Opportunities revealed by the Nepal multiple-use water services experience

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Few programmes in the field have methodically applied multiple-use by design approaches. To some extent, this reflects both the novelty of the MUS approach, as well as the disconnect between water research, policy and practice. While water policy-makers have in recent times found the MUS approach attractive, there is significant resistance to actualizing the interdisciplinary approach. Although policies are slowly changing, much of the MUS experiences on the ground have evolved from a more innate process of programmes delivering to the 'expressed' needs of user communities. Drawing on eight years of MUS development effort in Nepal, this paper describes the critical components of the multiple-use water services projects in Nepal and the outcomes seen at the community level from these projects. Further, it reviews some of the gaps and limitations of the projects in order to explore opportunities for future MUS implementation not only in Nepal, but globally.

Keywords: multiple-use water services, single-tank system, double-tank system,

The Challenge Program on Water and Food project PN28 (CP-MUS) developed and tested 'multiple-use water services' (MUS) in several water basins globally. The CP-MUS project implementation in Nepal largely occurred through the Smallholder Irrigation and Market Initiative (SIMI), a USAID-supported project implemented by Winrock International, International Development Enterprises (IDE) and local partners in Nepal. As participating partners in the CP-MUS project, IDE staff carried out process documentation over a four-year period reviewing project implementation reports, interviewing staff of partnering governmental and non-governmental organizations, and conducting field visits to observe and interview participant households. The extensive experience and lessons of the Nepal component of this action research project are compiled in Mikhail and Yoder (2008). Interviews were conducted for three particular case sites in three different districts – Chhatiwan, Senapuk and Krishnapur Tole – and relied on recall. Information in this article is based largely on individual

Three case studies were carried out in Nepal

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and group interviews conducted by Monique Mikhail during February to May 2007 and is supplemented by three other post-project case study assessments: Hendriksen (2008); Marble (2008); and Khawas and Mikhail (2008).

Background

Around 31 per cent of Nepal's population lives below the poverty line. While absolute poverty has been reduced from 42 to 31 per cent during the period from 1996/97 to 2003/04, several sources, both official and others, identify that national averages mask disparities in poverty by geography and ethnicity (World Bank, 1998; Government of Nepal, 2007). According to the Nepal Living Standard Survey (2003-04, updated 2007) there is a lower reduction in rural poverty (compared with urban) and poverty is more widespread and deeper in the mountain belt. Among ethnic groups, *dalits*, *Janajatis* and Muslims predominantly live below the poverty line compared with other social groups. Similarly, there are sharp variations in poverty and well-being by gender. The productive priorities and needs of the poor are also significant: the poorest have least access to productive land, and land cultivated by the poor often has low yields. Even though 86 out of every 100 households in Nepal actually farm, child malnutrition and food security are major problems (World Bank, 2006). Only a quarter of the very poor have high quality land, and then the median farm size is only half a hectare. Only 11 per cent receive irrigation water year-round, compared with a national average of 15 per cent (Government of Nepal, 2004).

The poorest have least access to productive land

Evolution of MUS

The SIMI project was developed in response to these issues, with the premise being the essential combination of micro-irrigation and connection to markets, resulting in increased income through growth of vegetables in the off-season. The initial project concept was not to address problems of water resources management or to link domestic and productive water services, rather it was to design and deliver micro-irrigation techniques that would draw on existing water systems.

When micro-irrigation kits (drip or sprinkler systems that irrigate 80–500 m^2 and range in cost from US$13.60 to $21.30) were made available to the farmers, they initially used their domestic water sources for irrigation as well. However, this approach was not appropriate. First, the systems were not designed to provide enough water for irrigation in addition to domestic supply. Second, the domestic water sources did not cater well to scattered land parcels. Third, it

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was 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. It was obvious that just selling the micro-irrigation kits, without addressing water sourcing and service delivery approaches, would not work.

These new multiple-use systems received high praise from the communities

Two main MUS designs ultimately emerged: the single-tank, one-line distribution system and the double-tank, two-line distribution system (see Figure 1). 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.

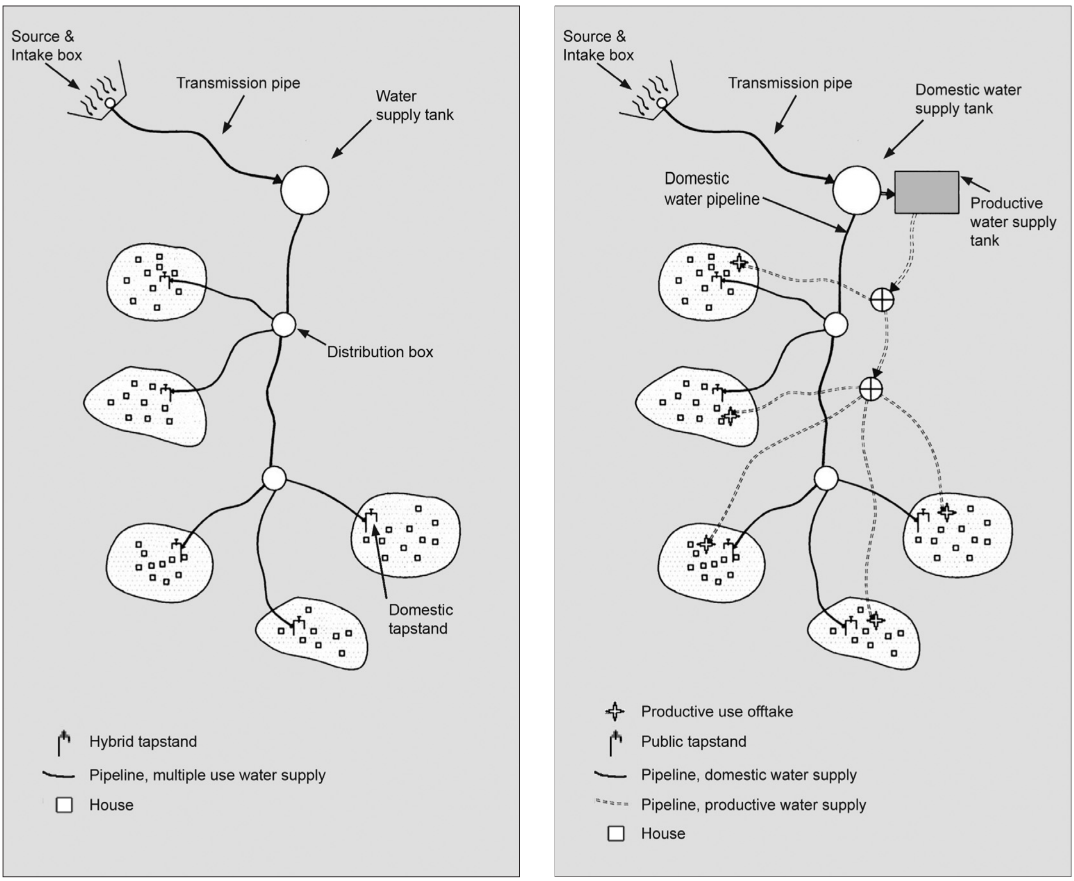

Figure 1. (a) Single-tank, one-line distribution system; (b) double-tank, two-line distribution system

Pillars of MUS

Implementation team

The composition and operation of the SIMI implementation team was critical to the way MUS projects took shape in Nepal. The district teams comprised:

- district manager;
- agricultural technician – technical support on production techniques;
- irrigation technician – technical support for system feasibility scoping, construction and use of micro-irrigation;
- marketing supervisor – organize local marketing groups (described below);
- social (district level) and community (local level) mobilizers – ensure community participation.

Local NGOs were often more adept at operating in the conflict-affected areas

Owing to the civil conflict in Nepal, local NGOs were often more adept at operating in the conflict-affected areas. Over time, SIMI staff recognized the utility of these local partners. Development of government policies in support of using local NGOs for project implementation further cemented the partnerships. Thus, SIMI utilized the following institutional roles:

- district-based NGOs for social mobilization, savings/finance and basic follow-up with agricultural production groups;
- government partnerships for basic production extension services and investment in infrastructure and public goods; and
- international and national NGOs for supply chain development, output market development, and higher level training on agricultural packages.

System design

To design each system, the domestic water delivery standard of Nepal (45 litres per capita per day, lpcd), which includes water for livestock, was used to calculate domestic demand for a projected 10-year population. Productive water needs (using the low-cost micro-irrigation kits) were estimated at around 400–800 litres/day/household, based on the evapotranspiration rate of the particular area and the types of vegetable that SIMI trained communities to grow on 100 to 200 m^2 plots. Communities then identified a possible source at an elevation higher than their village that could supply the required amount and installed a high-density polyethylene transmission pipeline.

Of the 123 MUS-by-design systems in existence, each serving 10–200 households, about half have a water supply that is considered adequate in all seasons to fully meet both domestic and productive use needs.

For these systems, a single-tank, one-line distribution system was designed (see Figure 1a). Distribution is managed by controlling the delivery time for each use, for example, two hours in the morning for domestic delivery and two hours in the afternoon for productive delivery. A rigid, strictly managed schedule is only necessary during the dry season months when discharge in some springs decreases.

Many communities selected the double tank option because it was easier to ensure equitable domestic supply

During system design, if community members anticipated periods of water shortage or difficulty in controlling distribution, a double-tank, two-line distribution option was proposed (see Figure 1b). The transmission line from the spring connects to the 'domestic' storage tank and when it is full, it overflows into a second 'productive' use storage tank. While constructing a double tank and distribution system is more expensive, many communities selected the double tank option because it was easier to ensure equitable domestic supply and monitor water use.

Water is delivered through high-density polyethylene pipes from the storage tank(s) to the domestic tapstand and irrigation off-takes. Tapstands are located to provide convenient access by a group of 4 to 10 households, while irrigation off-takes are shared by field neighbours (Adhikari and Mikhail, 2008).

Management/governance

The committee was responsible for negotiating the rights to use the selected spring source

Each community formed a construction committee to manage their input to construction. Perhaps most importantly, the committee was responsible for negotiating the rights to use the selected spring source. Owing to the tension between the statutory laws and customary water rights, there is often confusion which leads to conflict between user communities. Through experiences in certain villages, the necessity of reaching agreements between source users prior to project construction has become apparent. For example, in Kavre village in Lele VDC of Lalitpur District, project progress was stopped because of a conflict between the community that was building a MUS system, and the upstream community that had rights to the water source. The upstream users were from lower castes whereas the downstream community was a mix of upper and lower castes. Although SIMI attempted to help them reach an agreement, no resolution was found and the project was discontinued.

In especially difficult situations, involving the Village Development Committee (VDC) secretary (local government) sometimes helped to mitigate conflict. For example, conflict between two clusters (one upper caste and one *dalit*) within the same village of Bhirmuni Jodhane in Dhikur Pokhari VDC in Kaski District threatened to hold up the MUS system being built there. The MUS system was planned and constructed for the whole community, but the upper-caste households hesitated to use water from the same pipeline as the *dalit* community because of cultural norms that dictate that water *dalits* use is 'polluted'. During planning, the *dalit* community said that they would not contribute labour or materials to the scheme if they were not allowed to use the same source. The upper-caste cluster agreed to the use of the same source but not the same pipeline, so SIMI facilitated a community group discussion where the two clusters were required to meet together with the VDC Secretary to negotiate an agreement. The two sides finally agreed to have two separate outlets from the tank, one for each cluster, with an increase in labour contribution for both clusters.

In communities with water rights conflicts there was more need for follow-up

The importance of increased follow-up post construction in communities with water rights conflicts also became apparent. For example, the Maseri Tole MUS scheme in Birendra Nagar municipality of Surkhet District had a problem with lime clogging the system pipes, so the pipes were kept above ground for regular maintenance. Maseri Tole realized that other neighbouring communities were cutting the main pipeline. Yet, SIMI was unaware of this problem until an impromptu visit to the community by national-level staff. After this visit, SIMI helped the community devise a solution: the community decided to pay an operator to walk from the source to the tank several times per day to supervise.

Once the systems were constructed, the construction committee transformed into a Water User Committee (WUC), often electing new members. The WUC is responsible for managing system operation, generally including selection of a leader and other functionaries and assigning specific responsibilities: checking the intake and transmission line, releasing water from the storage tanks into the distribution system(s), collecting a monthly user fee for the maintenance fund, and system maintenance and repair. The WUC is also responsible for liaising with partners and representing the community during learning alliance workshops and site visits. The learning alliance is explained below.

For irrigation-only systems, water allocation is not necessarily equitable and may be based on land area

A domestic-only water supply system in Nepal is typically designed to give all residents equal access to public water points. On the other hand, for irrigation-only systems, water allocation is not necessarily equitable and may be based on land area or proportionate contribution to system construction. Thus, questions of how much water should be allocated for each purpose and how to achieve equality in distribution for all uses becomes more complex when establishing allocation rules for MUS systems. Often different sets of allocation rules are applied for each season, based on the availability of water and seasonal variation in demand for irrigation. The primary objective of the WUC is to provide appropriate allocation rules and distribution control so the community can maximize efficient water use while safeguarding the domestic supply and ensuring adherence to the rules.

Capacity building

Another critical component of the MUS project was the capacity building of both individual households and the whole community. This was accomplished partially through involvement in planning, construction and maintenance of the system as well as evolution of the user group. Multiple training sessions were given by SIMI within each of these broad areas:

- plumbing/masonry;
- scheme management training;
- water resource training;
- farmer-to-farmer training tour programme;
- micro-irrigation technology training;
- agriculture production techniques training;
- income-generation techniques;
- female-specific training.

> One of the best outcomes was the strengthening of the farmers' organization

In Chhatiwan Tole, farmers stated that one of the best outcomes of the project was the increase in the strength of their organization. They now had the capacity to lobby for new technologies and services for their village. Capacity building was also essential to strengthen the communities' ability to deal with the water rights conflicts mentioned above.

Connection to markets

> Production groups were established in each village to sell the cash crops

Most of the hill farmers that SIMI worked with had not sold vegetables as cash crops before, so production groups were established in each village. SIMI then linked village production groups into agricultural marketing and planning committees (MPC), of which there are now 112, based around key regional markets. Once the groups were established, collection centres were built where the marketing committee collects and weighs the vegetables and then takes them to the nearby market for sale. A fee is collected to cover the costs of operating the collection centre and arranging transportation to the market. A couple of districts also created apex marketing committees (there are now six) that represent the interests of the MPCs to government agencies and development programmes. The MPCs provide important services to their members and communities including access to market information, crop/commodity planning, technical assistance, facilitating supply of agricultural quality inputs and credit, and marketing services (Colavito and Nanes, 2007).

The learning alliance

The last major component of the MUS work was the learning alliance. The learning alliance approach was critical for propagating the MUS concept throughout Nepal and took two forms: advocacy of the concept through formal workshops at the district and national levels; and the creation of partnerships for project implementation through the search for matching funds.

Since project funds covered only part of the construction cost, communities had to search for matching funds; this was perhaps the most essential factor for garnering partner support. Not only did NGO and government partners contribute financially to projects, but they also attended community meetings and participated throughout the entire MUS process, integrating them into the work. The low cost (see Table 1) and short duration of project implementation and rapid payback of the systems, in terms of health and income-generation, encouraged all partners to become advocates for the concept. NGOs and government organizations alike received such appreciative feedback for their work that it encouraged them to support future projects and share the idea with other partners not yet involved.

Advocacy for MUS resulted in the buy-in of government departments and NGO partners

This practical advocacy for MUS was strengthened by the organizational linkages built through the more formal learning alliance meetings and workshops, and resulted in the buy-in of multiple government departments and NGO partners at both the district and the national level. It was critical for those attending the learning alliance workshops to be able to hear directly from users. Interaction with communities was expanded through participation in exposure field visits. During workshops, learning alliance partners analysed the best mechanism to incorporate MUS into the government structure of Nepal for wide-scale implementation, including how best to integrate various government bodies through enabling policy.

Table 1. Average cost of SIMI MUS system infrastructure in Nepal

Unit	*Average cash cost*		*Average cash + in-kind cost*[1]	
	NRs[2]	*US$*	*NRs*	*US$*
Per capita	776	10	1,261	17
Per household	4,385	59	7,127	96
Per system	113,846	1,534	185,033	2,494

[1] Cash cost averaged 62% of total system cost. Indirect costs (staff, overheads, etc.) were on average an additional US$740 per system.
[2] Nepalese rupees
Source: SIMI project data

Project outcomes

Each MUS project that was implemented had unique experiences with water rights negotiation, system construction and market development. However, there were several outcomes that were widespread across the projects.

Smallholders have increased the varieties of crops grown and the intensity of production

First, throughout the projects, smallholders have increased the varieties of crops grown and the intensity of production. Most smallholders in the middle hills focus on rice production on their best land and use the less productive land near their homesteads to grow a few rainfed vegetables. SIMI encouraged better use of this land with irrigation of vegetables, both traditional varieties and new ones. For example, in Tori Danda village, production of the traditional vegetables remained roughly the same as previously, but farmers cultivated much more of the high-value crops of cauliflower, cucumber, cabbage and tomato. For the 11 farmers interviewed there, vegetable production increased by 72 per cent (Khawas and Mikhail, 2008). In the community of Krishnapur Tole in Karre Khola village of Surkhet district, farmers increased production of their traditional crops as well as new ones (cauliflower, bitter gourd, cabbage, tomato, aubergine, pole bean, pumpkin, cucumber and radish). In just the first post-project season, the production of vegetables increased by 135 kg/household. Furthermore, the ability to grow vegetables both on- and off-season enabled many smallholders to increase their production to two or even three cropping cycles in one year. In Krishnapur Tole, 90 per cent of households now grow vegetables all year round.

Owing to the increased production and number of crops per year, households were able to raise their income. For example, in the cluster of Chhatiwan Tole in Palpa district, average household income from vegetable production over two seasons (after-consumption sales minus costs) was $330. In the town of Senapuk in Syangja district, households were able to increase income by $199 on average. Krishnapur Tole had an average income increase of $40.35 over just one season. By increasing the number of crops to three per year, the town of Tori Danda saw a $214–2143 increase per household per year (Khawas and Mikhail, 2008). In all of the clusters and villages, vegetable sales accounted for a larger portion of income for the poorest, and were thus more critical for them. Further, smallholders have reported that the increased income has enabled them to recover the cost of purchasing their micro-irrigation kits within one year.

Increased incomes enabled them to cover the cost of their micro-irrigation kits in one year

In addition to production and income improvements, communities with MUS projects derived all of the benefits found with increased access to domestic water. Women and girls reported reduction in time spent fetching water. For example, in Senapuk, each household now saves roughly 1.5 labour-hours per day (equivalent to about $100/

year using the local female wage rate). The time women save on water collection is now being spent on livestock care and vegetable cultivation, which has not reduced their overall daily workload, but shifted it to more economically productive activity. Furthermore, SIMI field staff and the interviewed communities all reported that school enrolment has increased. For example, in the Patnari community of Kaski District most of the people previously could not afford to send their children to school. With vegetable production and sales, they can now afford school fees and materials, so enrolment has increased. In Lele village of Lalitpur District, all 28 households worked in the stone mines, and the children of 15 of the households worked in the mines with their parents for extra income. Owing to the increased income from MUS, 10 households have completely shifted to vegetable production and stopped working in the mines, and all 28 families can now afford to send their children to school regularly.

Their health improvements were as important as the financial benefits

When interviewing the households, it became evident that the health improvements they felt were as important as the direct and indirect financial benefits. For example, prior to MUS implementation, seven households in the Krishnapur Tole cluster had latrines; afterwards, the availability of extra water enabled seven more to build latrines. Communities also reported that increased vegetable consumption has improved their feeling of well-being. For example, in Senapuk, household interviews indicated that roughly 20–26 per cent of the total production is consumed at the household level.

Another significant impact of some of the projects was a change in gender roles. In Senapuk, household interviews showed an increase in consultation and joint decision-making between men and women on farm activities. And, because the household tap is now nearer to their homes, men have begun cooperating with women to perform household chores, particularly fetching water and managing livestock. Women also have started marketing for the first time, which they claimed has made them feel more independent and confident. A similar result was found in Tori Danda village. Nine of 11 interviewees responded that women were now involved in making decisions about land preparation, variety selection and hiring of labour. 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' (Khawas and Mikhail, 2008).

Men had become more involved in roles previously considered as 'female'

Key gaps, limitations and opportunities

Gaps

Despite the positive impacts, several gaps remain. Most importantly, there was incomplete inclusion of the poorest of the poor, lower caste

Although the micro-irrigation kits were low cost, they were still prohibitively expensive for some

communities and women. Wealthier households within communities had the highest uptake of micro-irrigation equipment. Although the micro-irrigation kits were low cost, they were still prohibitively expensive for some members of the community (Table 2). Thus, without adequate credit options, the poorest were often unable to reap the efficiency, yield and other benefits of using micro-irrigation. Some of the poorest had difficulty even with the labour contribution to system construction because it was time spent without earning wages (Marble, 2008).

Additionally, the poor that were able to obtain a micro-irrigation kit increased their vegetable consumption, but did not always transition from subsistence to market participation. A study conducted in Patneri village of Kaski district and Moredada village of Palpa district showed that there were two categories of users: those who obtained a significant income from vegetable production ($63–234 annual income); and those who used their micro-irrigation kits mainly for consumption ($8–63 annual income) (Hendriksen, 2008). Because the agricultural technicians employed by SIMI were oriented towards production for market, these households were sometimes offered less technical support than middle and upper income households. Likewise, even though women were often the ones active in vegetable cultivation, the men were largely the ones receiving production training. This knowledge was not always passed on to the women, leading to less skill-building of female cultivators. As one female cultivator put it, ‘it is my husband who went to the one-day training but he left to India and I haven’t got any training yet’ (Marble, 2008).

Second, because SIMI staff had never worked on domestic water provision prior to this project, a sanitation and hygiene education component was not included in the projects. Some organizations that

Table 2. Adoption of micro-irrigation by economic group[1]

		Rich	*Middle*	*Poor*
Patneri	No. households	12	48	44
(104 HH)	No. adopters of micro-irrigation	8	18	9
	Percentage adopting micro-irrigation	67%	38%	20%
Ranitathi	No. households	11	5	8
(24 HH)	No. adopters of micro-irrigation	10	4	7
	Percentage adopting micro-irrigation	91%	80%	88%
Moredada	No. households	2	4	7
(14 HH)[2]	No. adopters of micro-irrigation	2	3	0
	Percentage adopting micro-irrigation	100%	75%	0%

[1] All households had access to water for productive purposes. Not all households purchased and utilized micro-irrigation kits.
[2] The wealth ranking for one household was unclear.
Source: data from Marble (2008)

> Explicit inclusion of a sanitation and hygiene education component would probably have had better results

were approached by SIMI to become a project partner were sceptical of MUS, citing the lack of a sanitation component as one reason for their hesitancy (Mikhail and Yoder, 2008). Although sanitation and hygiene were not explicitly included, according to SIMI project data, the increase in availability of domestic water, coupled with SIMI's encouragement of sanitation, resulted in 62 per cent of participant households building their own toilets. It is probable that explicit inclusion of a sanitation and hygiene education component would have resulted in even greater toilet construction and use coupled with better hygiene practices.

A third gap recognized by learning alliance partners was consideration of water quality (Mikhail and Yoder, 2008). SIMI followed the prevailing norm in the middle hills of Nepal for construction of gravity-fed domestic systems: it is assumed that spring water is of high quality and that treatment is unnecessary. As the project progressed, higher level filtration was added at the spring intakes to improve water quality. Yet, there was no testing and treatment. While this approach has worked thus far in the middle hills because of the availability of good quality spring water, as MUS spreads to other areas and sources of poorer quality are utilized, considerations of water quality will become more important. Additionally, as the concept of 'multiple sources for multiple uses' is adopted, quality considerations will be essential.

Limitations

Although MUS scale-up in Nepal is promising, limitations remain. The SIMI MUS designs were suited for the middle hills setting: a large number of small streams that could be piped by gravity to relatively small communities. However, taking MUS to the Terai region will require new designs. In the Terai, pumping will be required, which will dramatically increase both the capital costs of construction and the costs of operation and maintenance. Both community and landholding sizes are larger in the Terai, also increasing the complexity of scheme design. However, pilot MUS work undertaken in other countries can provide lessons (see van Koppen et al., 2009).

The productive component of MUS not only encourages communities to maintain the systems, but also provides the income to participating households to support this maintenance. Yet, the short duration of the construction period and limited SIMI follow-up due to budget and staff constraints places the long-term sustainability of projects in question. SIMI usually only managed to visit the communities a few times after completion of system construction. And, although SIMI trained the WUC and operator on system operation, sometimes communities are unable to solve all problems

Training of local government or NGOs could provide more long-term technical support

themselves (Marble, 2008). Thus, training of local government and/or NGOs could provide more long-term technical support. However, it is not enough to supply continual infrastructure support. Investment in infrastructure only reaps long-term benefits when coupled with the collective action of smallholders, including development of a set of written rules for system operation and maintenance (Lam and Ostrom, 2009). Therefore, long-term support is best supplied through more focused attention on strengthening WUCs.

Additional constraints come from the physical and political environment. First, one pillar of SIMI – market access – has much to do with road coverage. Yet, only 36 per cent of the rural population has access to all-weather roads (World Bank, 2007). Accurate market information is also difficult for smallholder farmers to access. This is slowly being addressed by SIMI's marketing committees. Second, many remain within the government who believe that small-scale water supply systems are a waste of resources, focusing on the greater perceived benefits of larger systems. Although this thinking is changing (Mikhail and Yoder, 2008), it is still a barrier to full government support of MUS. Third, the registration of rights to source use is overly complicated, particularly for illiterate and less politically savvy communities (Gautam, 2006). There is no single, clear process of registration, and although domestic use has formal priority, many streams or springs have long since been utilized for irrigation of rice. Thus, communities must negotiate with the previous source user(s), sometimes resulting in heavy costs of material or labour, or restrictions on the amount of the source that can be utilized. Furthermore, there is no central repository that collects water use rights in the country, and different departments have different procedures. These hurdles make the process difficult for newly formed WUCs.

The registration of rights to source use is overly complicated

Opportunities

Despite all of the limitations, there is greater opportunity for MUS coverage in Nepal. Yet, many who participated in the learning alliance believe that upscaling is only possible if the local government is in the driver's seat: the District Development Committee (DDC) should be responsible for MUS with support from the central government, line agencies and NGOs. The reasons included long-term support, continuity of planning, use of government resources and national efforts towards decentralization. And, with this model all districts could be systematically covered. Staff and budget constraints in the SIMI project discouraged working with more disadvantaged communities because of the extra time and effort required. Thus, it was often the already well-organized communities that received projects. Placing the responsibility for MUS with local government could help

MUS is now included on the approved list of development activities at the village/district level

address this problem. A recent critical policy change has encouraged this transition: MUS is now included on the approved list of development activities at the VDC/DDC level, meaning they can receive central government funds for MUS implementation. Additionally, the National Association of Village Development Committees in Nepal is developing a memorandum of understanding with IDE-Nepal for future collaboration on MUS projects.

Another large area of opportunity is the expansion of MUS systems to include other productive uses. Vegetable production may not be the preferred productive use for all households. And, since livestock is an important component of rural Nepali livelihoods, more explicit inclusion of livestock watering into the system is needed. Fish ponds and small-scale food processing were other uses in which communities expressed an interest (Mikhail and Yoder, 2008). And, MUS projects being initiated by learning alliance partners have begun to include micro-hydro power generation in their work. For example, in 2007 the Finnish International Development Agency began a development project that is incorporating pico-hydro or micro-hydro power in addition to domestic and micro-irrigation uses.

The use of small, closer water sources helps to dramatically reduce the cost of service

The MUS systems in Nepal allow for the efficient development of many small spring sources closer to communities in the hills that have largely been neglected by traditionally larger projects. The use of these small, closer sources helps to dramatically reduce the cost of service. MUS also allows for use of old infrastructure that may be limited in its current capacity to provide for community needs. By expanding on old infrastructure, costs can be cut.

Conclusions

Although in many ways it is easier to create a set model that can be replicated, what has been shown by the Nepal experience is that each setting has unique opportunities and constraints for service development. The fact that the MUS systems were designed largely through an organic process of community engagement, problem solving, feedback and iteration grounds the myriad lessons generated in one primary truth: projects must be designed to address expressed community needs. Therefore, a menu of options should be offered to each community for their selection, understanding the local context. A community may choose the double-tank, two-line distribution system even though it has a higher cost because they wish to rely less on system management for allocation and assurance of domestic priority. Other communities may choose greater management and lower hardware cost. Communities could choose to install direct household connections for added cost (Yoder et al., 2008). And, communities are not homogeneous. Some households may wish to irrigate vegetables for sale at markets while others prefer small-scale food processing or production of fish. A menu of options would allow for greater community inclusion in system design and the broadening of projects to include multiple sources and multiple productive uses. In addition, opportunities vary across the country; some have abundant supply and others less access. The MUS systems built thus far take this variance into account to some level, but greater inclusion of community choice in design will allow them to address their own needs with the resources available to them (within the community and through their lobbying efforts).

A menu of options would allow for greater community inclusion in system design

Further, the MUS work in Nepal demonstrates that system design and construction is not sufficient to provide communities with multiple-use water services. Several critical factors in MUS implementation surround the physical systems: the development of community institutions for long-term management; equity of allocation and marketing facilitation; inclusion of the appropriate project partners in a learning alliance; connection of communities to external resources (financial and technical); assistance in negotiating with neighbours for water access; and development of community and individual household skills. The critical importance of these 'soft' project components cannot be overstated.

With SIMI as the implementing organization, a relatively fluid MUS development process was the outcome. Yet, learning alliance partners conclude that long-term sustainability and scale-up of MUS requires government responsibility. Although MUS has gained much traction with policy-makers, many within government remain resistant to working in the interdisciplinary nature required by MUS (Mikhail and Yoder, 2008). The learning alliance was essential to begin the necessary evolution in thinking. And, the scale-up process has already begun: projects beyond SIMI exist, and the relationships that were developed through the learning alliance have led to continual sharing of the skills and ideas needed to move MUS forward.

Many within government remain resistant to working in the interdisciplinary nature required by MUS

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