterally with potential learning alliance partners at the national level, starting with organizations they already had relationships with. They shared the idea of MUS and some of the results that were beginning to come out of the systems that had been built.

In September of 2005 SIMI held the first national learning alliance workshop, including representatives from many existing and potential partner organizations. The concept of MUS was introduced and SIMI had community representatives explain their system operation and the impacts in their community. Six months after this first workshop a follow-up meeting was held with a smaller group of organizations that had expressed interest to continue with the learning alliance and a few others that had not been present at the first workshop. A discussion was held about who should lead the learning alliance activities at the district level and two organizations were debated – the National Federation of Irrigation Water Users Association, Nepal (NFIWUAN) and the Federation of Water & Sanitation Users Nepal (FEDWASUN). In the end, NFIWUAN was chosen because they had a more established network than FEDWASUN. A week later, SIMI staff met with NFIWUAN and although they stated that they did not have funding to work on the learning alliance, they indicated that they could raise the money. SIMI agreed to take key national level learning alliance partners for an exposure visit to some of the existing MUS projects. After this positive experience, SIMI realized that combining the practical and conceptual advocacy was very useful, so they held a second national-level learning alliance workshop in May, 2006 that included representatives from organizations in the Lalitpur District, the district adjacent to Kathmandu.

These national level workshops were successful at both increasing awareness about MUS as well as obtaining funding for future projects. Therefore, at the beginning of 2007, SIMI staff conducted three district-level workshops (Kaski, Palpa, and Lalitpur) to enhance the practical advocacy already occurring at the district level. These district-level workshops were held in March, April, and July 2007, respectively and both existing and potential partners were invited. The Kaski and Palpa workshops consisted of presentations by existing partners about the current MUS work as well as brainstorming of the roles, barriers to scale-up encountered, and areas of improvement in operations of various stakeholders – GOs, NGOs, local government, and communities. The Lalitpur workshop focused more on discussion about enabling MUS at the national level.

The MUS concept continued to spread through the effort of partner organizations. Most partners said that they regularly shared the concept within their organizations, with village communities, donors, other partners they work with, and at meetings and conferences. The more excited a partner was about MUS, the more they shared the approach.

Partner views of the MUS concept

Despite workshops where MUS was discussed by various partners, the difference in how directly involved partners were with implementation created differing ideas about what "multiple-use services" actually meant. Due to the type of systems that SIMI had developed, focusing on provision of water for domestic use and micro irrigation, many partners felt that the systems should be called "dual-use water systems" instead of "multiple-use water systems". Others broadened their vision to include uses that were not currently part of SIMI MUS systems but could be, such as micro hydro. Interestingly, when speaking to communities about other potential uses they were interested in, they listed fish ponds, fruit crops, food processing, and growth of fodder to enable more livestock.

This feedback adheres with another statement that many partners made: MUS is not a new concept to villagers. More than any other partner, villagers understand and apply the multiple-use concept, despite the limited-use systems that the government or NGOs have developed for them. The NFIWUAN representative stated that farmer-managed irrigation systems were *de facto* multiple-use and that 'MUS' was just a term for traditional irrigation systems. Several interviewees supported this statement, claiming that MUS was not a new idea but simply a representation of existing villager practices.

Those who were familiar with the integrated water resource management (IWRM) concept reflected that although the government included IWRM in their national water plan, they had not found a way to actualize it; MUS might be just the solution. An engineer with the Non-Conventional Irrigation Technology Project (NITP) within the Department of Irrigation stated that MUS was a way to "realize the true sense of IWRM". The MUS concept was seen by most as a way to more effectively and sustainably manage water resources. A few partners felt that this meant that MUS was actually a technology that allowed proper use of water. The NITP engineer stated that MUS systems were a "good combination of traditional thought and modern technology".

Although partners had various takes on the concept of MUS, all felt that it was relevant for Nepal. Nepal is a water rich country but most of the population has limited access. Uneven seasonal rainfall and geographical complexities effect distribution. Sources, primarily springs when domestic use is included, are often small in the middle hills. While frequently water sources are shared among neighboring communities, they have remained largely underdeveloped. Since MUS was considered to be an efficient way of managing water resources and the systems that were built had effectively tapped small sources in the hills, enabling irrigation with less water through micro irrigation systems, sources that had previously been dismissed as too small were now considered usable for small hill community water supply. Others highlighted the importance of MUS for helping poor farmers with small landholdings, assisting those who previously had not had access to water for productive use, or at least only for their rice paddies. Some partners felt that MUS had more of a community ownership approach than traditional water delivery systems in Nepal, leading to better community management. Others felt that MUS is only a small change from the current domestic water delivery systems in Nepal yet had significantly larger benefits for communities because of the productive use component. The NITP engineer stated that MUS required minimal extra management and cost but generated large returns.

Outcomes

The major outcomes of the MUS learning alliance were an evolution of the way partners perceived water resources development and service delivery in the middle hills, and subsequent financial and political support for the approach. Partners received much more positive feedback than usual with MUS projects. World Vision was surprised that after participating in one pilot study in Kaski, neighboring communities were requesting MUS systems. Most other partners echoed the same: wherever a system was built, neighboring communities were requesting them. SIMI staff found that their biggest problem was that more communities were requesting MUS systems than they had staff and financial resources to build. However, farmers gaining access to a small amount of water for irrigation were more willing to contribute to MUS development than for conventional water supply schemes due to the small investment required, fast returns, involvement of women, and scheme ownership. The fact that water supply systems could be cost-effective was a surprise to some.

The Deputy Director of the Department of Agriculture Planning Division also proclaimed that MUS encouraged a new type of institutional collaboration. Although prior there was institutional collaboration on the supply side, it was growing on the demand side. He said that farmers are the force pushing government institutions to work together to adequately address the farmers' needs.

Perhaps the most significant change in a partner occurred within the Department of Irrigation through its fledgling NITP program. The NITP provided the most substantial support for MUS at the national level, causing an important internal shift within the broader Department. The NITP was initiated based on funder motivation to broaden the Departments' work, and was not well-received within the Department. Those who were tasked with the NITP were looking for a way to prove the value of non-conventional irrigation approaches and became connected with SIMI's work in micro irrigation and MUS. This partnership both strengthened SIMI's work and NITP's image within the Department. The NITP Coordinator described the situation a few years back when NITP was established: almost the entire department resisted smaller-scale projects and even at the field level NITP had difficulty motivating staff to work on small projects. But, in only a few years that mindset has drastically changed: Department engineers and overseers are motivated to work on small-scale projects because they see rapid and direct benefits of their work for communities.

As the ethos of government partners like the Department of Irrigation expanded to include MUS through involvement in both the practical and conceptual advocacy components of the learning alliance, funding support steadily increased. Other partners were also encouraged to provide support through advocacy efforts. Workshops proved an efficacious avenue to secure funding pledges from partners. For example, at the Palpa District Learning Alliance Workshop, the Western Region Sub divisional Irrigation Office Chief Divisional Engineer said that after the workshop he would allocate Rs. 50,000 (US$ 714) per scheme for three MUS schemes within the year.

The district and national level learning alliance workshops were not only useful for securing financial support from partners, but also important for garnering public statements of support for MUS. The workshops generated the interest of potential partner organizations while existing partners brainstormed with each other about ways to overcome their previous hurdles in MUS implementation. Some partners requested technical training from SIMI in order to attempt their own projects. Others requested joint implementation with SIMI. For example, after the Joint National / Lalitpur district Workshop, the Manohari Development Institute decided to build 60 MUS systems in Makwanpur district with technical support from SIMI.

The more partner support SIMI generated for MUS, the more interest was generated with international donor and lending agencies. The Asian Development Bank funded a micro irrigation project headed by the NITP, and due to the IDE partnership with NITP on MUS and micro irrigation, IDE was invited to be part of the project and wrote a small MUS component into the proposal. As a result, one of the overall recommendations emerging from the project is the necessity of MUS for up-scaling micro irrigation.

Due to learning alliance efforts, a major MUS component was included in a 2007 Finnish International Development Agency project that focuses on encompassing all possibilities for water resource management in districts of the far western and mid-western regions of Nepal. The MUS work is incorporating pico-hydro or micro-hydro power in addition to domestic and micro irrigation uses. The Japan International Cooperation Agency is also planning to fund some MUS projects and have signed a Memorandum of Understanding with IDE to implement them.

Perhaps the most important outcome of the learning alliance in Nepal has been a critical step in policy: MUS has been included in DDC guidelines for VDC funds. Through activity on the SIMI advisory committee, the Ministry for Local Development has been involved in MUS development over the past five years. Their involvement led them to include MUS in their national fund allocation guidelines, a list of the types of development work the central government approves the district government to receive funding for. The inclusion of MUS in the guidelines authorizes all district governments nationally to provide funding for MUS projects to local government bodies within their district.

Benefits and shortfalls of the learning alliance approach

Need for a common understanding

The learning alliance accomplished a great deal in expanding ideas of water resource development and generating funds for MUS projects, however, it fell short in creating a common understanding of the approach. When interviewing partners it became clear that there were differing ideas about what multiple-use services is and what it could be. Those who see MUS only as dual use, based on the SIMI model, are limiting the potential of the concept. On the other hand, throughout the interviews, ideas of incorporating other productive uses like fish ponds, micro hydro, or small-scale food processing were discussed. The incorporation of micro hydro is being tested through the Finnish International Development Agency project. And, many voiced concern for increased efforts in sanitation to accompany MUS projects.

The idea of MUS as a technology instead of an approach may also be limiting. The low-cost technologies that SIMI chose were suited for the middle hills of Nepal and worked well for the applications chosen. Other technologies may work better in different settings such as flatlands where groundwater is the source instead of springs.

Another handicap is varying views of scale. For example, the IWMI-Nepal representative interviewed saw MUS as scale-based: something that was primarily developed to address small-sized water needs that would not apply on a larger level. On the other hand, a “bigger is better” mentality still persists in government organizations, particularly the Department of Irrigation and Department of Agriculture. Some government officials’ feedback at workshops was that MUS projects have too small of an impact and displayed skepticism that small amounts of water were sufficient for irrigation. Furthermore, national level officials sometimes view small-scale projects as the responsibility of local institutions only, while district and local level officials feel they must have a mandate from the central level to act. The inclusion of MUS in DDC development guidelines is an important recent step to bridge this divide, yet varying opinions on scale still create disconnect between implementing NGOs and government organizations, particularly at the national level. If MUS is envisioned as only small-scale and government feels that small-scale is not worth the effort, it may limit support for MUS. The approach is thus handicapped, pointing to the importance of messaging within the learning alliance. The broadness of the concept should be explained and more attention paid to envisioning MUS for different topographies and models. Communities should have a menu of options to choose from to diversify productive use. The learning alliance could be a platform to encourage partners to attempt different manifestations of MUS instead of simply replicating SIMI’s model. The learning from these various applications could then be shared.

The importance of strategy

One factor leading to the variance in understanding of the MUS concept was the lack of a strategic plan for the learning alliance. The practical advocacy grew out of a need for more funds. The conceptual advocacy was a suggestion of international partners. And, while the two efforts were successful at bringing partners together at various levels and generating interest, there was a lack of overall strategic approach. Although staff regularly worked with well-established partner organizations in various projects, attempting to expand a concept through a knowledge-sharing network was a new challenge. Staff used techniques that were familiar to them, such as exposure visits and workshops. In some ways, the organic nature of the process led to avenues that may have been overlooked with a strategic framework. On the other hand, effort was wasted on partners that were not a good fit. The Department of Water Supply & Sewerage was consistently resistant to involvement in the learning alliance despite repeated efforts of IDE staff. Because IDE had never worked with this department, staff were unaware that they were unable to work on MUS because of an internal policy restricting them from working with populations under 1,000[3]. Likewise, organizations that might have been beneficial partners were overlooked. The Department of Local Infrastructure Development and Agricultural Roads housed within the Ministry of Local Development was not approached until later in the learning alliance, yet they work on small-scale drinking water projects in rural areas.

IDE also did not follow up sufficiently with partners in between workshops. The workshops were not regularly occurring, resulting in a dissipation of momentum between meetings. Only those who were actually involved in project implementation were regularly in communication between meetings. This led to a die down of interest for the less involved partners and gaps in knowledge about the implementation activities that were occurring.

One reason for limited workshops was lack of resources. And, while it seemed a good idea to have NFIWUAN lead the learning alliance effort instead of IDE, they did not have and were unable to gather the resources necessary for the effort. This shows the importance of backing learning alliance approaches with appropriate funding.

Resistance to coordination

Yet, even if a strategic plan had been utilized for the learning alliance, it would have been impossible to completely change the embedded government resistance to coordination in the short project timeframe. Resistance remains to coordinating with other sectors in water provision or providing a service beyond the conventional mandate. Irrigation practitioners were much more likely to advocate for domestic practitioners to add irrigation provision to their systems than to include domestic provision in their own. Several irrigation practitioners stated that if a source had enough water, domestic water systems should incorporate irrigation. Conversely, domestic water practitioners were simply comfortable maintaining the conventional approach because they worried that domestic supply would suffer if irrigation were included. In the interviews, the most commonly listed problem with all government bodies was a lack of coordination and communication within, between, and among them. And, not only do the policies hinder coordination, but there is a culture within the government to meet their own organization’s plan and minimize work with other government organizations.

Projects matched to community need

Despite many difficulties encountered during application of the learning alliance approach, it was a significant factor in positive reception of the MUS concept within Nepal. As most forms of advocacy, MUS would not have moved forward without dedicated champions at each level. These champions connected partners and advocated for communities to get support for projects. For example, in Lalitpur district, the Lele village had approached their District Agriculture Development Officer for help as a poor, lower caste community with no previous development activity in their village. He advocated for them to work with IDE on a MUS project.

These champions understood that the MUS systems were fulfilling an urgent need of the community. And, if a community need is adequately addressed by a project, they will become advocates of the approach themselves. This was most poignantly explained by a Water User Committee chairwoman at the Palpa Learning Alliance Workshop. SIMI had worked with her community to purchase micro irrigation systems for vegetable production but had not developed a water source. When the SIMI project ended, they stopped using the micro irrigation kits due to lack of available water. After hearing about MUS from a neighboring community, they re-approached SIMI, requesting help to develop their water source. Now they are not only regularly using the MUS system and micro irrigation kits, but are promoting MUS to other communities in the district. Although the learning alliance was important for sharing the MUS concept, it would have gone nowhere if the projects did not address real needs within communities.

Seeing is believing

Since the projects did address a community need, the best way to share the concept was to *show* people, and exposure visits became a critical motivator for partner support. Partners who were lukewarm about the concept before their field visit became advocates afterwards. Even the Department of Irrigation Director General was so impressed after his field visit that he approved increased funding for NITP. Some partners even encouraged the construction of pilot projects in every district across the country to provide an example for the district and local governments.

This truism also translated into a stronger emotional investment of partners at the district level than the national level. District-level partners were able to see the projects develop and participate in that development. Expanding site visits to those at the national level who had contributed financially to MUS projects increased their interest and enthusiasm. However, seeing one model of the approach made it difficult for some to envision different ways of actualizing the idea.

Importance of low-cost technologies and marketing

Showing MUS systems to partners also enabled SIMI to share its fundamental pillars of low-cost technologies and marketing for smallholders. Although SIMI had not previously developed water resources for community systems, the low-cost focus pervaded their approach. Due to the low cost and simplicity of the systems, it was easier to convince partners to contribute. Communities could provide labor and local materials and purchase their own micro irrigation kits. The systems could be constructed in 1-3 months on average, allowing partners to see the fruits of their contribution in a short time.

And, although application of the multiple-use water services concept could have taken shape by linking domestic water provision with any productive use component, SIMI chose to combine the domestic portion with water for micro irrigation of high value vegetable crops because of their mandate and previous experience. While any productive use component would have allowed smallholders to generate income and provided incentive for proper system management, micro irrigation was a good fit. Micro irrigation uses less water, meaning that small spring sources could provide enough supply for domestic purposes and irrigation. And, with production of vegetables and establishment of marketing committees, smallholders could increase their income within one growing season, displaying rapid changes in the community. These quick improvements were critical in encouraging the MUS concept with partners.

Potential for scale-up

Barriers

One of the major topics discussed at learning alliance workshops and in interviews was the possibility of MUS scale-up within the country. Several potential barriers emerged. While there are many spring sources in the middle hills of Nepal, they are not always near enough to the communities to make MUS work viable using the current model. And, even if a source is available, neighboring communities may not be allowed to access it or may be too small to serve larger settlements. These issues relate to fear of future water conflicts. Some feel that by providing water for irrigation in addition to domestic purposes, upstream users will capture too much water, limiting the availability for downstream users. Thus far these types of conflicts as well as inter-caste conflicts have been mitigated by intra- and inter- community negotiation of rights. The importance of these negotiations cannot be understated, and will become even more critical during scale-up. Since the procedure for registering source rights are also difficult and confusing with multiple government body involvement, users suggested that the process be streamlined for scale-up. In their interview, IWMI-Nepal suggested using a watershed-based approach for MUS to ensure that communities are not capturing water at the detriment of their neighbors or others elsewhere in the watershed. Additionally, a major concern with up-scaling is that if a majority of springs are captured for MUS, flow in the streams and rivers could diminish, harming important ecosystem services. A watershed approach that fostered communication between partners at various levels and multiple Water User Committees could provide the planning necessary to prevent these problems.

There are also many barriers within the government structure that limit scale-up. Partners mentioned that planning for NGOs and communities is difficult due to delay in the release of government budgets. Sometimes the government agrees to give matching funds for MUS projects, but delivery of materials and funds is delayed due to extensive bureaucratic processes and the cost of the MUS scheme increases daily during the delay. Government organizations are also limited by policy that reinforces the sectoral approach to water resource development. For example, the Kaski District Agriculture Development Officer mentioned that he cannot provide financial support for domestic tapstands, only piping. Respondents repeatedly cited the need for policy change at the central level. The inclusion of MUS in the DDC guidelines should help address this issue, however, each department must address the limitations in their policies and planning documents.

Increased partner support

In addition to policy adjustments, partners felt that scale-up will require increased partnership and support, particularly from government. Many even discussed the necessity of embedding MUS within a government body in order to secure regular funding, more easily incorporate the approach into department policy, and have dedicated manpower and infrastructure. However, many felt that if one department were to take responsibility, other departments would have less incentive to be involved because it would be someone else’s mandate. Since MUS requires integration of various sectors, this could be detrimental. Ultimately, most partners agreed that the district-level government should lead. They claimed that it was communities through the DDC/VDC structure that had been and must continue to push integration of water resource use and true coordination between government agencies.

However, despite the understanding that the DDC/VDC should lead MUS implementation, government bodies that receive financial support from large donors such as the Asian Development Bank and the World Bank expressed the need for these funders to support MUS to truly achieve scale-up. Similarly, NGO partners said that support was required from their funders to be more heavily involved in implementation. Although there has been some support for MUS from the Asian Development Bank and overtures have been made to the World Bank, partners are still a long way from receiving emphatic support and substantial sums of financial assistance for MUS scale-up.

In addition to the support of district and local level government and funding agencies, it was expressed that MUS scale-up would need increased participation of the domestic water and sanitation sector. Participants of the district level workshops expressed the sense that the irrigation component was highlighted more than the domestic component of SIMI MUS work. And, some partners expressed a need for a larger sanitation effort as part of MUS.

Continuation of the learning alliance

The increased support of partners will be sought through the continuation of the learning alliance. Although the SIMI project is complete, due to the success of MUS implementation, work will continue through other IDE-Nepal projects. To build on the important partnerships created through the learning alliance, bilateral work is ongoing, but is focused predominantly on project implementation. Since the practical advocacy component was so important for project implementation, these efforts will continue, largely at the district level. Thus, district-level partnerships will continue to grow. However, the frequency of learning alliance workshops has slowed at both the district and national levels due to limited funding available to support the conceptual advocacy efforts. Despite funding limitations, district-level workshops are being planned for Lalitpur and Surkhet (which has not previously had a workshop.) Field visits for government officials that have not yet seen MUS projects are also being planned. Discussions are underway with the Department of Local Infrastructure Development and Agricultural Roads at the national level to provide funding for IDE technical support to place a pilot project in each district. IDE staff suggest that for MUS scale-up, IDE should provide technical training to partners so they can implement their own projects. IDE-Nepal and partners are continuing to press the large lending institutions to become involved in MUS, and make inroads with the domestic water and sanitation sector.

Conclusions

The two components of the MUS learning alliance approach in Nepal mutually reinforced one another and provided an interactive forum for IDE to learn from others and share experiences. It started with systems that fulfilled community needs in a low-cost way with quick rewards, and built on these efforts through advocacy of the approach. Practical advocacy was essential for securing funding for projects, developing partnerships with local and district-level partners, and building MUS advocates. Conceptual advocacy activities helped to share experiences and challenges, bring in new partners, and concretize the steps needed for future implementation. It was critical for those attending the learning alliance workshops to be able to hear from users about the changes in their villages as well as participate in exposure visits. While significant barriers remain, much headway has been made to both share the concept of multiple-use services and build partnerships for implementation. The SIMI model has been successful, but it manifests the multiple-use approach in only one way. For true scale-up that fits community needs and differences in topography, water availability and access, learning alliance partners should build on the SIMI experience and pilot their own versions of MUS. Vision of MUS possibilities should not be limited by scalar views and communities should be able to use water for a variety of productive applications. As additional government or donor funds are made available for MUS, building upon the already established learning alliance will enable rapid expansion by retaining and building on current partner knowledge, experience and lessons of the various models documented by the CP-MUS project.

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Notes

[1]The Global Lead partners on the CP-MUS project are the International Water Management Institute (IWMI); IRC International Water and Sanitation Centre, The Netherlands; International Development Enterprises (IDE), USA; and Khon Kaen University (KKU), Thailand. Each Global Partner worked with local partner organizations in five different river basins around the world: the Andes, the Nile, the Indus-Gangetic, the Mekong, and the Limpopo basins.

[1] SIMI is a USAID funded project being implemented by Winrock International as the lead organization with International Development Enterprises (IDE) and local partners: the Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED), Support Activities for the Rural Poor (SAPPROS) and the Agricultural Enterprise Center (AEC).

[3] The average size of a SIMI MUS project in Nepal is 36 households or around 215 people, well below the 1,000 and above limit for the Department of Water Supply & Sewerage.

Keywords

Multiple-use water services, learning alliance, Nepal, scale-up, policy

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

An overview of Water for Growth and Development in South Africa

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Water for Growth and Development signals a shift from earlier supply and demand driven approaches, through the period of concerted water service delivery to this sharply-focused response to current and future socio-economic demands and issues of water security. The new focus/thinking strongly emphasize the issue of "Bringing water to the forefront of development planning" which means that all economic and development planning must be influenced and guided by an assessment of water availability. A critical point for consideration is: Water is seldom the primary driver and catalyst of economic development in many instances; however, it can be a severe constraint to development initiatives in many parts of our country. Its availability, or potential availability, is therefore a crucial factor in all development planning initiatives and processes (whether local, regional / provincial or national) in the country.

Introduction

Water for Growth and Development (WFGD) is the clarion call for a radical change to the way water is managed in South Africa. The WfGD heralds a new era in the Department of Water Affairs and Forestry (DWAF) and water sector approach to the way in which water is managed in an optimal and sustainable manner.

WFGD is a critical response that seeks to mobilize a collective and sharply focused effort to address the rapid-paced current and future socio-economic development needs of the country. In the process of addressing South Africa's needs, WFGD serves to ensure that South Africa's prestige and reputation as a world leader in the realm of water management remains undiminished.

The purpose of this paper is to highlight South African Historical background which led to the way water is managed (climate, geography, politics & legislation, constitution and water users), WFDG vision and guiding principles, water and social development, women and water, social poverty risks, water allocation reform and addressing WFGD at macro and micro perspectives. Even though WFGD includes both economic growth and social development but this paper will zoom in to social development part for it to be relevant to Multiple Use Services Symposium

Historical background and context

It is important to briefly reflect on some of the historical "drivers" that have influenced the water management and development priorities in the country.

Climate

South Africa has an uneven rainfall regime, high evaporation rates and approximately 9-year wet and dry climatic cycles. There is a high level of unpredictability within these 9-year cycles with extreme weather events (droughts and floods) that have serious impacts on human life and property.

As the 30th driest country in the world, the country's annual average rainfall (at 470 mm) is almost half the world average of 860 mm. Furthermore, as a largely summer rainfall country 80% of the rainfall occurs during five summer months of the year. The only exception is the coastal area of the Western Cape region which experiences winter-rainfall. A further exacerbating factor is that our net precipitation rates are in the negative resulting in reduced run-off into our rivers.

Together, these climatic factors place South Africa as the 11^{th} country with the least annual renewable water per person in a 1999 assessment carried out by the UNDP based on 1955 and 1990 figures with projections for 2025. In addition to this, a further complication is the increasing impact of climate change; superimposed on the existing challenge of climate unpredictability.

Geography

Water distribution in South Africa mirrors the mean annual rainfall patterns in the country. There is a wet eastern seaboard which becomes progressively drier towards the central and western parts of the country. Overall, the country is described as being semi-arid.

The historical and political ideologies and legacies of Colonialism and Apartheid contributed to the skewed and differentiated human settlement patterns evident in large parts of the country, even today. Historical human settlement patterns did not appear to be affected and driven by the semi-arid nature of the country. Accordingly, these settlement patterns did not follow conventional trends of taking place where water was in abundance, but followed prevailing economic development patterns. This was agriculture and mining in the early- to mid-1900's; and later increased mining, urban & industrial developments that took place in locations unable to supply growing water demands for these activities and the human settlements around them. Government approved large investments in infrastructure to support agricultural water use and further infrastructure investments to support the industrial and urban centres located away from available water resources.

History, politics and legislation

Political ideologies and developmental considerations were translated into the prevailing legislation of their time. In the water sector, the Irrigation Act of 1912 reflected the agricultural needs and character of the country's economy during this period. This was repealed and replaced by the Water Act of 1956 which took cognizance of the changing developmental state of the country – that is, increased mining, industrial and urban water needs. This act underwent a substantial revision and amendment in 1984 to deal with the unprecedented and unanticipated extent to which mining, industrial and urban activities were impacting on water resources.

Unfortunately, the 1956 Water Act was based on British and European water law and was inappropriate for the South African situation where there was approximately eight-times less water. It was also based on the Roman-Dutch principles of riparian rights (which linked land and water ownership), public and private water and surplus and normal flows. The latter principles resulted in many difficulties in effectively managing water resources in their entirety, as well as entrenching skewed land ownership and water access only to the minority white population in the country.

The transformation of this inequitable access and basic needs supply of water to the majority of black and women South Africans, especially in rural areas, became the primary focus of South Africa's democratic government after 1994. Water legislation was again revised in its entirety and the National Water Policy of 1997, Water Services Act of 1997 and National Water Act of 1998 were promulgated in accordance with the 1996 Constitution of South Africa and its Bill of Rights.

The Constitution, sustainable development and Water for Growth and Development

Given the significant strides that have been made in addressing the basic water needs of South Africans since 1994, underpinned by the country's Constitutional injunctions and a range of very progressive and sophisticated policies and programmes, the WfGD represents the new generation of "thinking and doing" that seeks to elevate progress to the next level.

This next level challenges conventional thinking and approaches to water management and requires greater attention in collaboration and integration in purpose and action, inter- and intra-sectorally, towards common and shared outcomes with benefits for all. Accordingly, the WfGD gives further credence to the DWAF slogan of "some for all together, forever". This slogan echoes the themes of equity, efficiency and sustainability in the protection, use, development, conservation, management and control of water resources which are the central pillars of the country's water legislation.

An important consideration within the legislative and policy frameworks is the attention that must be given to both macro- and micro- socio-economic and planning elements. Significantly, equal importance is given to all issues, irrespective of whether these impact at a household (micro) or national (macro) level.

Thus, in summary, while the progress between 1994 and 2004 was primarily in the legislative, policy and water services sector (focusing on water supply); since 2004, the focus has shifted to policy implementation, addressing the sanitation backlog and issues of social justice in the allocation and re-allocation of water (WAR) – that is, moving people "beyond domestic water use to uses for productive, economic purposes".

Water use and contribution to employment and GDP

Irrigated agriculture remains the largest water user in the country (approximately 60%) but accounts for only 8.5% of total employment and contributes 3% towards GDP. On the other hand manufacturing which uses 5% of total water withdrawals employ about 14% of the workforce and contribute 18.4% to GDP. The same figures for mining are 3% water use 3.1% employment and 6.6% GDP. It is due to this increasing sectoral competition that water sector needs to be firm in terms of balancing water allocation.

The vision and principles for Water for Growth and Development

The Vision underpinning Water for Growth and Development is a robust, accountable and people-centred water sector, which ensures that water security supports social transformation and economic growth without compromising environmental integrity. Water security is defined as "reliable availability of an acceptable quantity and quality of water for production, livelihoods and health, coupled with an acceptable level of risk of high social and economic impacts of unpredictable water events" (Grey and Sadoff, 2005).

This vision is supported by a number of principles. The 'Fundamental Principles and Objectives for a New Water Law for South Africa', drafted in 1996 and reflected in the 1997 White Paper on a National Water Resources Policy for South Africa and the 1998 National Water Act, are still applicable in the context of ensuring Water for Growth and Development. The following additional principles also apply:

- All economic and development planning must include an assessment of water availability and effluent management.
- Decisions regarding the use of water must balance the economic, social and environmental dimensions of water.
- Decisions regarding the use of water must focus particularly on poverty eradication and social justice.
- Water investment should give equal emphasis to the maintenance and refurbishment of the current asset base, and the development of new infrastructure.
- Priority should be given to optimizing efficient use and productivity to obtain more value per unit of water
- Sound management and use of local resources, including groundwater, should be prioritized before accessing more distant resources.
- Institutional reform should tailor the institutional arrangements of the water sector to fit more closely with the capacity to deliver

Sustainable service provision and water management rests on a strong partnership between citizens and government, with mutual accountability.

Water and social development

South African water policy recognizes both the social and economic value of water and therefore, the role of water in socio-economic development. Safe, reliable and adequate access to water and sanitation is essential in achieving the Millenium Development Goals, including those that seek to eradicate extreme hunger and poverty, reduce child mortality, and combat a range of diseases. While attainment of the MDGs is a social objective in and of itself, ensuring better health and nutrition through the provision of water and sanitation will, in turn, lead to greater productivity with associated economic benefits. Greater economic benefits, if appropriately distributed and shared, will, in turn, lead to poverty reduction, and improved standards of living.

The social value of water is often harder to quantify than its economic value and, as a result, the social benefits of water, such as its impacts on health, dignity, food security, basic livelihoods and cultural and religious traditions are not always given their fair weight by decision-makers. The challenge is for water management to take place in a framework that balances social, economic and ecological value.

A key thrust of the Water for Growth and Development is to ensure that water contributes to social transformation and the social development of historically marginalized groups and individuals and currently vulnerable members of the population.

South Africa has a high and widening gap between rich and poor, and despite being classified as a middle income country, over 40% of the population live in poverty. The areas of deepest poverty remain the former homelands. Addressing the provision of water to poor households, both for domestic purposes and productive purposes, is an integral part of water for growth and development. A number of challenges must be met. The first is a reconsideration of the amount of water provided to poor households. The extremely high prevalence of HIV and AIDS in South Africa adds urgency to this review. People living with HIV and AIDS, and those who care for them, require good quality water, accessible sanitation facilities, and sufficient water for protecting health in the face of compromised immune systems. There is an argument to be made that the current Free Basic Water (FBW) amount is insufficient for households affected by HIV and AIDS and that it should be increased. A policy revision needs to be conducted to determine whether the volume of FBW should be increased and how best to fund and implement a revised policy.

A second is the implementation of water allocation reform. The water allocation reform programme is intended to correct historical injustice and ensure more equitable distribution of raw water according to race and gender. An important part of this includes the roll out of the rainwater harvesting programme, the rehabilitation of existing irrigation schemes, and the investigation of appropriate technology such as treadle pumps to bring water to poor households and communities for food gardening and micro enterprise development. Provision of water for food gardening and for small business development (e.g. brick making and hair salons) has the potential to contribute significantly to poverty eradication. Provision of household food from food gardens can free up a large portion of social grants. In the context of HIV and AIDS, improved nutrition is an important contribution to household well-being. The roll-out of the rainwater harvesting programme in the Umzimvubu pilot area will enable small scale development to take place while larger programmes are under investigation

DWAF will drive a national programme to encourage what is termed Schedule 1 use - use of water for domestic food gardens, watering household livestock and micro enterprise development. As part of this, DWAF will drive the roll out of the rain water harvesting programme, and will seek financial support from the private sector and National Treasury to further enhance this programme.

Women and water

Amongst the poor, it is women who bear the brunt of poor services - the work of fetching water, with backache from carrying heavy containers, time costs of queuing, the added work of caring for sick family members, the indignity of bad sanitation, safety risks after dark. It is women who benefit most from good services. Water for productive purposes can contribute significantly to easing the burden of the poorest of women in caring for their families.

Social-poverty risks

Water scarcity, unreliable supply, and limited access to water are predominantly felt by the poor - inadequate water supply is both a cause and a result of poverty. There are two aspects to the social risks associated with water. The first relates to water for domestic purposes. The poor are vulnerable to lack of domestic water or poor quality water due to their limited resources to adapt. Unless appropriate mechanisms such as Free Basic Water are in place, the poor use a disproportionate proportion of their income on water for domestic purposes. Water failures may result in the poor having to buy water from those with better access. A reliable and affordable basic domestic supply has significant impacts on household well-being.

Where water systems deteriorate or fail, poor people resort to increasingly inadequate local water resources or expensive vendor arrangements, while more affluent households may make alternative arrangements and take their water from non-municipal sources such as boreholes or bottled water. This compounds the impacts on the poor by reducing the income streams to municipalities for sustainable operation and network development, further compounding the downward spiral of water supply.

Water for productive purposes is often either expensive (in urban areas where potable water is used) or not supplied (in the under-developed rural areas), impacting on the ability of the poor to raise themselves out of the poverty trap. A small amount of water for productive purposes can considerably reduce vulnerability and hunger by allowing the development of food gardens or micro enterprises such as brick making, ice making and so on.

Water allocation reform

Access to, and use of water, is still highly skewed along racial lines. While government has made significant progress in providing basic water and sanitation to the poor, much still has to be done in this regard and to provide access to water for productive purposes, while there are growing calls for free basic water to be increased. Experiences from Bushbuck Ridge suggest that increasing the amount of water supplied can stimulate a range of local entrepreneurial activities from hair salons to brick-making. Many argue that 'basic needs' should accommodate the water required to support livelihoods strategies, including small scale market gardening and that affordable and sustainable mechanisms of supply should be found.

Interventions to make water available for productive use for historically disadvantaged groups, while slow, are being initiated, primarily around irrigation water for black farmers. Efforts to revitalize irrigation schemes in the ex-homelands areas are increasing. Land reform cannot deliver its intended benefits without secure water. Some agri-industries and food retailers are actively pursuing redress initiatives in their raw materials suppliers, to help support their own growth initiatives.

In some cases the water required by these redress initiatives is already available. In many cases, however, water must be found for black and women farmers and entrepreneurs. The options for making this water available are being addressed through the Water Allocation Reform programme, and may include reallocating existing water supplies, reducing assurance of supply for some existing users, increased storage (large and small) and more effective use of groundwater.

Addressing Water for Growth and Development from macro and micro level perspectives

Macro level perspective

The macro-level refers to the development and management of water resources at the level of water management areas in support of water for growth and development. This relates to water security and strategies to achieve water security. The high level panel discussion hosted by DWAF and WISA in June on Water for Growth and Development primarily addressed the macro level perspective where issues concerning water security were debated. Of significance was the need to create a minimum platform for water security which involves investment in water infrastructure and institutional capacity. Once this minimum platform is in place, a country is not only able to ensure that its communities are resilient to the destructive impacts of water (such as drought, flood, landslides, etc.) but they also have access to sufficient levels of water services to enable growth.

Micro level perspective

The micro-level perspective is the bottom-up perspective of multiple uses, where users are using their infrastructure for water for growth and development. The provision of water services that allows for these types of activities is central to the micro level perspective.

Within the high level panel discussion the following points were illustrated in terms of the micro perspective:

- Both water resource management and water and sanitation services are key to growth and poverty alleviation: It is not only water resource infrastructure that contributes to poverty alleviation and growth. Improved water resources *management and water supply and sanitation* are critical to economic growth and poverty eradication.
- Investing in water alleviates poverty: Those communities that have improved access to water and sanitation services also achieve local economic growth. There is a causal relationship between access to water supply and higher income levels.
- Water resource / development projects for productive use of water: Water resource projects that can directly benefit the poor should be promoted, such as restoring degraded water catchment areas and improving water storage for small irrigation projects. Communities should be encouraged to engage in water projects where water is used for productive purposes such as rain water harvesting for food gardens, and other development activities to improve their living conditions. This latter point has also been recognized in the various seminars on multiple use of water.

Conclusions

The timing is therefore appropriate for the WfGD to be located within this "new dynamic" and changed space in the water sector and the country, and WFGD forms part of this continuum of adaptive management in the water sector.

An understanding and appreciation of the timeline of all the initiatives undertaken within the sector and country since 1994, as well as significant milestones achieved, has been a critical point of departure in the conceptualization and planned roll-out of the WfGD.

It is also important to indicate that although the extensive nature of the WfGD may appear to reflect ALL of the DWAF business, it in fact sharpens the DWAF focus to those strategic elements that directly contribute to the changed dynamics of the country and the most important point of reference here is the changed socio-economic face of the country and its future sustainable prosperities

What is clear is that concerted action is needed from all spheres of government to ensure that any potential crisis in the water sector is avoided and that growth and development are supported, not hampered by the actions of the water sector.

It is equally clear that government will need to invest significantly in the water sector to ensure that water management supports the national growth targets. If South Africa is to maintain and provide reliable water services that support economic growth and social development, this investment will have to increase substantially.

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Sources of Water for Household Enterprises in Rural Vietnam

S. Noel [Tanzania]

Small-scale productive activities undertaken in and around the household (e.g., kitchen gardens, raising of livestock, small businesses) require adequate quality and quantities of domestic water to operate. The research analyzed 189 purpose-collected household surveys from 6 villages in 3 provinces in rural areas of Vietnam to investigate patterns of use of domestic water and the impact on household-based productive activities. The findings indicate that these enterprises almost exclusively used ecosystem water, primarily well water, rainwater and water from rivers and lakes. This result held even in villages where piped water was available within the household plot. The conclusions emphasize the importance of natural capital in rural livelihood activities and suggest that patterns of development which draw down wealth in terms of natural capital stocks may adversely affect the poor in developing countries in the long run, even while raising GDP per capita in the short to medium term.

Forthcoming paper

A paper providing the full research findings on the Vietnam study is forthcoming in the journal Water Policy.

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Analysing productive use of domestic water and wastewater for urban livelihoods of the poor: a study from Accra, Ghana

L. Raschid-Sally, D. Van Rooijen & E. Abraham [Ghana]

Using Accra as an example, the paper records the different urban livelihood activities that utilize domestic water/wastewater, quantifies such use and presents a framework for planning multiple uses in an urban context. The paper provides insights to city planners, water authorities, and researchers on the wide range of 'other uses' that urban domestic water supply and wastewater is utilized for and how to quantify such use. From preliminary findings we conclude that the interests of people who use domestic water for livelihood purposes can be better accounted for under conditions of improved access, which will reduce the price they pay for water and increase their profit margin. The constraining factor for making productive use of water is not so much water shortage, as inequity of water access in the city. In the case of wastewater, managing the risk is essential for ensuring sustainability of these livelihoods.

Introduction

Coastal Accra is situated in the Odaw-Korle catchment, and has a population of 1.66 million (within its current administrative boundary covering 240 sq km) and a population growth rate of 3.4% annually. The big city attracts people from rural areas in search of job opportunities and a better life. However, within Greater Accra, the 1992 Ghana Living Standards survey indicates that the poverty index is 20.8%, suggesting that there are 345280 people with a daily minimum wage of just under 2 USD per day (as of March 2006). It is not surprising therefore that 60% of the population lives in what are known as high density low income settlements. They seek livelihood opportunities that require a minimum capital outlay and many of these center around servicing the material needs of people. These types of "businesses" or small scale commercial activities are not officially registered and are therefore difficult to keep a track of. Many of these are also water dependent, but what is of interest is that the water used is not recognized as commercial water or water for livelihoods. Rather it is one of the "hidden" multiple uses to which urban domestic water is put.

The increasing demand for and use of domestic water in the city, simultaneously translates into wastewater generation. What is little known in most developing cities, and Accra is no exception, is that wastewater (including storm water runoff and all polluted surface water sources like city waterways) too, is used for multiple purposes by the poor. Notably, wastewater from cities which planners traditionally see as "useless", is a potential "water resource" popularly providing water (and nutrients) for irrigated urban agriculture.

Productive use of water is usually defined as the use of water to promote economic growth and improve livelihoods such as watering food-lots and livestock. Applying this concept to (treated) domestic water use, the case studies found in MUS literature, mostly address use of domestic water in a rural or small town context, for livelihoods activities centered on backyard irrigation, small scale livestock keeping, brick-making etc. Apart from a report for India (Verhagen & Bhatt, 2006) which discusses an urban context, and for Bolivia (CentroAGUA & IRC, 2005), where the peri-urban context of community supplies providing for multiple uses is presented; not much work has been done on the urban livelihoods dimension of urban water supply nor on the productive use of wastewater which also represents large volumes of "water" in an urban context. This paper attempts to present productive (multiple) use of water in a more inclusive manner by linking both urban water and wastewater into the urban livelihoods paradigm. The paper builds on exploratory work presented by Abraham *et al.* (2007) which was based on a small sample survey of urban water livelihoods in 6 electoral areas of the Accra Metropolitan Area.

Enterprises run by the poor

Per capita domestic water supply is said to vary between 60 and 120 liters per capita per day (in the well served areas only) and 25 to 60 liters per capita per day when poor households buy water from vendors (Abraham *et al.*, 2007). These same households are involved in various income generating activities requiring water. Some are typical service sector enterprises like street food vendors, restaurants and chop bars, hair salons and beauty parlors, others are involved in livestock rearing, and floriculture and other small industry to mention the common ones.

From the wastewater side various small enterprises like car washing, and much of urban and peri-urban agriculture, thrive on this resource; this, despite the fact that irrigation with wastewater poses health risks to those using the wastewater and those consuming the produce, in this case vegetables. It is estimated that up to 90 % of the most perishable vegetables are grown in (peri-) urban areas (Obuobie et al, 2006) where the water quality of most of the water sources used, is marginal, due to the mixing of natural drainage water with untreated wastewater).

Where urban water infrastructure is poorly managed and unable to serve the local communities, these types of livelihoods closely depend on small scale water vendors or purchase of water from neighborhood taps at tariffs much higher than the official urban domestic water tariffs (van Rooijen *et al.*, 2008). The poor entrepreneur buys water for these purposes at exorbitant rates often exceeding even the official water utility commercial rates.

Livelihood approach to planning multiple use urban systems

As Moriarty and Butterworth (2003a) said in their overview paper, while livelihoods approaches are very helpful in examining, understanding, and planning a multi-role use of water, it should also be kept in mind that these approaches are in effect applied common sense, a point also made by Critchley & Brommer (2003). A good introduction to livelihoods terminology, concepts, and how they can be applied to the water sector is found in Moriarty and Butterworth (2003b). Essentially, the livelihoods approach can be summarized as gaining an understanding of how people’s livelihoods work now, how they have changed over time and could be improved in the future, and of the critical opportunities for, and obstacles to doing so. For the urban water sector, taking a livelihoods approach means identifying the existing and potential role of water in people’s livelihoods – productive, health, consumptive – and identifying sustainable and effective ways of meeting these needs. For this paper, we will limit the scope of water and wastewater generated urban livelihoods, to their income generating potential only. Additionally the water dependent livelihoods which will be discussed here are those that use water/wastewater to provide a service, and not the enterprises that sell water directly.

Quantifying productive use of water and wastewater in cities

Water

The traditional approach to ‘basic needs’ excludes water for productive activities within the household. The figure of 50 liters per person per day currently used as the minimum basic requirement (sometimes also seen as the free basic requirement) was from Gleick (1996), and can be broken as follows in Table 1. This table does not however seem to include water for laundry purposes which may represent a substantial volume in this water budget.

Table 1: Domestic water supply norms

Purpose	Recommended minimum (liters per person per day)
Drinking water	5
Sanitation services	20
Bathing	15
Cooking and kitchen	10
Total	50

A small sample showed that in Accra urban domestic water use (for household purposes) in low income settlements can vary between 25 and 60 liters/capita/ day. (Abraham *et al.,* 2007). If an individual is using water for a service sector enterprise, clearly they need more. Preliminary results show that depending on the size of the enterprise, they may use from 30 – 400 liters per day of additional water (Table 2), for an average business that is not excessively water consuming (eg various food related enterprises, hair salons and beauty parlors, livestock keeping). A study in Gujarat, India showed that this figure could represent an additional 20-1000 liters per day, depending on size and type of enterprise (Verhagen & Bhatt, 2006) These are substantial increases from the basic daily per capita use by the poor. In most of these enterprises studied in Accra, the contribution of income derived from this enterprise represents 100% of total household income, which emphasizes the importance of this enterprise to household livelihood.

Table 2 : Typical daily use of water for productive purposes in Accra

Description of enterprise (no. of enterprises interviewed	Water requirement (liters/day) [dependent on no]*	Access constraints described (when)
Tea and beverage (2)	34 – 140	Absence of water seller [intermittent]
Porridge (1)	270	Distance to water source [daily]
Fast food joint (3)	135 - 160	None
Chop bar (4)	170 - 370	Low water flows [intermittent]
Restaurant (2)	1000	Low water flows [intermittent]
Beauty salon (1)	200 - 400	Low flow [irregular]
Hairdressing salon (5)	140 - 280	Poor access or unreliable [intermittent]
Livestock (5)	220 – 350	Poor access
Car washing (3)	1600 - 7300	Unreliable [intermittent

* volumes depend on numbers served but these figures represent the additional amounts of water that are taken out of the system for productive use.

Wastewater

Though sanitation coverage in the city is 88% with only 12% being un-served, the high figure does not reflect the fact that only 14% percent of the households have individual improved toilets (GSS 2005). The rest use shared facilities with neighbours, or more often, given the poverty conditions and space limitations, public facilities. But many of the latter may not be functional. Only 15% of the Accra Municipal area is sewered, thus most fecal sludge from the toilets is disposed of into the sea or at a sludge disposal site, both within the city. However greywater is discharged into drains and storm sewers. A small study carried out in Accra indicated that 53% of the population disposed of their grey-water directly into gutters and storm-drains. All this greywater supplemented by direct discharges from septic tanks and public toilets in low income areas, eventually empties into the stream and river network in and around the city, that serve as water sources for irrigated urban vegetable production.

It is estimated that a total of about 100,000 m^3 per day of wastewater is generated, though this is based on an average per capita daily consumption of 76 liters (MoWRWH, 1998), and a wastewater return flow of 80%. A portion of which is re-used by farmers. In Accra about 680 ha are under maize, 47 ha under vegetables and 251 ha under mixed cereal-vegetable systems. In addition about 50-70 ha are distributed over 60% of Accra's households (80,000 tiny backyards). Plot sizes under cultivation in the city range from 0.01-0.02 ha per farmer, and increase up to 2.0 ha in peri-urban areas. In Accra practically any open space is used for farming vegetables and other crops because of the high demand from the city. It is estimated that 800-1,000 farmers earn an income from this activity (Obuobie *et al.,* 2006). Based on the mentioned irrigated areas, the annual volume of wastewater that is used in Accra in urban and peri-urban agriculture is estimated to be 4.4 MCM (Million Cubic Meters) (Abraham *et al.,* 2007).

Appreciating productive/multiple uses of urban water and wastewater

Similarities in use between large and small cities

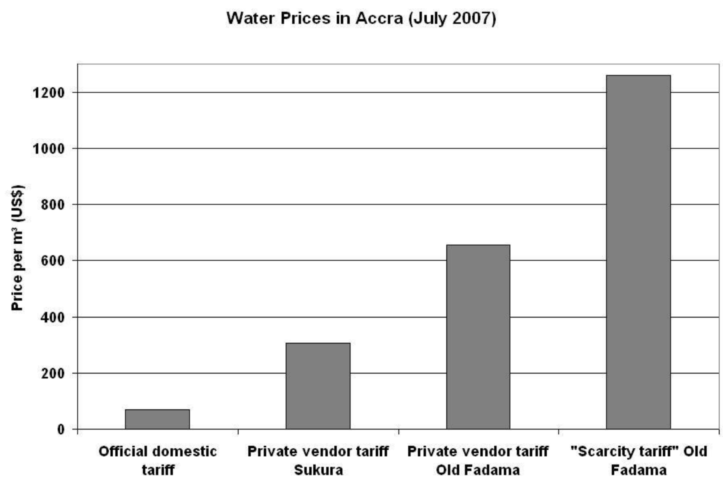
Productive use of water is not very different between small towns and big cities with large low income settlements, which have certain needs that the service enterprises discussed above, cater to. In a small town context in Vietnam, Noel *et al.*, (2006) report livestock keeping, preparation of food products and drinks typical to the country, and services like various types of eateries and snack bars, tea and coffee shops and of course beauty parlors and hair salons. Similarly in South Africa, the urban small town context has a similar cross section of business enterprises, which are also likely to be similar across countries and continents.

Incremental costs of supply are minimal, so why not plan for it?

Making the point that incremental costs are minimal, can encourage city water supply planners and water utilities to plan for catering to the additional need. An example from South Africa clearly Illustrates this (Moriarty and Butterworth, 2003b). According to their findings, once the capital costs for the system had been met, the extra capital cost implied in designing a system to supply 60 l/p/d from roof tanks compared to 25 l/p/d from yard tanks was Euro 96[1] per household even after including the extra O&M costs over a 20 year period. For this extra cost, an additional 35 l/p/d is available, equivalent to over 1,500 m^3 over twenty years! The combined additional cost per m3 was therefore Euro 0.11 (excluding capital repayment).

Unrestricted productive uses of domestic water may not always be positive and desirable specially where it is unplanned and where it uses water from under-designed ‘domestic’ systems. So, by explicitly recognizing that productive use is inevitable, it is possible to include it in planning and demand management. This is particularly relevant for Accra where urban water supply is already constrained. Moreover, since many of the people using water for productive purposes are within the low income bracket, including it in demand management could better secure access to water, which is one factor contributing to the sustainability of productive water use.

Figure 1. Comparison of water tariffs between official domestic and those measured in the low income areas of Sukura and Old Fadama in Accra (Van Rooijen *et al.,* 2008)



Forms of privatization, and its influence on productive use

It is recognized (by the World Bank and United Nations) that it is extremely difficult for a water utility, to operate a water service profitably and at the same time provide affordable services. Privatization is said to have failed because designing tariffs that do not discriminate against the poor are hard to achieve in practice (Solo, 1999). Whilst this may be so, it must be noted that in cities like Accra, even if the poor paid the commercial tariffs of privatized water supply, they would still be paying **less** than what they pay presently to small scale service providers.

In Figure 1, we see the price difference for water paid from different sources in two low income areas of Accra: the official domestic tariff of Ghana Water Company Limited (GWCL) is at 0.70 USD per cubic meter. The price that is paid for water if it is bought from private vendors is more than four times the official tariff in Sukura, at 3 USD per cubic meter, compared to 9 times the price in Old Fadama. This price differential is influenced by the fact that Sukura is a formal low income settlement, with some water supply infrastructure laid on, whereas Old Fadama is an informal settlement where water supply infrastructure is officially not permitted. There is a monopoly amongst private vendors and price is agreed upon by the water vendors alone. In times of scarcity, which is a couple of times every month in the dry season, the price in Old Fadama goes up to 12 USD, which is 18 times the official price for domestic users (Van Rooijen *et al.,* 2008).

It is clear that it is the 'other private sector' of small scale water providers who benefit from exploiting the poor, thereby cutting into the profit margins of small entrepreneurs. Usually these water providers are (1) the families with water connections who provide services to their neighbors (in Bamako such providers are responsible for 25% of the city water supply); or (2) water points managed by individuals, or (3) water tankers who supply to households and to the small water enterprises (who in turn re-sell, keeping a profit margin). Considering that the poor pay anything between 4 to 18 times the official water prices, it is likely that they will be willing to pay in order to access water for their livelihoods. If private water utilities were able to provide the service, even at non-subsidized rates, it is likely that the poor will still benefit. A key solution lies in a more competitive private water sector market, which will eventually lead to lower water prices for the poor.

Other constraints to productive use of urban water

Noel et al (2007) report that other constraints can limit the effectiveness of these enterprises even if water were not a limiting factor. The two most relevant to the Accra context would be:

- Poor access to capital and credit for investment - the poor reported difficulty securing loans for micro-enterprise start-up costs;
- Skills, technical knowledge, and education.

Use of wastewater

The two main uses seen in Accra were washing of vehicles and irrigated urban farming. An interesting perspective is that with wastewater the term multiple use is less applicable compared to the term productive use. And even unlike with domestic water the term 'productive' has a special connotation given that normally wastewater is 'non productive'. New approaches like ecological/sustainable sanitation, and design for re-use (which is an emerging concept) enshrine productivity of wastewater in their definitions. Accepting that even wastewater is seen as a resource by the poor in developing country contexts (Scott et al, 2004, IWMI, 2006, Raschid-Sally and Jayakody, 2008); it is imperative that urban livelihood analyses take cognizance of this and provide assistance to farmers and other users to mitigate the risks of such use. From and urban livelihoods perspective it is not so much a matter of providing the wastewater (which is 'freely' available in developing country contexts), as a matter of managing the wastewater related risks. In the case of irrigated agriculture, simple and cost effective methods have been tested (Drechsel et al, 2008) and are available, in line with WHO (2006) guidelines for safe use of wastewater excreta and greywater, which reduce the health risks to farmers and consumers.

Planning for multiple use of urban water

Using the insights and experiences gained from the case of Accra, a simplified framework for analyzing productive use of urban water is presented. Urban water is viewed within the urban water cycle with particular reference to water supply and wastewater generation. The two main steps in determining and addressing productive uses of urban water are:

1. Determining types of small scale multiple, uses using the sustainable livelihood based approach
2. Ensuring sustainability through water demand planning and wastewater risk management.

Determining types of small scale multiple uses using the sustainable livelihood approach

A sustainable livelihood based approach focuses on determining people's *actual* water needs and uses, the constraints they face in accessing water supply and thereafter designing an environmentally, socially and economically sustainable action/solution to meet these water needs and uses (see Figure 2 and Box 1 for an explanation of the livelihood framework elements).

Box 1: Key livelihoods concepts explained

Assets are usually broken down into five categories: human capital, natural capital, financial capital, social capital, and physical capital. Political capital is sometimes included under social, sometimes explicitly added as a sixth capital.

Shocks, trends and seasonality (or the vulnerability context): Shocks are sudden events, usually with negative impacts, and include things like natural disasters, civil conflict, losing one's job, a collapse in crop prices for farmers etc. Trends emerge over a longer period of time and examples include increasing population pressure, deforestation, declining commodity prices, increasing accountability of government and technological trends Seasonal changes are important in relation to the value, availability, and productivity of natural capital and human capital (through sickness, hunger etc)

Policy, Institutions and Processes: Policies, Institutions and Processes embrace a complex range of issues associated with power, authority, governance, laws, policies, public service delivery, social relations – gender, caste, ethnicity – institutions – laws, markets, land tenure arrangements – and organizations – NGOs, government agencies, private sector. These effectively determine access to various types of capital, and to decision-making bodies and sources of power, which influence the livelihood strategies adopted by individuals and households, and ultimately the returns to the pattern of livelihoods adopted.

Livelihood activities include all the activities that people engage in as part of making their living. They include farming crops and livestock, selling forest products, wage labor work etc.

Livelihood strategies are the full portfolio of livelihood activities, but linked to an understanding of the choices and decisions underlying them. They include: how people combine their income generating activities; the way in which they use their assets; which assets they chose to invest in; and how they manage to preserve existing assets and income.

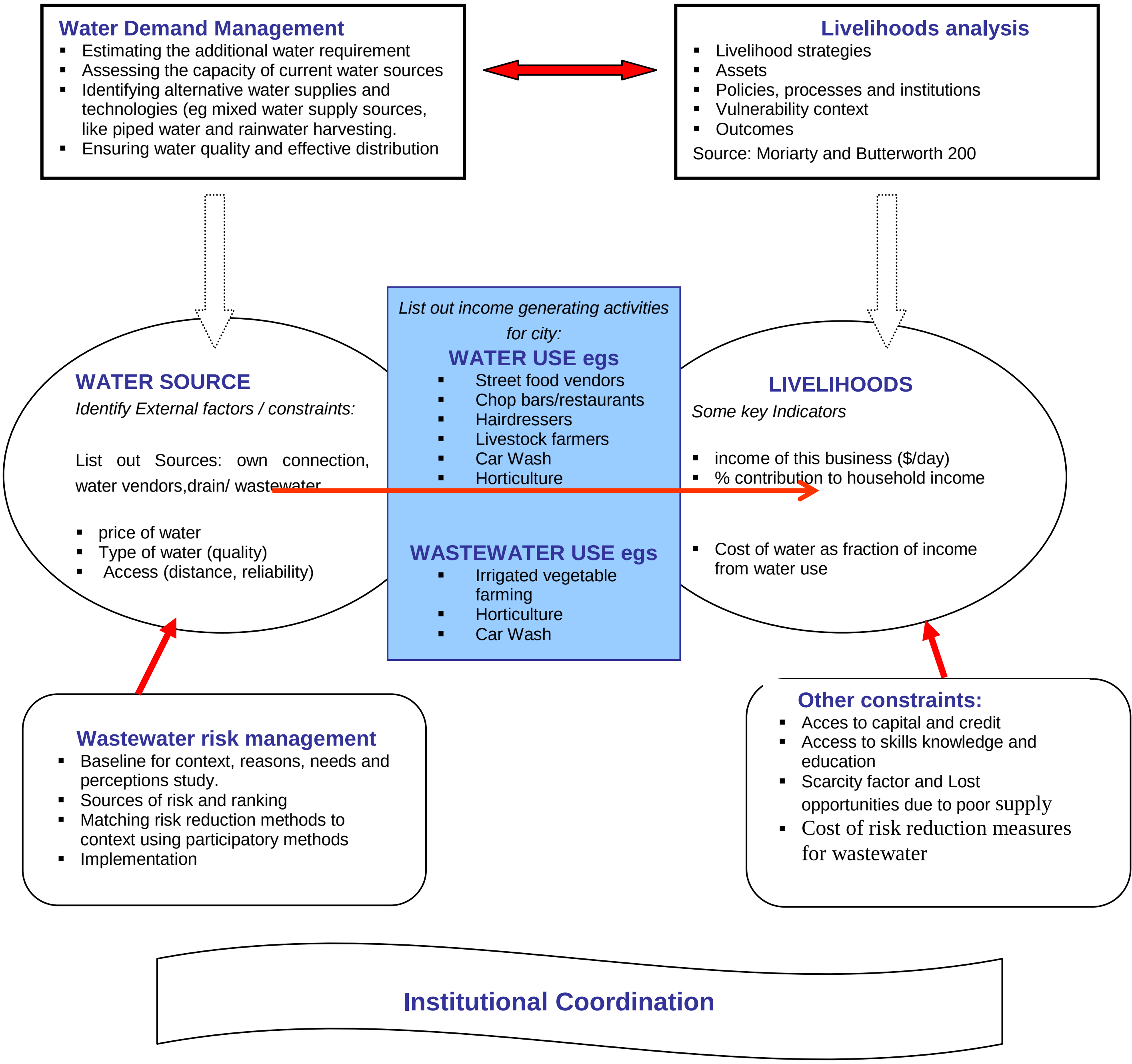
Livelihood outcomes are the achievements – the results – of livelihood strategies. These may include more income, increased well-being, reduced vulnerability, improved food security, more sustainable use of the natural resource base, improved social relations and status, and more dignity and (self)respect.

Source: summarized from Moriarty and Butterworth (2003b)

The first step in such a process is identifying the low income settlements within the city as these are the areas where service enterprises are concentrated, and also the areas which are poorly served by water supply systems. Thereafter a consultation mechanism should be implemented for each area to establish the following:

- The different types of small scale multiple uses in the area;
- The source of the water, namely is it domestic water directly from the scheme, or from a private water vendor, or wastewater;
- Volume and tarification: the volume of water used per activity; and the price paid;
- The contribution of the business to the household income;
- The fraction of total costs that is spent on buying water (indicating the importance of water for the livelihood activity);
- Accessibility and quality: accessibility (time and effort spent on getting the water), means of transporting the water from its point of origin to the place of final use; and the quality of the water used;
- Gender, age, and social exclusion related issues;
- Other factors that may influence the viability of the activity like access to credit and financing, availability of other relevant non-water related infrastructure, production tools, etc.

Figure 2 : Simplified analytical framework for quantifying productive use of urban water and wastewater



Ensuring sustainability through water demand planning, wastewater risk management and institutional coordination

Once the actual water needs and the different types of small scale multiple uses of water for a community, have been established, the next step is proposing the necessary interventions to improve water access. In planning for the increased water demand, the water supply authority should ensure that the resource can sustain the increase in consumption. At the city level, plans for increasing water supply to these communities have to be drawn up and the related infrastructure needs have to be identified. It is advisable that all potential water sources are considered. The impact on the catchment from increased abstraction for urban water supply has to be evaluated. The approach to supply management must thus be holistic, incorporating livelihoods considerations for poverty reduction and well being. New investments should target better distribution of the resource specially in low income areas, to create better access and subsequently lower water prices, instead of merely boosting water supply (Van Rooijen *et al.*, 2008).

The other two factors for sustainability are wastewater risk management and institutional coordination. The former has to be undertaken to identify the key entry points for reducing the risks resulting from wastewater use for livelihoods. The latter is essential as we are at the meeting point of water supply, wastewater/sanitation and agriculture with city planning authorities, and the health sector also playing an important role. Each of these is detailed below.

Water demand planning

Once the community's actual water needs have been established the water supply authority should consider the best and most efficient method, of supplying the water to meet the demand. In designing a sustainable and water efficient multiple water use supply system the following water supply considerations must be kept in mind:

- Confirmation that the resource can supply the additional supply requirements;
- Ensuring that the quality of the water is maintained, especially if other sources besides conventionally treated water are used;
- The most appropriate water abstraction and transfer mechanism;
- The identification of alternative water supply sources if necessary, and technologies to meet the water demand and quality requirements in an environmentally, socially and economically sustainable manner;
- The possibility of using mixed water supply sources such as piped water and rain water harvesting to meet demand needs and,
- The best location for the water supply points to satisfy the water demand and ensure effective distribution.

Wastewater risk management

The following steps are suggested to manage the risks from wastewater use. Various complex risk management frameworks are available in literature which can be simplified and modified for wastewater risk management in the case of productive use of wastewater.

- Baseline survey of livelihood activities using wastewater, to understand the context and reasons for its use, and the needs and perceptions of users;
- Identifying the sources of risk and ranking them by order of magnitude[2;]
- Matching tested simple cost effective methods for risk reduction (WHO, 2006) to the local context, and adapting them using participatory methods with the end users;
- Implementing these methods.

Institutional coordination

Urban livelihoods analyses should be an integral part of city planning. A platform for coordination is necessary at this level, which includes the stakeholders from the different sectors mentioned. In order to avoid duplication, if an existing platform is available, then the missing stakeholders can be co-opted when urban livelihoods issues are on the agenda.

Concluding remarks

It is now clearly recognized that domestic water services in rural and community settings have multiple benefits and some measures are being put in place to cater to these needs. What is less well recognized is that this is equally so in urban contexts – probably more so, as rural urban migration comes with certain expectations for the poor and many urban water dependent livelihoods are their only recourse. The few studies in literature show that they have an appreciable impact on livelihoods and poverty (Noel *et al.,* 2006, Verhagen and Bhatt, 2006).

Productive uses of domestic water and wastewater often occur in the less-visible informal sector that caters to the lower income groups. In the case of water supply, most planners and engineers are not even aware that such use may represent a large water requirement especially in poorly served systems. Furthermore planners use norms for designing systems but current norms do not include such use, hence they are being left out of water allocation priorities. In the case of wastewater, authorities usually ignore such use, as it is difficult to control, thus inadvertently contributing towards sustaining the risk.

Narrow approaches to water supply and wastewater use, that neglect productive uses of urban water, can be seen as missed opportunities for addressing urban poverty. Additionally failure to account for this additional demand at the design stage may well lead to system failure in some cases.

Accepting the potential for productive uses of urban water clearly means an increased demand by small-scale users, even where waste has been curtailed. As Table 2 shows, this increased demand, is sometimes substantial compared to the individual domestic use, depending on the size of the enterprise and the type of livelihood activity. It may be argued however, that in the larger water supply context, these additional volumes will represent only a small increase in the supply, compared to the volume of water used for domestic activities. However the importance of this water to household income generation must not be underestimated.

From preliminary findings we conclude that the interests of people who use domestic water for livelihood purposes can be better accounted for under conditions of improved access, which will reduce the price they pay for water and increase their profit margin. The constraining factor for making productive use of water is not so much water shortage, as inequity of water access in the city.

Ensuring sustainability of urban livelihoods requires consideration of three factors: sufficient provision of water, managing the risks from wastewater, and institutional coordination. In the absence of any one of these factors the system is likely to breakdown.

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Note/s

[1]2003 rates. Currently 1 Euro = 1.42 USD

[2]We are not suggesting here that quantitative and comprehensive risk assessments are done which are complicated and costly, but that an understanding of the sources and a ranking of these is carried out using simple indicators for quantification.

Keywords

Urban water use, wastewater, urban poverty, livelihoods, privatisation

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Service Oriented Management and Multiple Uses of Water in modernizing Large Irrigation Systems

D. Renault [Italy)

20 large irrigation systems (average system size is 171.000 ha) mainly in Asia are scrutinized for multiple uses, functions and purposes. Most of them have been investigated by FAO as part of its program on irrigation modernization. The concept of Service Oriented Management (SOM) is central in the latest developed approach, called MASSCOTE [Mapping Systems and Services for Canal Operation Techniques]. This SOM approach on irrigation systems paves the way to identifying multiple uses and functions of water services within the gross command area of these systems. Analysis shows that only two systems out of 20 can be classified strictly as single use, all the other systems, are dealing, with varying degree, with multiple water uses, multiple functions, and/or externalities within their command area and therefore can be qualified as medium or high Multiple Uses of Water Services (MUS) system. Not many irrigation systems are designed/developed for providing service for multiple water uses, or are integrating MUS in absolute terms, but not many systems rank high in service oriented management either. However many systems (7) are already following practices related to MUS, only 6 systems have low MUS integration. It is found that the higher the degree of MUS the higher the integration of SOM in the management. High SOM level goes always with high integration of any other use when practiced in the command area. For some low SOM systems integration of MUSF in the management is still made at a similar low level as the one practice for crop water services.

Introduction: Approaches on Multiple Uses and Functions of water services

Multiple uses of water is attracting an increasing attention of decision makers and water professionals from different perspectives, domestic water and irrigation of course, but also power generation, environment and tourism, etc. Generally speaking Multiple Uses of water services (MUS) has been for long, and still often is a de facto and sometimes unknown practice that has been exposed as a result of studies carried out to address concerns regarding water services provision to poor people and farmers, the impact of irrigation development/management on eco-system (externalities of irrigation development) and the issue of low performance on irrigation systems. The three main approaches that have been helpful in addressing the above mentioned concerns and revealing the existence and extent of MUS are: the livelihood approach, the ecosystem services approach and the service oriented management approach. These approach reflect also the various scales of MUS dimension respectively the household, the catchment and the scheme.

The livelihood approach revealed how much especially poor people can benefit from using water in multiple ways from the same infrastructure to satisfy basic needs that would cost a fortune to satisfy by other means (van Koppen B. et al, 2006, Renwick M. et al, 2007). The ecosystem services approach has been historically another source for revealing in various instances the high value of multiple uses (positive externalities) when it is threatened to merely disappear. A good example of such an ecosystem services approach is the paddyfield cultivation the multiple values of which have been (re)-discovered and documented when this agriculture practice has been seriously jeopardized on the solely basis of rice economic, abundant examples of that exist in Asia but also in other parts of the world. Another good example of this concern is modernisation of irrigation techniques at field level and the risks associated to other uses when water losses are effectively reduced or eliminated as a result of the program. For instance in south of France this recognition has led in the 80s to specific modernization programs maintaining a high proportion of surface irrigation at field to avoid the depletion of groundwater highly dependant on deep percolation from irrigated fields (Renault D. 1988) and which are the sole source of domestic water to some towns during summer.

Similarly to what has been done in the Millennium Ecosystem Assessment, ecosystem services related to water can also be divided into the following types: Provisioning, Regulating, Cultural and Support services (see CA 2007 Chapter 6). Irrigated paddy cultivation is practiced in what is classified as a "manmade wetland system" which yields to multiple values in many dimensions as shown in figure 1.

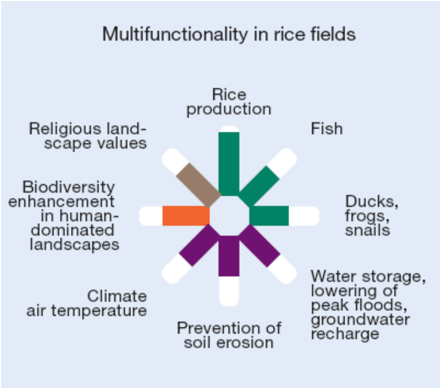

Figure 1 Ecosystem services in rice fields (Extracted from Chapter 6 CA 2007)

The service oriented management (SOM) approach applied to large irrigation systems as part of an irrigation modernization strategy also clearly reveals the various uses and users "beyond the crop" and beyond the farmers. In medium and large irrigation systems the concept of multiple uses of water which was neglected or even sometimes rejected, has gain momentum during the last decade as the result of SOM. The necessity to improve service to users and to progressively balance the account for operation and management has led managers to cense more carefully uses and users and ultimately the potential payers of the services.

Drastic revisions of the notion of services and users have resulted, and irrigation managers are now keener to face the reality of their multi-sectoral business. They are progressively abandoning some of the theoretical "fiction" on which irrigation infrastructure has been developed initially such as "imposed cropping pattern", "single use", etc. MUS in irrigation systems is clearly the result of the principles of reality and of service oriented management.

This paper relates to Service Oriented Management approach and Multiple Uses and Functions of Water services, analysing the experience gathered recently on FAO modernization projects on large irrigation systems.

Mapping System and Services for Canal Operation Techniques

The Land and Water Division (NRLW) of FAO initiated in the mid 90s a program on modernization of irrigation management with a particular focus in Asia. As part of this programme, various tools and methodologies have been used to develop the capacity of the irrigation engineers in the region. The most recent approach (FAO, 2007) is called "Mapping System and Services for Canal Operation Techniques" (MASSCOTE). It integrates/complements tools such as the Rapid Appraisal Procedure (RAP) and Benchmarking to enable a complete sequence of diagnosis of external and internal performance indicators and the design of practical solutions for improved management and operation of the system.

MASSCOTE aims to organize project development into a stepwise (see Table 1) revolving frame including:

- mapping the system characteristics, the water context and all factors affecting management;
- delimiting manageable subunits;
- defining the strategy for service and operation for each unit;
- aggregating and consolidating the canal operation strategy at the main system level.

Table 1. MASSCOTE STEPS	
Mapping	**Phase A – Assessing baseline information**
1. The performance (RAP)	Initial rapid system diagnosis and performance assessment external and internal indicators
2. The capacity & sensitivity of the system	Physical capacity of irrigation structures to perform their function of conveyance, control, measurement, etc. Sensitivity of irrigation structures in reacting to input changes
3. The perturbations	Perturbations analysis: causes, magnitudes, frequency and options for coping.
4. The networks & water balances	Main features of the irrigation and drainage networks, Water balances at system and subsystem levels.
5. The cost of O&M	Costs associated with current operational techniques and resulting services.
Mapping	**Phase B – Vision of SOM & modernization of canal operation**
6. The service to users	Mapping and economic analysis of the potential range of services to be provided to users.
7. The management units	Management organization in units and sub-units
8. The demand for operation	Resources, opportunities and spatial demand for improved canal operation.
9. The options for canal operation improvements / units	Improvement options (service and economic feasibility) for each management unit for: (i) water management, (ii) water control, and (iii) canal operation.
10. The integration of SOM options	Integration of options at the system level (cohesiveness check).
A vision & a plan for modernization	Consolidating a vision - finalizing a modernization strategy

Service-oriented management in irrigation: revealing MUS

Service Oriented Management is a managerial approach that focuses on the supervision and control of the delivery of a service from a service provider to a service requester. In irrigation management, the latter is called a service receiver. The three pillars of SOM are the service itself and the two actors – the provider and the receiver (or user and beneficiary) – as illustrated in Figure 2.

The actors of the service

In business language, receivers are considered customers or clients. In an irrigation system, receivers are these but also actors or stakeholders of the management through effective participation in the governance of the scheme. For example, in a Water User Association (WUA), farmers are not only the customers of the service, they also are involved in the decisions about it. In this sense, the farmers are also actors.

The elements of the service

The first element is the water. Water delivery is central in the service, but it is not the only important component. Information is also an important element of the water service. Information flows in both directions, from providers to receivers and vice versa. Users need to have information about the allocation of water, the scheduling of supply, and about measurements of deliveries. Money is also a critical element of the service approach. The bill for the irrigation management services has to be paid by someone, now or later, for own use and for someone else. Therefore, it is a major responsibility of the management to organize effectively the flows of money for covering the cost of producing the services .

Indeed, the service consists of three main flows: service = water + information + money which are intrinsically linked to each other (Fig.2).

Defining services to users

The diagnosis of MUS in a command area of an irrigation system does not proceed from a priori methodology but is clearly and without doubt the consequence of the approach of Service Oriented Management. The compulsory focus on services leads to uncover the multiple uses when they do exist.

Irrigation systems were originally built to supply farmers with water where crop requirements could not be met by natural precipitations. Thus, service to farmers has been and should still be the central focus of the management. However, over time, it has become increasingly apparent that other beneficiaries besides farmers are taking advantage of irrigation water supplies for uses other than crop production, which of course may sometimes conflict with irrigated agriculture. The services to users are today much broader than at the initial stages of irrigation development although water demands by farmers are still the central focus of management and agriculture often remains the main consumer of water.

Diversifying services for agricultural uses

Many irrigation systems have been designed to supply the same water service to farmers throughout the entire command area, considering quite uniform needs for water based on assuming uniform conditions of crops, soils, local water access, etc. However, we know much better now that agricultural demands are not homogeneous. Some physical conditions differ from one location to the other, access to alternative source of water varies highly in a command area. Furthermore in most of the irrigation systems diversification of cropping patterns has largely occurred since inception time. The demands of an organic farming community, growing vegetables and flowers, will be very different from uniform rice-based smallholder systems, which are again quite different from large cotton or sugar-cane estates. Their irrigation requirements will not only be different in terms of all performance variables, but their water demands will also be based on considerable differences in irrigation techniques, labour requirements, economic returns, vulnerability to service failures, bargaining power, status, gender divisions, etc. Crop water requirements for the different crops and varieties will be the basis of any irrigation service demand, but they are not the only rationale in farmers' irrigation strategies.

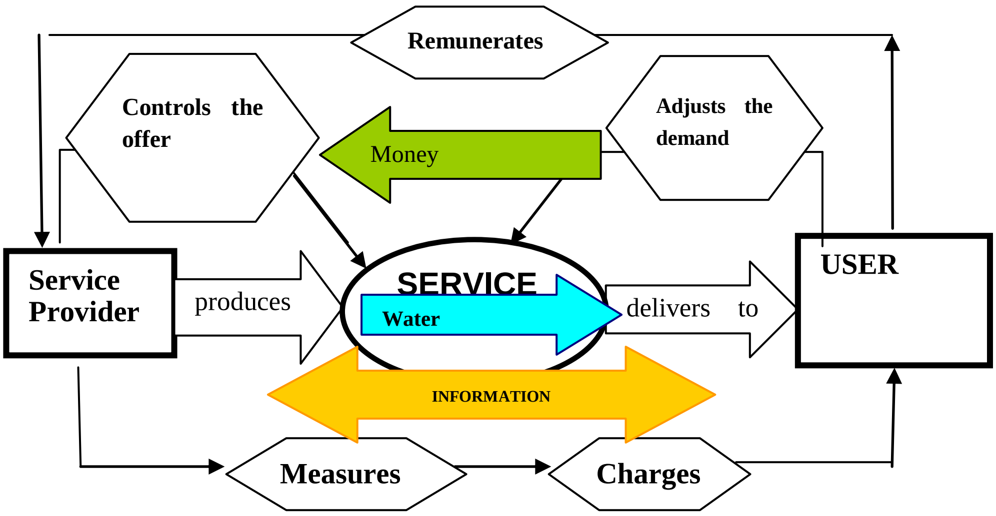

Figure 2. Sketch of Service approach with the 3 basic flows: Water (blue), information (yellow) and Money (green) [After Renault and Mountginoul, 2003].

In summary, it is important to remember that the demand for irrigation services even for the same type of users (farmers) is heterogeneous in time and space within a command area. The motto for modernization and SOM is then to define the right service at the right cost to each use and with each user.

Provision of service for other uses

The above-mentioned various additional uses and specific needs related to water management require different types of water service, ones that differ from the service for crop production. These extra services are context-specific, sometimes simple and at other times complex; they need to be discussed and tackled locally. The services for other uses might be of the following types:

- Supplying water to a delivery point
- Maintaining flows in local streams and waterbodies
- Maintaining water levels in local waterbodies
- Maintaining water quality in natural streams
- Maintaining the capacity for storing water and control floods

Types of operation required for multiple services

In theory, the basic physical operation of gates in the system is the same for providing any type of service. However, the process of decision-making and planning for these activities may differ from that of farmers and canal managers.

An important aspect of operation for these “other uses” is planning and allocation. Canal managers need to know the water demands and requirements, as well as available resources, for these different users in order to be able to allocate water properly for these activities.

The multiple uses can sometimes conflict with one another and there is a need to compromise when the operation requirements are antagonists.

Table 2. Type of target and service for different uses

Use/function	Type of service / target
Delivery to farms	A time (and volume) bound water delivery A share of flow
Domestic water	Bulk water delivered [Discharge or volume per period]
Drinking water for cattle	Water supply to small ponds. Construction of ramps on canal side to ease access to water.
Support/recharge to natural surface streams (surface and groundwater) & environment	A specific discharge to outlet Water presence in canals and at field (seepage and percolation) Water quality through water dilution and/or drainage control
Industry and Hydropower	Discharge and head availability. Water supply to small ponds for small industry
Tourism, fishing, recreation, wild animals & natural parks	A water presence & a given water level in waterbodies
Control of vector-born diseases in waterbodies	Water-level fluctuations
Flood control	Water storage capacity
Control of drainage return flow	Maximum discharge

Analysis of 20 large irrigation systems with respects to MUS

A set of 20 medium to large irrigation systems mostly in Asia, totalling a Gross Command Area (CGA) of 3.4 Million ha, probably hosting more than 10 millions of inhabitants have been considered in the analysis. 18 of these irrigation systems have been directly investigated through RAP and MASSCOTE by FAO since 2004, the size of the gross command area varies from 13,000 ha to 540,000 ha with an average of 171,000 ha. All systems qualify as large systems with the exception of two having a GCA below 25,000 ha which for Asian standards is considered as medium.

Two medium size systems, one in Sri Lanka the Kirindi Oya Irrigation System, and one in France, the Canal Saint Julien, have also been included in the study because they are both well documented and can serve to a large extend as references on MUS in many ways.

The analysis of the 20 systems has been first carried out considering a typology approach the features of which are presented in table 3. Results against this typology are mentioned in table 4 column 4 for multi-purpose and column 5 for the multiple uses. The ecosystem dimension and the multiple functions are addressed on column 19.

Important to note that the set of systems cannot be considered as representative of irrigation in Asia as 15 out of 20 systems are from South Asia. The paddy systems, dominant in South Asia, are under represented here, only 3 systems are rice based partly or totally.

Out of 20 systems 8 are considered Multiple Purpose Reservoir while 5 systems are Multiple Purpose Network, 10 systems are classified as MU + , 7 are considered as MU Seq and 3 are MF (total is more than 20 as some systems are exhibiting several types). Only 2 systems are classified as true Single Use of Water, namely Jamiakou in China and Naryani in Nepal. In both cases domestic supply if well provided, through a separate network in Jamiakou, through the presence of shallow groundwater in Naryani.

Table 3. Classification of MUS per type			
TYPE		**Sharing**	**Typical situation**
MPR	Multiple Purpose Reservoir with separate networks	Reservoir	Reservoir used for irrigation, environment, domestic and flood control.
MPN	Multiple Purpose Network based on a single distribution infrastructure	Network	Main canal serving cities, irrigation, industrial sites, environment,...
MU +	Single Use distribution network yielding opportunities and externalities for other uses.	Water resource & Network	Domestic + Irrigation +
MU Seq	Sequential system: drops cascading from one compartment to the other, one non consumptive use to the other.	Water cycle/pathway	Conjunctive use of water System with recycling (re-use) facilities
MF	Natural Multi dimension/functions/services	Territory Eco-system	Paddy Field system Wetlands

How SOM and RAP-MASSCOTE reveal Multiple Uses

In the following sections, we examine some of the criteria and outputs of RAP/MASSCOTE applications and illustrate how a SOM approach leads compulsory to the identification of Multiple Uses and Functions of water services when they do exist. First of all RAP/MASSCOTE exercises by putting “Services” as a plural reverse the common trend to consider one single use of water (irrigation). In that sense the considered norm is MUS and the exception is Single Use which has to be proved. This radical attitude is usually supported by various aspects of the managerial investigation that can point out on the existence or not and the importance of MUSF. Among many:

- Water balance (MASSCOTE STEP4) is a fundamental critical entry point for management which allows mapping down the water consumption by the irrigated crops and non-crop elements (other uses). This is a critical step in asking where do the water goes, to which uses and users? It is always striking to see how managers are flabbergasted when they discover the low share of crop water consumption and inversely the high share of other uses.
- Field survey (during the application of RAP/MASSCOTE) allows assessing the degree of perennial vegetation (natural and home garden) in the command area and by comparing it with non irrigated near by areas to estimate the possible contribution of irrigation water to sustain non crop vegetation (for productive purpose and biodiversity).
- Field survey can also reveal activities which are water dependant, such as fishery, small industry, recreational, tourism, etc...
- Presence or not of separate domestic water network is also a good indicator of the reliance of people on irrigation water to support other uses than crops in particular drinking/domestic water and cattle.

Degree of MUS

The degree of MUS has been analysed for each system of the set by adding the number of different uses that have been reported in the RAP/MASSCOTE. It is equivalent to the number of dimensions shown in figure 1. It does not express though the magnitude of the multiple uses which should be assessed through more detailed analysis of the water balance and/or the various values generated by the different uses. Only few systems are enough documented to reach that level of understanding.

The maximum degree recorded is 7 for Kirindi Oya IS. The irrigation systems can be grouped in 3 categories:

- Single Use: 2 systems
- Medium MUS (degree between 1 and 3): 14 systems
- High MUS (degree>3): 4 systems

Table 4. Features of Multiple Uses reported in the sampled systems

C olumn 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
System	Country	GCA (ha)	Multi-Purpose	MU type	Conjunctive-Recycling	Irrigation as % water input	Hydro-power	CITY & Industrial	Dom. Villages/Cattle	FISH	TREES & Afforestation	Environment	Flood protection	Tourism Recreational	DEGREE of MUS	SOM	MUS in Mgt GCA	Comments/Functions/Externality
Gathapraba GLBC	India	180000		MU + MU-Seq	YES	54	YES	Margin	YES						2.5	1.3	2.0	High Conjunctive Use
Badra	India	162000	MPR	MU-Seq MF	YES	57	YES	YES	YES	YES		YES		YES	6.0	1.0	2.0	Paddy cover 1/3 of CA - Domestic water raising
Hemawathi	India	265000	MPR	MU-Seq MF	YES	70	YES	YES							2.0	1.1	2.0	Paddy covers 40 % of CA - TREES important
Almatti LIS	India	87400	MPR	MU +		52				YES	YES	YES			3.0		2.0	New system: MUS to build up
Gondorinala	India	13516		MU +		45				YES		YES			2.0	1.3	3.0	New system: MUS to build up
Benniethora	India	25863		MU +		65				YES		YES			2.0	1.0	3.0	New system: MUS to build up
Jaunpur	India	542000		MU + MU-Seq	YES	54			YES	YES					2.0	1.2	1.0	Raw water supplied to tanks for cattle
Doukkala	Morocco	104300	MPN	MU + MU-Seq	YES	35		YES	Margina						1.5	2.3	1.0	Supply city of Safi
Jordan Valley IS	Jordan	42000	MPR MPN			999									1.0			Domestic water to capital Amman
Sunsari Morang IS	Nepal	107400	MPR			25			Marginal						0.5	0.7		
Naryani IS	Nepal	37400		SU		26									0.0	0.2		Indirect impact on arsenic issue due to poor services
Gohthki	Pakistan	518000		MU + MU-Seq	YES	87			Margin	YES		YES			2.5	0.9	1.0	Irrigation canal used as sewage system/garbage disposal
Jamrao	Pakistan	411903	MPN		YES	80			YES						1.0	1.4	2.0	Irrigation used as sewage system
Akram Wah	Pakistan	229395	MPN		YES	77		YES	YES						2.0	1.0	2.0	Contamination from industry
Fuleli Guni	Pakistan	419379	MPN		YES	83		YES	YES						2.0	0.8	2.0	
Jiamakou	China	22000		SU		0									0.0	2.9		Separate Domestic supply network
Sanganhe	China	41333	MPR			15		YES							1.0	1.6		Main reservoir contribute to Beijing water supply
Zanghe	China	173000	MPR	MU +			YES	YES	YES			YES	YES		5.0	2.9	4.0	Negative ext. on donwstream lake
Canal Saint Julien	France	10000		MU +		0		YES	YES		YES	YES			4.0	3.7	4.0	Canals buried in cities - Delivery to Garden
Kirindi Oya IS	Sri lanka	25000	MPR	MU + MU-Seq MF	YES	50		YES	YES	YES	YES	YES	YES	YES	7.0	1.0	3.0	PADDY dominant - Negative ext. to coastal lagoons Dom. supply integrated in management practice

SOM Indicator

An indicator has been specifically defined for this study to capture the degree to which Service Oriented Management is conceptually incorporated and practiced by irrigation managers. This indicator has been derived mostly by aggregating internal indicators of the Rapid Appraisal Procedure. The rationale is to capture the extent to which the three flows defining the service (see Figure 2) are well incorporated in the management.

$$SOM = Water * Money * Information$$

The "water" indicator is calculated as a weighted average of the "water measurements" indicator to the individual ownership units and the quality of delivery from the reported indicators of flexibility, reliability and equity.

The "money" indicator has been calculated by multiplying the indicator for budget coverage of Management Operation and Maintenance (MOM) from RAP multiplied by a factor between 0.5 if this budget is entirely covered from state budget and by 1 if it is entirely covered by users. This weighting factor was added to reflect the flexibility between the service users and the payers.

The "information" indicator is calculated aggregating indicators of institutional development (WUA) and communication related to canal operation at various levels.

Finally the SOM indicator is then taken as the average of the above 3 indicators. The results are displayed in column 17 of table 4. On a scale of 1-4 the median SOM indicator is 1.1 which appears to be very low by any accounts [range 0.2 and 3.7]. This is a clear indication that SOM has a long way to go to become a well spread practice.

The SOM indicator and performance of irrigation system in terms of gross production per unit water ($ US/m3) are well correlated [Perf ($US/m3)= 0.4xSOM-0.24 with R^2=0.78] which means that high value systems go with high SOM practices.

Integration of MUS in the management

The integration of MUS in the management has been evaluated by ranking between [0] and [4] the management attitude towards MUS as described in table 5. One important aspect of the ranking is the differentiation between what is stated or recognized by managers and what is actually practiced at local level. This differentiation is a common approach is the RAP exercise aiming at evaluating the gap between central management and field practices. The ranking of MUS integration accounts for that as stipulated in the Table 5. For instance moving from an indicator of 1 to 2 corresponds to a change of practice at local level not from the central manager attitude.

The multipurpose dimension of the systems have not been accounting for here as it is normally expected that integration should reach a high value [3 or 4] for the multiple uses they have been designed for. In system which classifies as multipurpose (MPN and/or MPR), the degree of integration is evaluated only for the additional multiple uses. Results are:

- High integration i= 3 or more 5 systems
- Medium integration i=2 7 systems
- Low integration i=1 3 systems
- No or very low integration 3 systems (some of these systems are multipurpose)

The two single use systems are not accounted in the above partition.

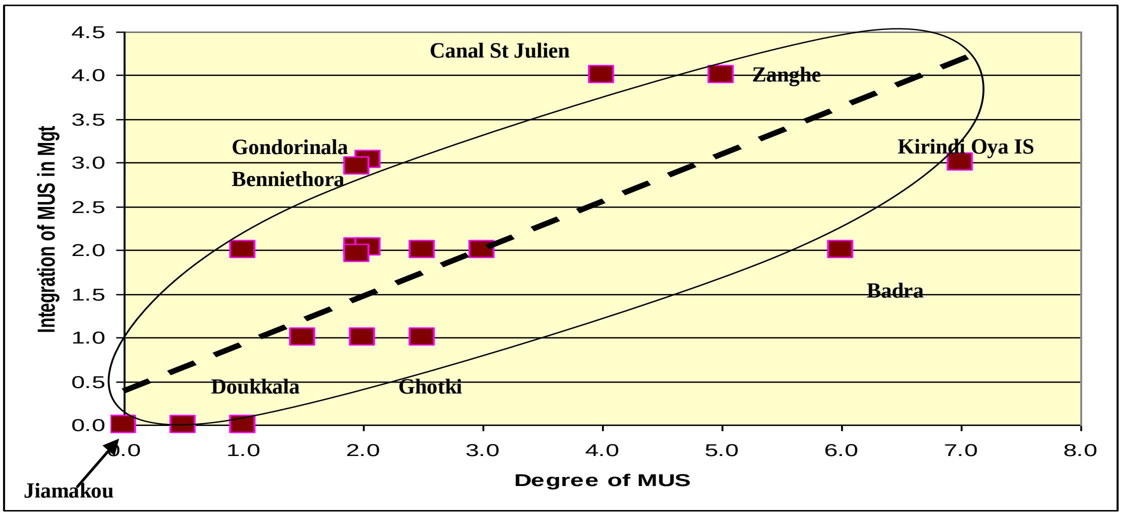

Figure 3. Degree of MUS recorded and integration in management

Relationship between degree of MUS and its integration in management

In figure 3 we plotted the assessed indicator of integration of MUS as a function of degree of MUS. There is clearly a positive trend between the two: the higher the degree of MUS the higher the integration of MUS in the management.

Relationship between SOM and MUS

Last analysis performed on the indicators is about the relationship between the level of SOM and MUS integration. Results are displayed in Figure 4. Of course these two indicators are as expected somehow independent. High SOM does not necessarily mean high MUS and vice versa. Still interesting lessons can be learned and some affirmation can be drawn from the analysis of SOM vs MUSF.

- **Affirmation 1** When SOM is high, existing MUS is integrated. This can be seen looking at system with SOM indicator greater than 2.
- **Affirmation 2** Low SOM can still go with relatively high MUS integration. In that case it means that the various multiple uses of water are somehow treated in the same way as water delivery to crops. This is in particular the case of the paddy system in Kirindi Oya IS.
- **Affirmation 3** Management attitude matters. Despite the fact that Gondorinala and Bennithora systems are brand new and still under development with no evidence of MUSF as yet, these systems are ranked high for MUS integration (3) because the manager immediately after the RAP/MASSCOTE exercise has incorporated MUS in its concerns and management interventions in particular on monitoring water flows throughout the command area.

Table 5. Ranking of integration of MUS

Indicator value	Management attitude	Manager attitude [as stated]	Local level operators and local practices [as seen on the field]
0	Ignoring or denying MUS and/or its magnitude	"There is only one single use for irrigation"	
1	Blind eye on MUS practice by users	Manager is aware of some MUS related practices but do not consider them as part of his job.	No intervention to reduce direct pumping from canals No particular concerns about groundwater pumping No intervention to prevent use of canal as a waste disposal.
2	Positive marginal practices to support MUS		Local operators accommodate in their day to day practices the other uses of water. e.g. letting unfixed leakages to drainage when water is used by downstream people/villages. letting unauthorized gate flowing into near by small tanks or drainage.
3	Integration of other services concerns into the operation	Manager knows and organise the management to serve other uses or to ensure that operation for irrigation do not penalised the other uses.	Bulk water deliveries to villages tanks Main canal filled with water after irrigation season to provide water to people in the GCA. Local reservoirs managed to account for other uses. Minimizing period of canal maintenance.
4	Integration of Multiple Uses Services into the management and governance.	MUSF is fully integrated in the Management Operation and Maintenance. Governance is made on the basis of multiple services with multiple users/stakeholders.	Each service well defined. Users well identified, they pay for the services, they have a say on decisions on the system management.

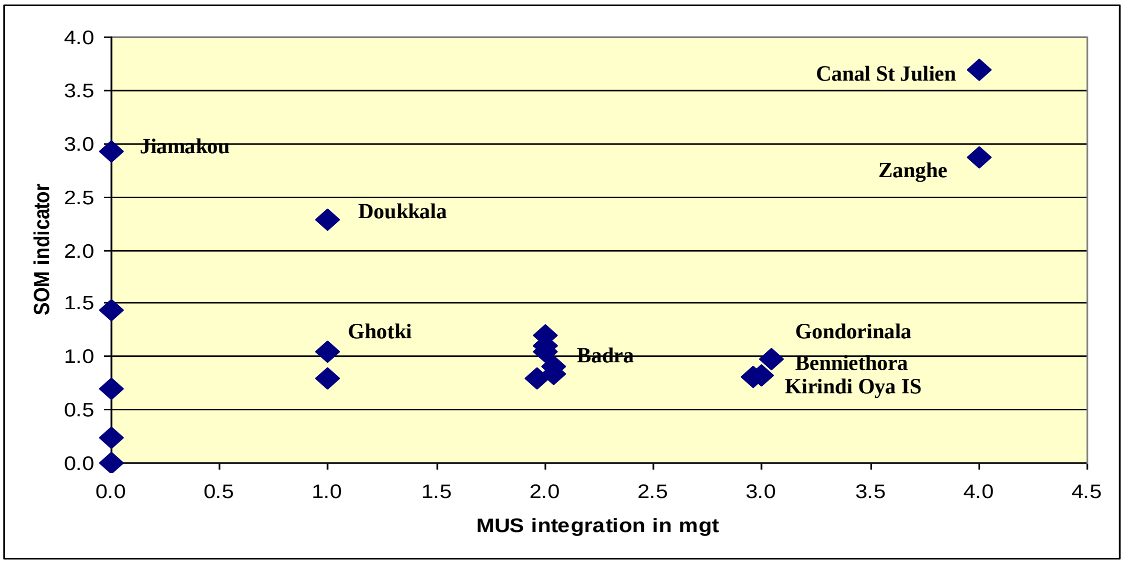

Figure 4. MUS integration and SOM practices

Table 5. Insights from some systems	
System	Interesting features for SOM and MUS
Kirindi Oya IS	**High MUS Medium/Low SOM.** Well known and documented paddyfield system (Renault et al, 2000) almost every type of water uses, multiple functions such as tourism and flood control (paddy system) are met. Multiple values of this system has been also documented for some key components such as food and fisheries (Renwick M., 2001, Hermans et al 2006). Irrigation consumption only one third of the total water inputs - Trees grown on homestead garden and in the landscape is the more important uses of water 44 % but generates high values for the people [Coconut trees are the tree of life]. Also noticeable negative externalities to coastal lagoons as too much fresh water is drained jeopardizing the shrimp population (both a source of incomes for some people and feed for migratory birds)
Canal St Julien	**High MUS High SOM.** Well documented old canal South east of France (Canal St Julien, 2008). Only 13 % of water withdrawal is consumed by agriculture crops. The remaining 87 % are shared by Groundwater recharge – Environment: strengthening of surface natural streams – Home Gardens - Trees in cities. Cost sharing was a strong motivation to assess and manage MUS which is now well integrated into the governance and management process of the association.
Zanghe	**High MUS High SOM.** A very interesting case well documented from China (Dong Bin, 2008). Remarkable for the huge changes it has experienced. Between 1970 and 2000 water for agriculture has been dramatically reduced annually from 600 MCM to less than 200 MCM while other uses have been raised from almost zero to 450 MCM.
Badra	**High MUS Low SOM.** One of the highest degree of MUS reported, multipurpose reservoir, a large complex cascading system, paddy fields mostly at tail end, large domestic water use, drinking and washing, cattle drinking water, power production. Yet SOM is low and integration of MUS remains low.
Ghotki	**Highly reliant on irrigation water.** The system is part of the Indus River infrastructure, as first one in Sindh province Pakistan. Reliance on irrigation water is extremely high (80 % of the water inflows). Fish ponds - domestic uses - cattle drinking water, are the main other uses that are highly dependant on irrigation water flows. Urban areas are using canal systems as waste water drainage and garbage dumping facilities.

Conclusions

This article is a starting point for a further thorough review of Service Oriented Management and Multiple Use and Functions of water on large irrigation systems. The preliminary analysis of 20 of these systems, yields encouraging signals about the importance of MUS in general and on its strong relationship with the modern concept of service oriented management.

Until recently, irrigation system managers often saw the dimension of multiple services as a problem to which they are confronted or to uses which they are tolerating. However the analysis shows that things are changing, the attitude towards MUS is no longer the merely ignorance of it. Average reported attitude includes at least operational practices addressing MUS.

It is clear that the initial reluctance in considering MUS has more to do with the fact that “service oriented management” is not the current practice everywhere. Once the concept of SOM is, at least conceptually, adopted then MUS can easily be brought in. Obviously cost sharing is a strong motivation for integrating MUS. It has been known for long that the more economically sustainable irrigation systems are often Multiple Uses type, for instance associating hydropower generation and irrigation. The challenge today is to assess, value and incorporate in the operation and management various additional informal uses, externalities to and functions of water services.

Many important questions have to be answered: How to assess properly the various uses? How to value them? How to govern multiple uses system? How to operate them? How to define, produce, deliver and remunerate the water services? How to ensure water quality matches diverse needs? Obviously some issues remains to be solved; some obstacles at local and national levels have to be removed to allow more efficient and sustainable MUS in irrigation system management.

However to a large extend it also depends on the good will of the managers to embark upon MUS in a stepwise process which may include as a starting point assessing the share of water by uses, determining the values associated to these uses, setting the specific services required, as well as develop the awareness of all shareholders on MUS. Ultimately reaching full SOM and highly integrated MUS is a long term objective but significant progresses can be achieved in that end with reasonable efforts.

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Keywords

service oriented management; multiple uses; irrigation; modernisation.

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Multiple uses of water: a view from the reality of rural communities and national politics in Colombia

I. Domínguez, S. Corrales, I. Restrepo, J.A. Butterworth [Colombia]

The water needs of people living in rural areas are integrated, and take into account personal hygiene, drinking water, food preparation and small scale productive activities. These activities are all important to provide food security, income and reduce the vulnerability of poor people. The interventions made by water supply projects that follow national policies and regulations in Colombia are, like in many other countries, fragmented and usually neglect innovative approaches. Innovative approaches that consider all basic water related activities linked to livelihoods can make a significant difference to household economies in poor areas. This paper presents evidence on how families manage water in rural areas of the Valle del Cauca Department (Colombia), and how this reality has been ignored by national policies and regulation. Proposals to reduce the gap between rural practice and policies for this sector are also suggested. These recommendations should help policy makers to take the rural context into account, to improve the regulations, and to contribute to poverty alleviation, equity and sustainable development.

Introduction

This paper summarizes findings from Colombia in the international Project "Models for implementing multiple uses of water systems for enhanced land and water productivity, rural livelihoods and gender equity" (mus; see www.musproject.net), sponsored by The Challenge Program on Water and Food. The paper presents evidence on how water is really used by rural communities in Colombia, and how legal and institutional frameworks for providing water in the country unfortunately fail to recognize this reality. reflections are made and proposals formulated to help find ways to reduce the gap between policies and reality. This work was carried out following the Learning Alliance and Action Research methodologies that engaged stakeholders at community, regional level and national level.

Methods

This research was implemented in three phases: 1) understanding the relevance of productive uses of water for poor rural families in Colombia; 2) analysis of the legal and institutional framework for water supply in rural areas, and 3) policy advocacy to propose changes to these frameworks which are under the responsibility of the Vice ministry of Drinking Water and Sanitation, dependent of the Ministry of Environment, Housing and Territorial Development in Colombia. Study cases were developed in five rural communities of Valle del Cauca department and in some productive farms of the Quindio department to help understand local water use practices. In addition, the interventions by the Rural Water Supply Program (PAAR[1]) were studied in 91 rural communities in 29 municipalities of the Valle del Cauca (Figure 1). This information was analyzed regarding the topics considered related to water for domestic and productive uses, livelihoods and sustainability. A comparison between the evidence gathered on rural water use practices and the approach of the the water sector in Colombia including policies and the legal framework was established. Through the methodology of Learning Alliances which engaged [say something about the people involved here], collective proposals were developed to improve the planning, execution and management of water supply projects and to contribute to a more integrated approach of project development. Stakeholders involved in the learning alliance selected the case studies and were involved in field visits to assess the interim research results. It was expected through this methodology to facilitate the institutionalization of knowledge and its application in several social contexts and over x years a series of y workshops were held (I think you have some references here to the papers you produced on LAs, PAAR etc. They could be usefully cited).

Results and discussion

Understanding the reality of rural water uses

Productive activities at the household level were found in all the settlements studied, both where the PAAR program was working and also in all the case studies specially selected for the MUS project (Figure 2). This information is also supported by the results from the national census (DANE, 2005), which indicates that 73.4% of the rural households in Colombia developed some agricultural activity. In rural areas, some of the most intensive agriculture occurs just around the homesteads of families. In 77% of the households served by PAAR systems, coffee together with banana or fruit trees were found around homesteads. Vegetables, beans, corn and yucca were also common. Animals for own consumption and in some cases for sale were found in 67% of the households. Medicinal plants and vegetables are also an important source of income. The households without animals or crops, are often involved in activities linked to agriculture like transportation, food preparation for people working in the field, etc. In rural communities located close to urban centers, small businesses also thrive.

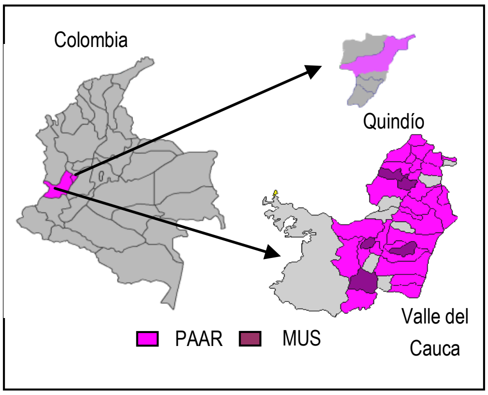


Figure 1. Case study locations

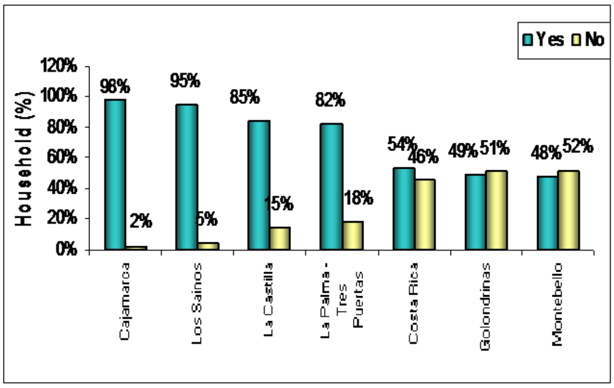


Figure 2. Households with productive activities

The size of the family plots varies, and as a consequence the space availability for productive uses, however results show that these activities are developed at small scale. The scale decreases with proximity to urban centers as land is used even more intensively. In almost all the cases studied the size of plots was under 1 ha (Figure 3). Regarding animals, the survey showed the importance of pigs, cows, chickens, and in some cases horses. The results show that most families with animals have less than 5 units of cows, horses and pigs. The number of chickens is between 6 and 30 units (Figure 4). Activities are gender related. Men are usually in charge of the most profitable crops (coffee, pineapple, corn and beans), while women share with men the responsibility for vegetables. Men care for horses and cows, and there is a shared responsibility for pigs while women are normally in charge of keeping chickens (78%).

The research showed that family income is correlated to using water for livelihoods. In 61% of the households in Cajamarca, 80% of the income depends on access to water. In La Palma – Tres Puertas, income depends less on water (38%) because here many people work as labourers growing field crops on land which is not their property. In this specific settlement water availability is also much less than in Cajamarca so people have less productive activities at household level. This situation is reflected on the income level of the families: in La Palma – Tres Puertas income is around US$150 per family per month, while in Cajamarca, with more water available at home, 70% of families have profits over US$150 per month and 27% higher than US$600 per family per month (Figure 5). The income produced makes it possible to pay the tariff for the water service.

The survey showed that in PAAR practice, surface water is the main source for water projects with 86% of the systems supplied by small streams and rivers. In 23% of the projects the water supply systems take water from 2 to 4 small streams but the use of other complementary sources like ??? was never considered.

On the contrary, some projects were not developed in communities suffering water scarcity.It was found that most of the households use the water from the water supply system for all their activities, without considering the required quality for the use. The resource from the water supply system is used in most of the cases (90%) for cooking, drinking (human and animals), and cleaning, which includes water for excreta evacuation. For irrigation, the reported use is less (around 70%) which shows that these are relally multiple use systems meeting domestic and irrigation water needs (Figure 6). during the dry season, water supply systems are even more important to meet irrigation demand. The willingness to use alternative sources of water increases with the scarcity. In Montebello, 46% of the families have used rainwater and 24% greywater for activities like cleaning (floors, baths), excreta evacuation and irrigation (López 2005). In this settlement the water was only supplied for two hours every alternate day.

The total amount of water required to satisfy domestic and small scale productive uses was on an average across all systems studied found to be 213 l/person/day. In the cases of Golondrinas, La Castilla y Los Sainos, human and domestic consumption had the greatest demand because it includes water for sanitation and washing of clothes. Irrigation demands are around 100 l/person/day, due to the small size of the cultivated areas, and in several cases rain fed. The reported consumption for kept animals was between 20 – 48 l/person/day.

Figure 3. cultivated area at the plots

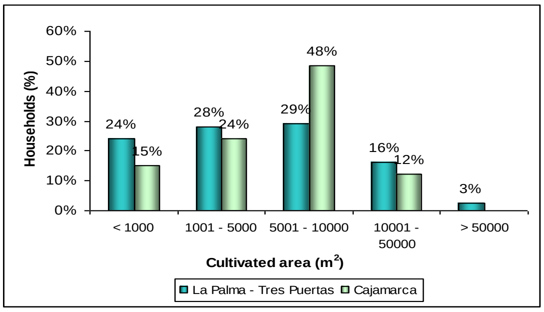
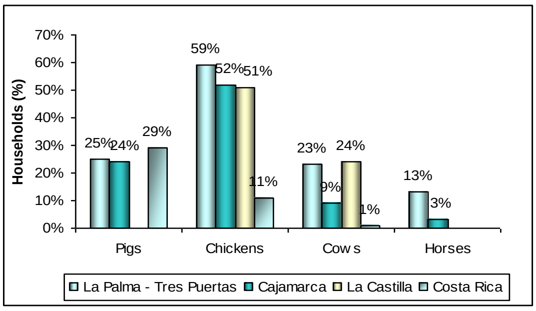


Figure 4. Households with animals



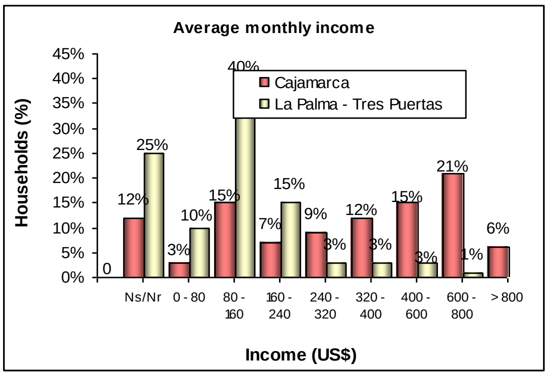


Figure 5. Monthly income per family

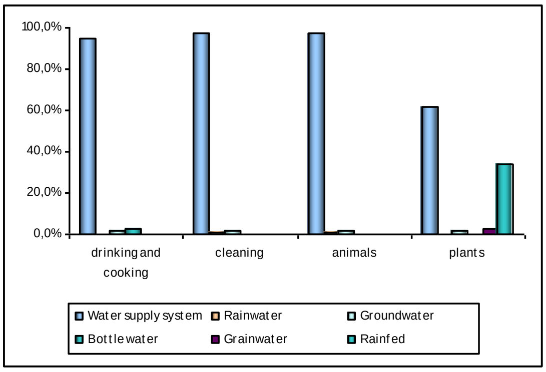


Figure 6. Uses and water sources

Limitations in the legal and policy frameworks to satisfy the water needs of rural families

In Colombia, the Government is responsible for guaranteeing that public services are provided efficiently to people. Its mandate includes infrastructure investment and formulation of regulations to provide public services. At the national level the most important institutions related to water resources are the Ministry of Environment, Housing and Territorial Development, the Ministry of Social Protection, and the Agricultural and Rural Development Ministry. The Environment Ministry has a Vice Ministry of Water and Sanitation which is responsible for the formulation of policy and directives and has the role to orientate the investments made in the sector. This Vice Ministry is in charge of drinking water for "human consumption", and as consequence, the policies and investments in this sector have this orientation. In contrary, the Ministry of Agriculture lack clear policies and regulations oriented to water supply, and its investments are sporadic programs or projects to improve competitiveness in rural areas. Thus while families use water in integrated ways in rural areas, the institutional setup of government hampers integrated water development and service delivery from the start.

The 1594 (1984) Act establishes as water uses: human and domestic consumption, biodiversity preservation, agriculture, recreation, industrial and transportation uses. Different institutions have different responsibilities over the water depending on the uses established. The 1096 (2000) Resolution, Basic Regulation for the Drinking Water and Sanitation Sector (RAS) indicates that in drinking water projects for "human consumption", besides domestic use the commercial, industrial, institutional and public use should also be considered. This appears to encourage provision for multiple uses. However, the 302 (2000) Act, related to water and sanitation services provision, stipulates as one of the causes to suspend the service to the customer is to use the water for a purpose which is not mentioned in the contract agreement. Generally the permitted use is the "human and domestic consumption". The latter include just water for cleaning and washing clothes.

The RAS 2000 guideline also stated that the supply depends on the number of inhabitants in the settlement. It is lower for communities less than 2500 people (100 – 150 l/person/day) but there is no upper limit set for communities with more than 12500 people. These guidelines, although formulated for urban areas, have been traditionally used for rural communities. In 2007, a rural RAS was formulated, but it adopts the same criteria for the allocation of water and kept the orientation of systems on only human and domestic use.

The RAS 2000 defines possible water sources for human consumption as surface and groundwater. It emphasizes that just in exceptional cases may rainwater be considered. RAS 2007 makes a small advance to suggest the possibility to implement rainwater harvesting in areas of water scarcity. RAS 2000 also presented recommendations on water treatment levels, depending on water quality and the need to achieve the requirements of the 1594 (1984) Act and 2115 (2007) Resolution that establish drinking water quality criteria.

Conclusions and recommendations

Policies and regulations for designing rural water supply systems do consider different categories of uses and users, but do not recognize domestic users with small scale productive activities. Rural water needs have been understood largely as domestic needs thatdo not include the amount of water required for small crops and animals. However these uses are important to guarantee people livelihoods.

Although rules suggest surveys to establish local conditions and the possibility to increase water allocations, the general practice for designers is to use the "number" established in the directives. It also promotes inequality, by recommending less water provision to people living in small settlements and more water for those living in more populated settlements.

The approach of the regulations to supply drinking water to accomplish an impact on health has led to the promotion of surface water and groundwater as the only source for water use. This situation has been exacerbated with the general perception of water abundance in the country. The use of alternative sources has been promoted by policies and laws, but without significant change in the regulations that actually support the practice.

Legislation to design, manage and operate rural water supply systems needs to recognize the multiple water needs of poor rural people. According to the results of the research, typical needs include: water for domestic uses, water to irrigate a cultivated area no more than 10000 m2 during the dry season, and water to keep 10 chickens, 2 pigs or 2 cows. The amount required for all these uses would be around 250 lpcd but it could be less, if efforts are also made to ensure water is used more efficiently through efficient technology and good practices. It is important also to establish incentives at the policy level on the use of multiple sources for multiple uses especially, to facilitate rainwater harvesting. The use of alternative sources is a way to promote the efficient use of water and also to maintain the "better" resource for activities that demand better water quality.

The water quality standards for water supply systems in rural areas need to be more flexible and be based on the different uses of water. In some cases it could be more efficient to promote water treatment at the household level, to maximize the use of the community resources (natural, human, economic).

Acknowledgements

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Note

[1]The main objective of the PAAR Program is to provide water to rural communities of the Valle del Cauca department, by building or improving water supply systems. This initiative brings together several public and private institutions of the department.

Keywords

Multiple uses, rural water supply, livelihoods, policy, Colombia

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Characterising the multiple use approach at community level: findings from case studies in 8 countries

S. Smits, B. van Koppen and P. Moriarty [Netherlands]

Multiple-use services (mus) have gained increased attention, as an approach to of providing water services that meet people's multiple water needs in an integrated manner. This paper tries to characterise key elements of mus at community level, and assesses performance through a review of case studies conducted in Bolivia, Colombia, Ethiopia, India, Nepal, South Africa, Thailand and Zimbabwe. The cases show that people almost universally use water for domestic and productive activities at and around the homestead. The case studies demonstrate how levels of access can be provided by different types and combinations of technologies, and incremental changes made. These need to be accompanied by additional financial and management measures to ensure sustainability of services. The additional requirements posed are considered not to be insurmountable and can all be addressed in a feasible manner, and often justified by the additional benefits.

Introduction and objective

Over the last few years, the multiple-use services (mus) has emerged as an alternative approach to providing water services (Moriarty *et al*., 2004; Van Koppen *et al*., 2006). It is defined as an *approach* to providing water services that meet people's multiple water needs in an integrated manner (Van Koppen et al., 2006). This approach aims to overcome some of the limitations of sectoral approaches to water services which often limit people's access for their multiple water needs: domestic water supply programmes do not cater for people's small scale productive needs, while irrigation projects mostly do not explicitly cater for people's domestic needs or their productive activities around the homestead. The multiple-use approach is an approach to considering these needs in water programmes, and explicitly tying to cater for these. It is not a specific type of technology or system, but rather an approach to, or even philosophy of, water services provision.

Whereas this is a broad all-encompassing definition, it does not provide planners, policy-makers and other water sector stakeholders with clear guidelines and tools on how to provide such services in practice. The MUS (Multiple Use Systems) Project, a project under the Challenge Programme on Water and Food (CPWF), aimed to fill this gap by researching *de facto* and planned multiple-use services, and developing operational models for mus on the basis of these practices. The objective of this paper is to present a characterisation of the multiple-use services studied in the project, and to define how these can be used as building blocks in applying a multiple-use approach.

Methodology

Framework for analysis

This paper follows the framework proposed by Van Koppen et al. (2006). Central in this multi-layered framework is the individual user: who uses water in a range of livelihoods activities. At this level, we characterise water use patterns in relation to people's water-related livelihoods activities. The framework also considers that the extent to which water can be used for livelihoods, is determined by the level of access to water, defined by factors such as quantity, quality and distance between source and point of use.

We can therefore usefully analyse the relation between the use of water in people's livelihoods and access levels, and present this in the form of a water ladder.

Access, in turn, is determined at the level of the community by four inter-related factors: technology (or infrastructure), community-level institutions, financial arrangements and water resources. For each of these elements, an analysis is made in this paper of how they affect access in the case study locations. On the basis of these findings, indications are given on how these factors need to be addressed in order to facilitate multiple use of water. The framework can therefore help to frame better interventions.

Finally, the framework indicates that in order to support and scale-up mus, a number of elements need to be in place at intermediate and national level. Although the MUS Project did look into those issues, they are reported elsewhere and this paper limits itself to characterizing the factors at community level.

Case studies

The MUS Project was carried out in 8 countries: Bolivia, Colombia, Ethiopia, India, Nepal, South Africa, Thailand and Zimbabwe. Over 30 (groups of) villages were studied across these countries. In each of the villages, the different elements of water use, access and water services provision were assessed, using both qualitative and quantitative methods. The results have been synthesised in the form of a series of case studies (see Van Koppen et al (forthcoming) and MUS Project, 2008 for an overview). The case studies were complemented by bringing together service-providers, policy makers and other relevant actors in so-called Learning Alliances (Smits et al., 2007) acting as fora to guide the action-research, and to discuss the implications of findings for service provision and scaling-up. Table 1 provides an overview of the study areas, and the main focus of the study. The countries and cases represent a wide range of contexts, in terms of geography, socio-economic characteristics, types of systems and institutional settings. Nearly, all the cases discussed here however can be classified as "domestic-plus" systems, i.e. they provide water for productive uses, on top of domestic uses.

Table 1. Study areas

Country	Study area	Main focus in study area
Bolivia	5 communities around Cochabamba	Community initiatives for planned multiple-use services in peri-urban areas
Colombia	6 communities in the Quindío and Valle del Cauca Departments	De-facto multiple-use of domestic gravity-fed piped systems, and inclusion of lessons-learnt into government water programme
Ethiopia	One Peasant Association of 11 villages in Dire Dawa woreda (district)	Mus pilots by NGOs in extremely poor areas, with very low levels of access to services
India	Two villages in the Nasik district, Maharashtra	Piloting mus within the government domestic water supply programme.
Nepal	Three communities in different districts in the Southern Himalayan foothills	Piloting gravity-fed piped systems for multiple-use
South Africa	One ward of 11 villages, in Bushbuckridge Local Municipality	Introducing mus into the integrated development planning of the Local Municipality.
Thailand	4 groups of farmers in Buriram, Chayaphum, Khorat and Yasothon provinces in Northeast Thailand	'Farmer Wisdom Network' focusing on self-sufficient farming, through rainwater harvesting
Zimbabwe	Marondera, Murehwa and Uzumba Maramba Pfungwe districts	Technological innovations of NGO programmes

Findings

Water use and access to services

In all of the cases, water was being used nearly universally for a broad range of small-scale productive uses around the homestead such as kitchen gardens, animals and home-based industries alongside domestic use and field-scale agriculture (both irrigated and rainfed). However, the type of use, and the relative importance of these uses is highly variable across countries, communities and even households since such uses are closely related to the level of access provided. Two of the most important, out of four characteristic affecting 'access', are quantity of water and distance between water point and point of use. The table below provides an overview of the relation between access and the types of use of water found in the cases.

Table 2. actual water use and livelihoods activities

Site and technology	Distance or roundtrip	Range of average daily water use (lpcd)	Use of water
Ethiopia Communal piped systems with very few standpipes	Roundtrip up to several hours	8-17	Domestic uses, few litres a day of grey water re-used for fruit trees
South Africa Communal piped systems with scattered street taps	Roundtrip up to an hour	30	Domestic use, few families have gardens and home-based industries
India Communal piped systems with frequent standpipes	At homestead or short roundtrip	40 (design supply)	Domestic, small backyard gardens and communal cattle troughs
Zimbabwe a communal boreholes with hand pumps b. individual shallow wells with windlass and buckets c. individual shallow wells with rope pumps	a. 0-500 m b. at homestead c. at homestead	a. 10-15 b. 60-70 c. 80-90	a. Domestic, few cattle and community gardens b. Domestic and household gardens c. Domestic and extensive household gardens
Bolivia a. tankers b. piped systems with household connections	a. at homestead b. at homestead	a. 30 - 40 b. 60 – 80; in one village up to 140	a. Domestic use only b. Domestic use of 50-60 lpcd and remainder for dairy cattle (6-8 heads per family), or household garden (up to 50 m^2)
Nepal Communal piped systems with stand pipes shared between 2-3 houses	Short roundtrip	137-225 (design supplies)	Around 45 lpcd for domestic uses, remainder for extensive household gardens of 125-250 m^2
Colombia Communal piped systems with households connections	at homestead	75-120 in peri-urban communities, and 190-250 in rural ones	a. around 75 lpcd for domestic uses, remainder for irrigation of extensive gardens (up to 350 m^2), over 10 heads of cattle and small animals, and processing of coffee
Thailand a. farms with ponds and other sources b. farms without ponds, with other sources	a + b: at homestead	a. 80-1000 b. 80-500	a + b. domestic uses: 20-60, gardens: 100-300 b. Rice irrigation: >500

The cases show a high diversity of consumption patterns, ranging from less than 17 litres per capita per day (lpcd) in the villages in Ethiopia, where a roundtrip to fetch water may take several hours (Scheelbeek, 2005; Jeths, 2006), to over 200 lpcd in communal systems in Colombia (Cinara, 2007), and up to 1000 lpcd use in Thai farm-pond systems. Despite these differences, in all cases people used the water for productive as well as domestic purposes. Even in Ethiopia, people use a few liters a day for a cow or some fruit trees. But, with higher access to water, the extent to which water is used for small-scale productive uses increases disproportionately. With increasing access domestic use stabilises at some 40-75 lpcd, and any quantity above that is used productively. As the distance between water points and point-of-use increases, quantities used decrease rapidly as for example is found in Ethiopia (Scheelbeek, 2005).

These empirical data, in combination with data from other studies and expert estimates have been used to describe a more generic relation between access characteristics and the water needs that can be met in the form of a water ladder (Van Koppen and Hussain, 2007; and further adapted by Renwick et al., 2007), categorising "multiple-use" service levels (Table 3). Because of the variability of contexts, the ranges are quite broad and boundaries between categories are not always clear. This table can be used by planners, in thinking through the access characteristics that need to be in place to meet a certain level of water needs.

Table 3. Multiple-use ladder (based on Van Koppen and Hussain, 2007, and Renwick et al., 2007)

Service level	Distance or roundtrip	Quantity (lpcd)	Potential needs met
Maximal multiple-use service	Water at the homestead	>100	All domestic needs Not all but in some combination: Livestock Extensive gardening Small-scale enterprises
Intermediate level multiple-use service	Water at the homestead, or within 5 min roundtrip	40-100	Basic domestic needs Not all but in some combination: Couple of large livestock Gardening up to 50 m^2 Some micro-scale enterprises
Basic multiple-use service	Round-trip less than 15 min at distance between 150 -500m	25 – 40	Basic domestic needs Not all but in some combination: Some livestock Some gardening, especially with re-use Some micro-scale enterprises
Basic domestic service	Round-trip up to 30 min, or distance less than 1 km	10-25	Sufficient for drinking and cooking Hardly sufficient for basic hygiene Insufficient for other domestic uses Possibility for re-use for occasional trees and very limited livestock (e.g. few chickens or a goat)
No domestic	Round-trip more than 30 min, or more than 1 km	< 10	Sufficient for drinking and cooking Insufficient for basic hygiene

A quantity of water between 40-100 lpcd, within less than hundred meters from the point of use, is the estimated access level required to support multiple-uses of water at a significant scale. In addition, water needs to be available with certain reliability. Domestic uses require daily availability, either through daily supply from the system, or through storage at the household level. The same goes for livestock. For gardening, supply can be more be more infrequent. Water quality issues are not mentioned in the table above, but should not be forgotten. For drinking, the quality of water obviously needs to meet (inter)national quality norms at all levels of the ladder. For other uses, quality needs are less stringent.

Technological options

As already seen in Table 2, access is closely related to the type of technology. The technologies found in the case study locations were assessed in terms of their potential to provide a certain level of access on the ladder (Table 4). From the case studies we identified various incremental changes that can be made to develop technologies with the specific aim of facilitating multiple-use.

Table 4: Potential of different technologies for multiple-use services

Group	Technology	Potential for reaching multiple-use level	Incremental changes in technology	Examples from the MUS Project
Household-based options	Wells	Intermediate level of mus, although reliability may be limited due to fluctuations of groundwater levels.	Installing additional lifting capacity to facilitate multiple-use.	Family wells in Zimbabwe.
	Rooftop rainwater harvesting	As stand-alone source, it normally it does not have sufficient storage capacity, particularly not in semi-arid areas, for all uses. It can be used as complementary source to increase household access level.	Increasing storage capacity for as far as possible.	Rooftop systems in Zimbabwe and Thailand.
	Household ponds, and other in-field rainwater harvesting measures	Potential for meeting water for productive uses to maximal level. Water quality is mostly not apt for domestic consumption, and needs to be complemented by good quality source.	Including point-of-use treatment technologies.	Farm ponds in Ethiopia and Thailand.
Communal single access point systems	Communal wells or boreholes with hand pumps	Basic domestic to basic multiple use level.	Include communal infrastructure for productive uses such as a communal cattle trough, or community garden next to water point. Increasing household storage capacity.	Bushpumps in Zimbabwe
	Village ponds	Maximal level of access for productive purposes around the pond. Sometimes also domestic uses, though water quality and distance may be limiting.	Including point-of-use treatment technologies.	No examples in MUS Project, but more can be found at www.smallreservoirs.org
Communal distribution networks	Piped systems	Potential for multiple-use depends on system capacity and average distance between point of use and water points. Household connections can provide up to maximal access level. With scattered standpipes, only basic domestic level can be attained. Water quality may be a concern in case of surface water sources.	Reducing average distance between point of use and water points. Increasing household storage capacity Increasing overall capacity of different infrastructure components. Various treatment options at different levels in the system	Spring systems in Colombia, Ethiopia and Nepal Groundwater-fed systems in Bolivia and Ethiopia
	Gravity fed open canal systems	Potential for maximal level. Continuity and quality may limit domestic uses.	Various treatment option, especially point-of-use treatment Increasing household storage capacity.	No cases in MUS Project. But more can be found for example in Boelee and Laamrani (2004).

The findings show that mus does not require any "new" technologies. Current common technologies all hold potential in providing the required access though to different degrees. Technologies that bring water close to the homestead, i.e. household wells and ponds or piped systems with household connections, can achieve the highest service levels. Least potential in meeting productive needs lies with communal boreholes with hand pumps or piped systems with scattered standpipes, as distances to the point of use are high and design supply quantities are low. These can accommodate communal-level multiple-uses, such as community gardens or communal cattle troughs, but normally don't allow for productive uses at or around the homestead.

This table of technologies, in combination with the water ladder (Table 3), can be used to identify the technology needed to provide a certain level of access, and types of livelihood activities that might be supported. In addition, it can help to identify incremental changes that can be made to existing systems to improve the access level. Finally, it allows for the planning of combinations of technologies to achieve a certain access level, such as building rooftop harvesting tanks to complement a communal borehole (as in Zimbabwe) or various overlapping distribution systems (as in Chaupisuyo, Bolivia).

Community-level institutions

Providing water services for multiple-use brings additional management challenges compared to conventional services. Providing a higher level of access in itself may not be a key management challenge. The main difference lies in explicitly catering to a wider diversity in demands within a community where not everyone has similar livelihoods needs, and ensuring a basic supply to everyone without overuse of services by some impacting negatively. This section looks at measures applied by community-level institutions[1] in dealing with these *additional* management challenges.

Most of the studied community organizations (with de facto mus systems) hadn't developed specific measures to deal explicitly with the additional management challenges of multiple-use of water. Only some of the ones with planned mus systems had developed such measures. They included:

- Rules and regulations to ensure that everybody gets some water before larger users take more. For example, in one of the South African villages, the community established a rule that everybody should first be able to fetch two buckets of water before additional productive use would be allowed (Cousins et al., 2007).
- Regulations to limit the maximum amount of water to be used for productive purposes. In one of the Bolivian villages, the community established that water could only be used for livestock and backyard gardens, but not for irrigating larger field plots (Heredia et al, 2006). Some of these measures were hardwired into the technology, e.g. through metering in Bolivia and Colombia; through the use of small diameter pipes for household connections in India; or, by only allowing excess water from the tank to be used for irrigation as in Nepal (Mikhail et al 2007a and 2007b).

In nearly all these cases, communities were assisted by an external agency in developing these rules but they were set locally. Most of these systems have only been functioning for a short while it is too early to assess performance of community institutions in enforcing the rules, and ensuring equity in access. Evidence from other cases, for example in Honduras (Smits et al., 2008), shows that these kinds of measures can indeed help to regulate multiple-use of water particularly when they differentiate between different types of users within a system.

The water committees responsible for *de-facto* multiple-use systems struggled more in addressing management problems - specifically related to multiple-uses - such as failure to ensure payment for the service or conflicts with other users in the catchment over water quantity. Nor did they receive external support in addressing these problems.

Both types of systems experienced a range of other problems within their community institutions such as lack of leadership or poor accountability between the committee and the community. These and other management challenges are not exclusive to multiple-use services, but may lead to poor performance of systems and actually lead to reduced access. For example, the capacity of the systems in Bushbuckridge in South Africa is in theory sufficient to provide a basic level of multiple-use services. However, due to a myriad of institutional problems in combination with poor technical operation real access levels are much lower (Cousins et al., 2007).

It is increasingly recognised that community-managed domestic supply services require external long-term support mechanisms to be sustainable (see Schouten and Moriarty, 2004; Whittington, 2007). This also applies to community-managed multiple-use services.

Financial management

Providing a higher level of service for multiple uses implies that investment as well as operation and maintenance costs may increase. This section assesses how these additional costs were addressed. The investments in the main infrastructure were in nearly all the cases largely made by an external agent, government, a donor or an NGO, with only small contributions by the community. Only in Bolivia, did users provide the bulk of investments in communal piped systems. For household options, like rainwater harvesting systems in Thailand, or complementary on-farm technologies such as drip kits in Nepal (Mikhail, 2007b), users did assume the bulk of the costs.

The operation and maintenance costs were assumed fully by the community in nearly all cases in line with the prevailing community-management model. Different types of tariff systems were found (see Table 5): 1) volumetric systems, i.e. payment per unit of water used (common in systems where water is lifted by pumps) where the unit-rate may be differentiated; 2) charging a flat rate per month (often in systems where water flows by gravity); or, 3) water is provided for free. In most cases, the tariff charged is more or less in line with the operational costs. However, few communities are making saving for major repairs, expansion or future replacement costs. High non-payment rates may in some cases put the financial sustainability of services at risk.

Table 5: tariff systems and financial sustainability

Site	Tariff system	Financial sustainability of service
Challacaba (Bolivia)	Volumetric system	Tariffs cover operational costs, as well as savings for expansion
Chaupisuyo (Bolivia)	Volumetric system, with different rates for domestic and irrigation users	Tariff is much higher than what is needed for operational costs
Cajamarca / San Isidro (Colombia)	Volumetric system, with different rates for large and small farmers	Tariffs cover operational costs
Various communities of El Chocho (Colombia)	Flat rate, with one case of cross-subsidy between poor and better-off	Tariffs cover operational costs, but actual income is too low, due to high default rate
La Palma – Tres Puertas (Colombia)	Flat rate for basic consumption, and volumetric above that	Due to high non-payment rate, actual income is too little to cover all required costs
Legedini (Ethiopia)	Volumetric system (payment per jerry can)	Actual income insufficient for major repairs
Samundi (India)	Flat rate	Tariff covers operational costs
Chhatiwan (Nepal)	No tariff system. A revolving loan is set-up, and the interest is used to cover operation and maintenance costs	Too early to tell, as system just went into operation
Senapuk (Nepal)	Flat rate and additional contribution of labour	Too early to tell, as system just went into operation
Ward 16 of Bushbuckridge (South Africa)	Water is provided for free to users as part of Free Basic Water policy. Municipality covers operational costs.	No data on implications of financial sustainability for the Municipality

Investments in multiple-use services have brought benefits to users. Renwick et al. (2007) analysed a global data set of multiple-uses and found that most of these investments are cost-effective. However, this does not automatically mean that the additional investments that are required or desired are fully auto-financed by users or indeed by anyone else. Shared financing mechanisms are required, for investment and operational costs:

- There is potential for user contribution to the incremental costs in communal multiple-use systems, especially for additional household-based hardware. However, there is still a large cost component for basic infrastructure. In line with current practices this can be expected to remain largely in the domain of public service delivery.
- Communities can assume the operational costs and use differential tariff systems according to the local situation. However, it is not clear whether many communities can also assume full replacement costs. This is not unique to multiple-use services. In conventional rural water supply systems it is not common to find tariff systems that successfully cover full replacement costs. To our knowledge there haven't been any reported evidence that communities are better able to raise tariffs to cover replacement costs of multiple-use services, than for conventional ones.

Access to water resources

Climbing the water ladder implies the use of more water as compared to basic domestic supplies. Yet the amounts required are still relatively small when considered at a catchment scale even if a large number of villages would develop mus systems. The extent to which water resources can accommodate such increases, and the type of measures required for management depend on the status of the basin:

- In closing basins, there may be some unallocated water for multiple-use. For example, in the Sand River catchment in South Africa, sufficient water resources are available in the area to increase supply up to 60 lpcd to the entire population of the Bushbuckridge municipality without negatively affecting other users (Smits et al., 2004). Only in fully closed basins, such as in the case studies in India would there be a need for re-allocation between other users (such as field-scale irrigation) and multiple-use services.
- Open basins with local or temporal competition between neighbouring communities that use water for multiple-uses were reported in Bolivia, Colombia and Nepal. For example, in the El Chocho mountain stream in Colombia, the *de facto* use of water for multiple purposes contributes to the competition between 4 rural communities, together with other factors such as rapid population growth and inefficient water systems (Cinara, 2007). In nearly all these cases, local mechanisms for dealing with competition were developed ranging from negotiations around customary water rights to springs in Nepal (Mikhail et al, 2007b) and Bolivia (Quiroz et al, 2007) to a catchment forum in El Chocho (Cinara, 2007).
- Open basins with no competition for water resources were also included. These are the typical cases of economic scarcity, such as Ethiopia and Zimbabwe, where water resources are available but where infrastructure is lacking to extract and convey water.

Conclusions

The objective of this paper was to present a characterisation of multiple-use services at community level and provide a basis for defining building blocks in applying a multiple-use approach. It did so by analysing case studies from over 30 communities in eight countries covering a range of physical, socio-economic and institutional contexts and including both *de facto* and planned multiple-use services.

We found that, even though not all inhabitants of a community may be involved, people almost universally use water for domestic and productive activities at and around the homestead even in places where access to water is very limited. The extent to which households undertake these activities primarily depends on their level of access to water. The better the access to larger quantities of water, delivered closer to the homestead, the more that additional water is put to productive use once basic domestic needs have been met. For small-scale productive uses to take place at a significant level, typically between 40-100 lpcd are needed, delivered within a short roundtrip from the homestead. The empirical relation between access to water and its use for different purposes was summarized in the form of a water ladder that can be used to plan for the level of access required to meet certain water demands.

The cases show how different types of currently common technologies provide different degrees of access. Household-based options or communal systems with household connections hold high potential for multiple use. Incremental changes can be made to existing systems to improve access.

Water committees managing multiple-use services face the additional challenge of having to deal explicitly with distribution of additional water, so that diversified demands in the community can be met while a basic supply to all can be guaranteed. Evidence was found that this is happening, particularly through establishing internal rules and regulations. But communities may need external support to develop rules. Specific attention needs to be given to this in support programmes for community-managed services.

Renwick et al. (2007) indicated that additional investments in multiple-use generally come at modest costs and can easily be justified through the benefits obtained from them. But, this doesn't automatically mean that multiple-use services can be easily financed (e.g. by users). While there is scope for significant community-contributions to the incremental investments, the public sector will probably need to continue to assume a large part of investment costs and eventual replacement costs. Communities can assume operational costs, but need support in developing equitable tariff structures and financial management.

Even though the amounts required for mus are relatively small, access to water resources can be a limiting factor to mus development in closed basins. In open basins there is scope to develop access to water resources for multiple-uses. Where there is a risk that this will contribute to local and temporal competition with other users this needs to be managed within a framework for local water resources management.

The multiple-use services approach is in essence one of climbing the water ladder, i.e. creating higher levels of access to support people's multiple water needs. We have identified a number of implications requiring changes in the way in which water services are provided under the conventional approach to service delivery. However, none of these should be considered unfeasible, and can be justified by the additional benefits of the mus approach.

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Notes

[1] With the exception of three, all case studies were community-managed, which is the current management paradigm for rural water supply. The other cases involved management by a utility or directly by local government. These are not discussed further here.

Keywords

Multiple-use services, access, technology, institutions, financing, water resources

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

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).

Keywords

Multiple-use services, rural water supply, sustainability, livelihoods, Honduras

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INTERNATIONAL SYMPOSIUM ON MULTIPLE-USE WATER SERVICES

Community-scale multiple-use water services: 'MUS to climb the water ladder'

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The Challenge Program on Water and Food-supported MUS project (PN28) developed and tested 'multiple-use water services' ('MUS'). This new approach to water services takes multiple water needs of rural and peri-urban communities as the starting point for planning and design of new systems or rehabilitations. By overcoming the administrative boundaries between single-use sectors, MUS contributes more sustainably to more dimensions of wellbeing than single-use approaches: health, freedom from drudgery, food and income. The action-research took place in 25 study areas in eight countries in five basins. The project brought global, national, intermediate-level and local partners together who were champions of MUS at the time in five benchmark basins of the Challenge Programme on Water and Food (CPWF). At community-level, the project identified generic models for implementing MUS. This was done through pilot-implementation of innovative multiple-use water services and by analyzing de facto multiple uses of single-use planned systems. It was found that by providing 50-100 lpcd, so doubling or tripling the common design norms in the domestic sector, multiple cost-effective benefits could be achieved from homestead-scale MUS. At the intermediate, national, and global level, the project's 'learning alliances' engaged in the wide upscaling of these community-level MUS models, with the aim to establish an enabling environment to provide every rural and peri-urban water user with water for multiple uses. This paper presents general project findings.

Introduction

Multiple users take water from multiple sources and use and re-use it for multiple purposes. This reality is obvious for rural and peri-urban water users at the local level. When they develop water themselves, they do so for multiple uses. Moreover, infrastructure that is designed for a single use, e.g., 'domestic water' or 'irrigation water' is *de facto* used for multiple purposes by communities. Similarly, at the highest levels, water professionals who provide bulk water supplies or manage national or basin-level water resources are well aware of the integrated nature of water resources and their multiple sources, uses and users. However, this straightforward insight is lacking among many service providers at the levels in-between. At this level, water professionals from each water sector carve out one particular end-use, which becomes the mandate and structuring principle of the entire sector. Other water uses, even by the same user taking water on the same site from the same source, are ignored. In externally supported water development and storage, this blindness is strongest for storage, conveyance and use at homesteads and at community or sub-basin level. This is the gap that the 'Multiple-use water services' or MUS project (PN28) attempted to fill.

The MUS project developed, tested and upscaled an alternative approach to water services at household and community level: 'multiple-use water services' (MUS). MUS is defined as water services planning and design of new systems or rehabilitations that starts with people's multiple water uses and re-uses and needs at their preferred sites within communities' holistic land- and waterscapes. By accommodating for multiple uses, multiple livelihoods benefits are achieved, in particular freedom from drudgery, health, food, and income. These benefits contribute directly or indirectly to all Millennium Development Goals. Hence, compared to conventional single-use water services approaches, MUS contributes more effectively to rural development, gender equity, and, if well targeted, poverty alleviation.

Methodology

At its start in 2004, the MUS project brought those partners together who were pioneering MUS approaches at the time. Encouraged by the call for innovative partnerships by the Challenge Program on Water and Food (CPWF), the project included representatives from the domestic and productive water sectors and both scientists and implementers. Working in five CPWF benchmark basins, each of the global lead partners chose their national and intermediate-level partners and selected sites for case studies, again according to the criterion of being a MUS innovator. Thus, IRC International Water and Sanitation Center became the basin coordinator for the Andean (Bolivia and Colombia) and Limpopo basins (South Africa and Zimbabwe); IDE International Development Enterprise coordinated MUS project activities in the Indus-Ganges basin (India and Nepal); Khon Kaen University and the Farmer Wisdom Network led the MUS project in the Mekong basin (Thailand); and International Water Management Institute led the project in Ethiopia in the Nile basin, and was the lead partner. A total of 25 study areas were selected (either one or more communities or a group of adopters of a similar technology). This selection process gave a wide diversity in partners and contexts, which allowed exploring diverse perspectives on MUS. In 19 study areas, 'MUS by design' was piloted. In six sites (all from the domestic sector), *de facto* multiple-use systems were studied. The project partners encompassed all four main categories of water services providers: water users with self-supply, private providers, NGOs, and governments. Also, the three main technology groups were covered: private homestead-based technologies; communal systems with single-access points; and communal systems with distribution networks to public standpipes or homesteads. Socio-economic conditions varied from low-income Ethiopia to middle-income South Africa. Hydrological contexts ranged from 300 mm average annual rainfall in Maharasthra to up to 2200 mm in Nepal.

Across all sites, the first objective was to establish generic, field-tested, and convincing models of MUS at household and community level. The second objective was to widely upscale these models in order to reach, ultimately, all rural and peri-urban people with water services that meet both domestic and productive water needs. So the challenge was to create an enabling environment at intermediate, national, and global level that responds adequately to communities' multiple water needs. This institutional innovation was taken up by 'learning alliances'. In each country the national MUS partner forged horizontal and vertical exchange with other water service providers in the local study area and at intermediate, national and global level. These learning alliances raised awareness about community-level MUS models and through 'learning by doing' they induced institutional changes towards an enabling environment, which continue beyond the project life. As the MUS partners driving this process encompassed all four categories of service providers (plus researchers), insights in upscaling were generated from these different perspectives.

In order to structure the action-research and allow for global comparison and generic conclusions, a 'MUS conceptual framework' was developed at the start. For this, the team identified the conditions, or principles, that should be in place if MUS were to work at community-level and if MUS were to be upscaled at intermediate, national and global levels (Hagmann 1998; Van Koppen et al 2006). Learning *how to* realize those conditions was the focus of research. At community level, the principles were: livelihoods-based planning and design of water services; appropriate technologies; adequate financing; equitable institutions; and sustainable water resources. At intermediate level, these were: participatory planning, coordinated long-term support, and strategic planning for further MUS innovation. At national level, the principles were: decentralization of support and enabling policies and laws. This paper synthesizes some findings, conclusions and recommendations. Over 100 project's national outputs, international publications and two books are available and forthcoming at www.musproject.net.

Results

Models for community-level MUS

With regards to the principles of livelihoods-based services and affordable technologies, a strong link was found between people's multiple water uses for livelihoods at and around homesteads and water availability as captured, conveyed, and stored through technologies. Table 1 shows this link. Water-dependent productive activities that increase in number and size with higher water availability included small and large livestock keeping, trees, crops and vegetable irrigation, crafts, and small-scale food and other enterprise. This finding confirmed the project's hypothesized 'multiple-use water ladder'. This is a critique on the conventional 'service ladder' in the domestic sector, which assumes that when water quantities available at or near homesteads increase up to 100 liters per capita or more per day (lpcd), this is only used for more drinking, sanitation, cooking, cleaning, bathing and laundry. Instead, the MUS project proposed a ladder that reflected all water uses for livelihoods, distinguishing basic domestic (less than 20 lpcd), basic MUS (20-50 lpcd), intermediate MUS (50-100 lpcd) and high-level MUS (more than 100 lpcd) (Van Koppen and Hussain 2007).

Table 1. Relationship between technologies and water use in selected study areas

Country	Technology	Range of average daily water use (lpcd)	Levels
Ethiopia	Communal piped systems with very scattered standpipes	8-17	Basic domestic
South Africa	Communal piped systems with scattered standpipes	30	Basic MUS
India	Communal piped systems with frequent standpipes	40 (design supply)	Basic MUS
Zimbabwe	a communal boreholes with hand pumps b. individual shallow wells with windlass and buckets c. individual shallow wells with rope-and-washer pumps	a. 10-15 b. 60-70 c. 80-90	a. basic domestic b, c. intermediate MUS
Bolivia	a. tankers b. piped distribution systems with household connections	a. 30 - 40 b. 60 – 80, with exceptions up to 140	a. basic MUS b. intermediate MUS
Nepal	Communal piped systems with frequent standpipes	137-225 (design supplies)	high MUS
Colombia	a. Communal piped systems with households connections (rural communities) b. Communal piped systems with households connections (peri-urban communities)	a.190 - 250, with some cases much higher b.76-118	a. High MUS b. intermediate MUS
Thailand	Farms with ponds and other sources	>100	High MUS

The far-reaching policy implication of this finding is that water services that aim at meeting people's livelihoods needs at and around homesteads should double or triple the conventional design norms in the domestic sector of 20-30 lpcd for domestic uses only (for Sub-Saharan Africa or South Asia). Instead, 50 - 100 lpcd, or more is required to ensure that services meet people's livelihood needs so they can 'climb the multiple-use water ladder'.

The benefit-cost ratio of investments in homestead-scale MUS is high, especially for intermediate-level MUS (50-100 lpcd). This is in addition to health, social, gender and age benefits. only productive uses are considered. At the income side, the CP-MUS found an increase of net annual household income of USD100-500, or, as expressed per volume of water 0.7 – 2 USD per M^3. This is in line with results from Renwick et al (2007) who found that each additional litre per capita per day (above the 20 lcpd for basic domestic needs) generates an estimated USD 0.5 to USD 1 per year of income. Increasing water availability requires incremental expansion of one type of technology (e.g., through better lifting devices), jumps from one type to another, or further combinations. These incremental investments in hard- and software to 'climb the water ladder' can be repaid in 6-36 months (Renwick et al 2007).

With regard to the other principles (financing arrangements, equitable institutions and water resource availability), many challenges were similar to those in conventional domestic or productive water services. However, one unique feature of MUS concerned equity notions for water sharing under scarcity. Homestead-based multiple uses were small-scale compared to relatively few large users, most of whom use water beyond homesteads. Under scarcity, basic domestic needs were prioritized and, after that, minimum water supplies for both domestic and small-scale productive uses for all. Thus, within communal systems, the risk of over-use by few was mitigated by pricing, institutional, and technical measures. Within areas with limited water resources, for example in water-scarce Maharashtra, homestead-based multiple uses by all were seen as higher priority than sugar cane farming by few. In national water legislation, as in Thailand, the MUS project partners ensured that small-scale multiple uses were better prioritized over commercial users.

When moving from homestead- to community-level water development, another typical MUS finding was that synergies can be forged if river intakes, storage and conveyance structures are holistically designed and incrementally improved for shared water provision, whether to homesteads or fields. Failing to build upon prior community-level abstraction, storage, and conveyance infrastructure for any use leaves unmanageable 'spaghettis' of layers of infrastructure.

Innovation and upscaling: creating a supportive environment for MUS

At intermediate, national, and global levels, project partners initiated learning alliances that started creating an enabling environment for MUS at intermediate, national and global levels. In all countries, the *visible* and *documented* successful performance of community-level MUS in sufficient cases to allow for some generic validity appeared vital for awareness creation. There were also many differences between the learning alliance processes in the respective countries. They were primarily related to the different starting points of each category of water service providers that drove the upscaling process. Table 2 lists the steps taken and obstacles in realizing the three principles for upscaling MUS at intermediate level from the angle of the each of the water service provider categories. These findings show that the different water service providers bring different strengths to upscaling MUS at intermediate level. Collaboration according to those strengths, with a gradually stronger role for local government, will contribute to the enabling environment for broad upscaling of homestead-scale and community-scale MUS.

At national level, the Department of Water Affairs and Forestry of South Africa 'embraces MUS' in its policy on Water for Growth and Development. In Nepal, national guidelines for local government promote MUS as an activity to be financed. The CP-MUS, together with the MUS Group hosted by IRC (www.musgroup.net), stimulated many global agencies to consider MUS. They include: African Development Bank, Asian Development Bank, Bill and Melinda Gates Foundation, Collaborative Council and Water Supply and Sanitation, Comprehensive Assessment on Water and Food, FAO, GWP, ICID, IFAD, World Water Forum 4 and 5.

Conclusions and recommendations

The CP-MUS identified and tested new homestead-scale and community-scale models for meeting the multiple water needs of people in rural and per-urban areas. MUS improves health, freedom from drudgery, food and income. Homestead-scale and community-scale MUS is particularly effective way in rural and often in peri-urban areas for achieving the MDGs. Taking water from multiple sources for multiple uses appeared obvious for water users' self-supply and private service providers. NGOs and local government at the direct interface with communities are also increasingly responsive to people's multiple water needs. The same holds for a number of highest-level policy makers and global organizations. Through the learning alliances a start was made to create an enabling environment from local go global levels.

- Promote multiple uses from multiple sources as the norm, and recognize single end-use as the exception, in all water policies, laws, programs and funding of local government, line agencies, NGOs, international water programs and financing agencies
- Adopt 50-100 lpcd or more as the design norm for water services to homesteads, so double or triple the domestic sector's conventional design norms in order to allow people to climb the multiple-use water ladder at and around homesteads
- Target poor women and men within the overall goal of reaching full coverage of service provision
- Plan water services together with communities according to people's own priorities for multiple end-uses, in particular at and around homesteads within communities' holistic spatial and temporal land- and waterscapes.
- Create an enabling environment for broad upscaling of homestead-scale and community-scale MUS by forging collaboration at intermediate and national levels between water users, private providers, NGOs, government, and research and education centers according to their respective strengths and by enhancing the capacity of local government.
- Pool technical, financial and institutional resources from former sub-sectors in the joint planning and design of integrated water infrastructure hardware and software for multiple uses from multiple sources
- Tap professional expertise on the specific water requirements of various uses and on strategies to use water more beneficially: in particular for water quality, higher productivity integrated farming and enterprises, and creation of better markets.

Table 2. Water service providers' steps taken and obstacles in realizing principles for upscaling MUS

Driver of learning alliance by category of water service provider	**Steps taken**	**Principles for upscaling at intermediate level**		
	Obstacles	**Participatory planning**	**Coordinated long-term support**	**Strategic planning for upscaling**
Self-supply Thailand (Farmer wisdom network) South Africa (Water for Food Movement	Steps taken	Multiple water needs obvious High own contributions in cash and kind Own experimenting, mutual learning and knowledge generation	Providing integrated mutual support Soliciting needs-based integrated support within limited implementation capacity	Outscaling based on mutual help Strategic alliances at highest policy levels for concretizing policy and soliciting support for outscaling
	Obstacles	None	Uncertain future of informal networks with ageing leaders	Limited resources for outscaling Less priority for advocacy among cumbersome other intermediate level agencies
Private service provider Bolivia (Agua Tuya)	Steps taken	Multiple water needs obvious Client communities' own choice for technology, site and lay-out	Providing infrastructure and training for higher sales	Sales-driven outscaling Facilitating information exchange between users and municipality Procuring assignments from municipality
	Obstacles	Self-financing may exclude the poor	Services may not reach the poor	Market-driven outscaling limited for small business
NGOs Ethiopia (CRS) Nepal (IDE) Zimbabwe (various NGOs)	Steps taken	Responsive to multiple water needs More or less participation in technological design Participatory community-scale MUS (Partial) subsidies	Poverty relief or technological innovation fostering more coordinated support	Strategic alliances with local and other government for upscaling of innovations
	Obstacles		Short-term, project-bound.	
Local government Bolivia Nepal, South Africa (with NGOs)	Steps taken	Responsive to multiple water needs Accountable to constituencies	Permanent presence (Potentially) able to integrate support without strings	Developing generic methodology for integrating multiple water needs in local planning frameworks Influencing national policy and guidelines
	Obstacles	Can be politicized Limited participatory community-scale MUS	Limited resources and implementation capacity	
Government/ parastatal domestic sector Colombia (with university) India (with NGO)	Steps taken	Mandate to serve all, so including the poor Focused on homesteads Somewhat more participatory design	Financial support Expertise on domestic end-uses Expertise on technologies and management for small water quantities to homesteads Add-ons for non-domestic uses, e.g. livestock Improving efficiency of productive water uses (drip irrigation) at homesteads	Awareness raising about livelihoods benefits of *de facto* multiple uses Promoting immediate multiple uses of 'domestic' services planned for future expansion National advocacy to align design and water quality norms with local needs
	Obstacles	Top-down standard packages Limited participatory community-scale MUS	Design norms for domestic uses only Water quality norms unrealistically high Short-term, project bound	

Government productive sector Learning alliance members	Steps taken		Financial support Expertise on productive end-uses Expertise on technologies and management for high water quantities to fields or fisheries Add-ons for non-irrigation uses, e.g. livestock Improving efficiency of productive water uses (drip irrigation) at homesteads	
	Obstacles	Technology-driven single-use planning with (declining) bias to large-scale systems Targeting a proportion of farmers only, often larger-scale farmers Limited participatory community-scale MUS	Hardly attention for productive *and* domestic uses at the homestead Short-term, project-bound	Awareness raising about livelihoods benefits of *de facto* multiple uses National-level innovation to support small-scale productive uses, also at homesteads
Knowledge centers (IWMI, IRC, CINARA, Centro-Agua, Khon Kaen University, Mekelle University)	Steps taken	Identifying untapped opportunities of a better match between people's multiple water needs and sub-sectoral service provision Articulating communities' knowledge	Expertise and resources for: Conceptualizing MUS Analyzing, reporting and providing feedback on MUS principles through case studies Comparison for generic conclusions	Disseminating tested generic solutions and policy dialogue with intermediate, national and global level policy makers, financing agencies, implementers and academia for outscaling and upscaling
	Obstacles		Short term, project bound	

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