CHAPTER 14

CONCLUSION

Photograph by Deepak Adhikari.

An abundance of lessons emerged from the MUS work in Nepal and Maharashtra, India. While the experiences in the two places were incredibly different, several common threads emerge, albeit with distinctive situational spins.

MUS EXTENDS INTEGRATED WATER RESOURCE MANAGEMENT

Perhaps the simplest emergent theme is that MUS is not a new concept for rural villagers in either Nepal or Maharashtra. In both regions, communities have found ways to achieve their own integrated water resource management by combining various "projects," either brought to them via external implementers (the government or NGOs) or accomplished via their own efforts. As demonstrated most clearly in Kikwari, but also in Samundi, Chhatiwan, Krishnapur, and many other MUS villages, communities piece together various financial and physical resources over time to meet their water-use needs. Kikwari (chapter 10) used four successive projects over the past twenty years to gain village access to groundwater for domestic use: through a drinking water project; by augmenting groundwater capture by constructing runoff barriers; by capturing greywater and recycling it for productive use; and through further augmentation of the water supply through Jalswarajya, to which MUS is attached. Samundi (chapter 11) also combined multiple projects: they protected the nearby forest land and constructed small check dams on the nearby river and recharge pits at each household for groundwater recharge; they banned open defecation and built toilets; and they increased their water supply through Jalswarajya. In Chhatiwan (chapter 3) the community lobbied the local VDC council to provide them with a half-inch pipe to deliver water directly from the source to their community for domestic use and later incorporated this pipe into the MUS system. In Krishnapur (chapter 5), the community took these steps: used their branch of a previously existing farmer-managed irrigation system; lobbied the DoI to line the canal for additional water; built household storage to allow flexibility in use; and tapped a small nearby spring to augment the water supply.

Yet, MUS takes this community-led integrated water resource management one step further by formalizing the community-management structure into a Water User Committee (WUC) in Nepal and Village Water and Sanitation Committee (VWSC) in Maharashtra. This ensures access of disadvantaged groups (women and lower castes) and builds the overall community's capacity to access both physical and financial resources to accomplish their water-use goals. It also engenders a greater level of buy-in from the community for system care: because MUS provides for a combination of domestic and productive needs, all community members have an increased stake in its smooth operation. And with the rise in income from the productive-use component, households can better afford the operation and maintenance costs of the sys-

tem. The importance of the financial boost of the productive-use component cannot be understated; i.e., the connection with high-value crop production and marketing is critical (as seen clearly in the Nepal cases—chapters 3–5).

Whereas MUS is not a new concept for communities, it is a shift in approach for water resource development implementers. Despite the sectoral nature of water resource development in the country, the Nepal program was able to achieve significant buy-in from implementing partners with a single-purpose mandate. Because MUS inherently requires the involvement of multiple sectors, players within the government who largely do not coordinate were brought together in Nepal—the Ministry of Agriculture and Cooperatives; Ministry of Finance; Ministry of Women, Children & Social Welfare; Ministry of Local Development; and the Department of Irrigation. All of these government participants regularly communicated with NGOs, local community groups, and WUCs. Fortunately, MUS coincided in Nepal with a larger movement within the Department of Irrigation called the Nonconventional Irrigation Technology Project. Their interest in microirrigation opened the door for MUS and generated great respect for the fledgling department within the DoI at a time when it was seeking to build recognition and respect. Witnessing the positive impact on communities improved NITP staff morale and gained the department accolades.

BLEND OF COMMUNITY AND INDIVIDUAL ACTION AND BENEFIT

Another reason for increased community buy-in is the important blend of community and individual action that MUS achieves. All community members are tied in to the MUS system through use of a common resource, reception of water service, and participation in the WUC/VWSC. The entire implementation process creates community cohesion and effective community management of a shared resource. But MUS also provides water for individual household productive use. Households can choose how they wish to use their water allocation from the system. In both Nepal and Maharashtra, IDE encouraged use of microirrigation kits on small plots/kitchen gardens for growth and sale of high-value crops. Households could choose whether to purchase the kits or not with their own money. They chose the size of kit they desired and how much water to allocate for its use. Thus, individual households benefited from the increased consumption of vegetables as well as the income vegetable cultivation and marketing brought them. Furthermore, the community in turn benefited from the increased ability of households to pay for the operation and maintenance costs of the system.

In Nepal, the combined individual/community action also sometimes led to a change in water-use behavior. As evidenced by the situation in Senapuk, the connection between closing taps and availability of water in the system was an important driver toward water conservation. By connecting domestic

and productive use, the incentive to conserve is higher. As a community system, community members can keep one another's water consumption in check. Hence, individuals are encouraged to close community taps instead of letting water consistently flow, as was the common practice prior to MUS implementation. Conversely, water conservation action was not observed in communities where IDE only supported individual household microirrigation technology use. Thus, it appears that collective action is required to encourage individual conservation behavior.

The MUS systems in Nepal also have an important connection to the situation of the migration of male villagers to work abroad and send home remittances. As in Senapuk (chapter 4), women who were the current heads of their households in MUS villages found increased financial independence through the cultivation and sale of vegetables and improved social standing through participation in the WUC. And given the inconvenience and stress on the family when men are away for most of each year, the productive-use opportunity opens an option for income generation that will enable some to earn more by staying home.

In Maharashtra, the individual/community action linkage takes on a different, but no less important, implication for mitigating the acute effects of groundwater overdraft in the state. Irrigation for agriculture in the state has historically been through either large-scale irrigation-canal systems built by the government or groundwater abstraction of wealthy farmers through digging wells or drilling of individual household bore wells. On the other hand, domestic water provision has predominantly been through community wells. Therefore, irrigation was largely an independent enterprise while domestic water provision had greater community consequences. However, with recent severe droughts and overabstraction of groundwater from individual household wells, community water planning is becoming increasingly important and increasingly practiced. NGOs and the government are beginning to train communities to budget their water resources in order to: raise the level of understanding of the resources they have available; develop ways in which to recharge the groundwater; and encourage efficient and equitable water use. Unfortunately, due to the historical separation of domestic and productive-use provision, productive-water use has largely been excluded from community water budgeting efforts, leaving individual households to continue depleting the groundwater reserves. The MUS concept is a positive step forward for Maharashtra communities because it incorporates the missing productive-use component into water budgeting. Consequently, the community can choose to allocate a set amount of water to farmers to prevent overuse of the resource. This in turn will protect the source for much-needed domestic purposes as the population escalates. It also allows the community to encourage the cultivation of less-water-thirsty crops. Kikwari (chapter 10) is a good example of a village that has begun to make these connections between individual and

community action and efficient use of available resources. Through a visionary farmer who leads the VWSC in the village, they have undertaken numerous groundwater-recharge activities; collected greywater for cultivation of crops on community land; allowed a women's SHG within the community to lease community land for their own crop cultivation; and encouraged the shift toward production of less-water-thirsty crops. Hopefully as the MUS concept spreads, other villages will make this connection. For future MUS efforts, the association between individual and community action should be made explicit.

IMPORTANCE OF SYSTEM/PROJECT OWNERSHIP

SIMI implementation staff indicated that the difference between MUS and government water resource development projects is real community ownership. The importance of system "ownership" is undisputed. However, the actuality of what is meant by "ownership" differs widely. IDE considers communities to own their systems if they have complete control over the future of the system. In order to have complete control over the system's future, a community must manage its construction, have the right to choose who uses the system, make operation and maintenance rules, and be able to enforce the rules. In systems where government initiates the system, even if "handover" for operation and maintenance occurs once the system is built, control over who has access to the system remains with the implementer. In Nepal, the communities were required to negotiate with neighboring communities to ensure legal rights to use the water source or a portion of the source. They were also responsible for lobbying other NGOs and government agencies to contribute matching funding. Communities contributed on average 47 percent of the total system costs (cash, local materials, and all unskilled labor) in addition to individual households purchasing microirrigation kits at full cost. The WUC was responsible for ensuring equal contribution from each household, and if wealthier households chose to opt out of labor contribution, they hired less wealthy households to contribute for them. This substantial input—negotiation for rights; lobbying for partner support; and cash, material and labor contribution—built strong community pride in their systems, ultimately increasing desire to keep the system well functioning.

In Maharashtra the communities have greater control over system construction than in previous state-run domestic water projects, but too many restrictions remain for true ownership. The state-level bureaucrats running the Jalswarajya/Aple Pani projects established specific rules of implementation, set lists of NGOs and contractors that could be "hired" by the community for various roles, set system designs the engineers were allowed to choose from, etc. This left too few real choices for the community. Additionally, Jalswarajya/Aple Pani relied far too heavily on NGOs to build the capacity of the community without the adequate measures to ensure their success. There was no quality control to ensure that the NGOs were actually transferring

skills successfully, and remuneration was far below what was needed to ensure NGO initiative and sufficient support. Thus, the communities who were lucky enough to secure exemplary NGOs were more successful than those who were not. Furthermore, the Jalswarajya/Aple Pani systems in Maharashtra were much larger and more expensive than those in Nepal due to larger populations, the need for pumping of groundwater, and the fact that entirely new projects were built without incorporation of preexisting infrastructure. The community was responsible for contributing 10 percent of the total cost (5 percent for tribal communities), while the rest was provided by the state. The community hired contractors and NGOs from the predetermined list to design and build the system.

Determining rules of distribution is a critical piece of system ownership. Interestingly, in both Nepal and Maharashtra, the "equal share" concept from domestic-only systems supersedes other distribution rules seen in irrigation-only systems. In irrigation-only systems, it is not uncommon to base allocation on land area or share of system contribution per household. In Nepal, since the system was servicing both domestic and productive needs, all households were expected to contribute equally to the system and thus receive the same share of water, regardless of the amount of agricultural land they wished to irrigate. All communities applied the use of flow regulators to ensure equal distribution despite different outlet elevations. This equity-of-use rule is more flexible when water is abundant (as seen in Chhatiwan where households simply take as much water as they wish for both domestic and productive uses). However, when water becomes scarcer, the rule is more strictly enforced. In Krishnapur, the WUC determines the water schedule depending on the time of year (based on the flow in the canal and spring). Communities also purchased their own homestead storage to increase their flexibility of use during the interim periods between water deliveries.

Ownership also comes through choice. In Nepal the communities jointly planned system design with SIMI. The systems are flexible enough to allow for adaptive management as need and resource flow shift both throughout the year and over multiple years. This allows them to adjust system management over time. However, SIMI engineers still had significant input into system design. Greater community control could be accomplished if SIMI were to provide a wider menu of options. This would increase community flexibility to choose between system cost versus more intensive management.

Since IDE was not the direct implementer in Maharashtra but worked within a state-level domestic water project, the scope for MUS was limited and community ownership was not fully reached. A combination of all aspects of water resource use and recharge is needed. Drawing on NGO watershed-development experience (water budgeting and groundwater recharge) and government experience building domestic systems, in combination with efficient and equitable allocation for multiple uses, would truly achieve MUS. However, the reality is such that MUS may need to be achieved through

state-level programs. Thus, using the extra water for the projected population growth that is currently in the system for productive use, such as kitchen gardens, is a good way to move toward MUS within the existing constraints of large-scale domestic provision.

COMPARISON OF THE TWO LEARNING ALLIANCE APPROACHES

The Learning Alliance (LA) approach was used in both Nepal and Maharashtra but with somewhat different outcomes. Although the LA was important for MUS development in both places, it was in some ways more successful in Nepal because of the way it was conducted. In both places district and national (or state level in Maharashtra) workshops were held. However, in Nepal there was greater government involvement than in Maharashtra, which relied mainly on NGO partners.

The limitation of IDE's small staff in Maharashtra greatly impacted the form that the LA took. With constraints on direct implementation, IDE staff decided to begin MUS work in Maharashtra through the LA approach. Staff focused on encouraging the concept with partner organizations to implement MUS themselves or approach communities they were working with through Jalswarajya/Aple Pani to incorporate a MUS component. While this approach generated some level of success and interest with NGO partners, it was restricted in its scope. Several NGOs were interested in MUS until they realized that no funding would be generated. Likewise, NGOs were bounded by the structure of the Jalswarajya/Aple Pani project. However, the Jalswarajya/Aple Pani program heavily emphasizes the role of NGOs in the project, acting as both support organizations (SOs) and capacity building consortiums (CBCs). Thus, building partnerships with these organizations is critical for infusing MUS into project implementation by ensuring that communities are made aware of the full range of choices. The supportive role played by NGOs is also essential for building the capacity of communities to push for the incorporation of all of their needs into future projects, or at minimum to better link various projects to supply their needs.

In Nepal, the LA and MUS project implementation reinforced each other. As mentioned above, the communities were responsible for obtaining matching funds from partner organizations, both NGOs and government agencies. This search for matching funds cemented partners who were then encouraged to be involved throughout the implementation process. These partners and additional organizations were invited to attend district and national-level workshops. Workshops were important for showcasing community-group representatives to individuals who had not yet visited MUS sites and for discussing potential mechanisms for scaleup. Key agency officials were also part of the SIMI Advisory Board, keeping them regularly involved in the progression of MUS over the years.

Critical to this involvement, however, was the fact that actual MUS systems were built before the LA approach was initiated. Field visits of partners to these concrete (and successful) examples of MUS were crucial for garnering support of future MUS systems and LA activities. When comparing the propagation of the MUS concept in India versus Nepal, it becomes clear that seeing MUS in action is much more compelling than simply explaining the concept. In fact, the most striking example of this is the visit of an Indian partner NGO, Dilasa, to Nepal. As part of a different Challenge Program project, Dilasa staff traveled to Nepal and were taken on a field visit to MUS sites. Although Dilasa had been part of the LA prior to their visit, seeing the MUS-by-design systems in Nepal turned them into instant advocates of the concept. Upon return to Maharashtra, they were so excited by MUS-by-design that they sought out three separate sources of funding for implementing their own projects.

On the other hand, perpetuating the MUS concept by encouraging field visits to existing MUS-by-design projects encourages viewers to equate the MUS concept with what they see. This limits their vision of MUS to what has taken place in the site they visit. This makes it difficult to encourage creativity in conceptualizing other possible manifestations. In both Maharashtra and Nepal, partners tend to view MUS as simply drinking water and microirrigation of small plots of land. However, some emerging projects in Nepal are expanding this concept to include microhydropower for grain milling and electricity production as well as other components.

LINKAGE WITH DECENTRALIZATION EFFORTS

In both India and Nepal there has been a recent trend toward decentralization of government, particularly when it comes to infrastructure development. Through the Nepal LA, participants discussed the potential for MUS scaleup in the country. Many individuals felt that long-term sustainability of MUS systems would only occur if MUS were to be imbedded within the government structure itself. The general consensus was that the district and local governments (DDC/VDC) should be in charge of MUS implementation with various government line agencies and NGOs providing funding and technical support for the various components of MUS. This mechanism for MUS scaleup was recently accelerated when the Ministry for Local Development added MUS to their fund-allocation guidelines. Inclusion of MUS in the guidelines makes it an official government development activity, authorizing the district government to provide funding to village governments for MUS projects.

For Maharashtra, decentralization is transferring greater control to the local government (Gram Panchayat—GP). Although the state-level government still has somewhat of a top-down approach, Jalswarajya/Aple Pani is the first step toward strengthening the involvement of the community in water resource development. The GP, in conjunction with the VWSC, is primarily

responsible for project implementation in each village. However, to overcome the barriers to scaleup and have real MUS-by-design that is truly community-led, greater decentralization of the process would be required. The state level would need to provide much greater flexibility in the way the projects are implemented to place actual control with the community and local government. On the other hand, if MUS is to be incorporated into domestic-water-development programs such as Jalswarajya/Aple Pani as they are designed today, then achieving full buy-in from the state level is critical for scaleup of MUS in the state.

DIFFERENT MUS APPROACHES NEEDED FOR VARYING CONTEXTS

Ultimately, the comparison between the Nepal and Maharashtra MUS work shows the need for different MUS approaches for varying contexts. One factor that impacts the system design is the location of land in relation to homes in the village. In Nepal, the bari land upon which they were growing vegetables with microirrigation kits was usually near the homes. This made the combination of domestic and productive water more feasible. However, there were some households who had bari land much further from their homes. These households were generally only provided domestic water because provision of productive water was too cost prohibitive. In Maharashtra, the villages are much more densely populated, leaving little land to cultivate for kitchen gardens except at the edges of the village. Agriculture is also generally larger scale and conducted on plots further away from the village. This makes MUS-by-design more complicated and expensive and highlights the need for greater creativity. Kikwari and Samundi already display this type of innovation through greywater filtration and reuse on community plots, irrigation of community land by women's SHGs, creation of the tribal community goat farm, etc.

The landscape and type of water resource available heavily impact system design and cost factors. Nepal was largely so successful with MUS implementation because there was either existing infrastructure that had excess water for use (i.e. Krishnapur's use of the farmer-managed canal system and Chhatiwan's use of the source already shared by multiple communities for drinking water) or small springs that had yet to be tapped (i.e. Senapuk's MUS source and the additional source tapped by Krishnapur to augment the canal supply). The use of excess from existing systems reduced infrastructure costs. The use of springs allowed for gravity-fed systems, preventing the need for expensive pumping. Consequently, the small systems in Nepal allowed for impressive impact with low investment and use of sources that were previously thought (by government and NGOs) to be too small to be useful. The low investment with important positive impacts for communities—increased income; improved nutrition and health; empowerment of women; reduction

of time spent in water collection; skill building of community members; increased school attendance, particularly for girls; increased water conservation; and shifting caste and gender power dynamics—increased the buy-in of all stakeholders. See chapters 3–6 for more on project impacts.

Maharashtra, on the other hand, has mostly groundwater or streams to use for MUS. This requires construction of a large overhead storage tank, pumps, and the cost of running pumps. Overall, the costs are much higher for this type of system. Due to the need for use of groundwater, greater scarcity of water in general, and the depleted groundwater resources in the state, groundwater recharge efforts factor heavily in Maharashtra's water resource development work. Water budgeting and allocating set water quantities for various uses in addition to the encouragement of efficient water use (as in use of microirrigation and moving away from sugarcane cultivation) can ensure future water availability for all uses. In Maharashtra, water budgeting and groundwater recharge has already become critical, but Nepal is not immune to overuse of resources. As Nepal begins to use more of the small springs in the hills, a larger plan for water use will need to be conceptualized and implemented in the country to ensure that those downstream do not suffer water shortage. And MUS implementation in Maharashtra can guide MUS implementation in the flatter region south of the hills, the Terai.

Regardless of the system design and natural-resource limitations, experience in Nepal and Maharashtra has shown that combining MUS with microirrigation creates a powerful duo. Microirrigation ensures the ability to grow more "crop per drop" and conserve the much-needed resource. As population growth causes resource demand to grow, cognizance of broader policies that encourage certain types of crops (i.e. sugarcane in Maharashtra) must be part of the MUS movement.

Notes

Part 1 Introduction

1. The Global Lead partners on the CP-MUS project were 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.
2. Ujyalo aims to strengthen support for the victims of conflict and conflict-affected communities through an integrated community-level program that combines economic and social support activities designed to address the physiological and economic consequences of Nepal's conflict. The BDS-MaPS project, funded by USAID and implemented by a consortium of INGOs and private businesses, aims to increase income opportunities of 22,000 smallholder farmers and gatherers in six target districts of Nepal by boosting production, improving quality, and increasing demand for nontimber forest products. BDS-MaPS PRIME is focused on women entrepreneurs and is partially funded by USAID. The subsectors under this program are based on their adaptability to women producers and include high-value crops like vegetables, poultry, and mobile retail shops.
3. For the purposes of this book, MUS will be used to mean the Multiple Use Services project funded by the Challenge Program on Food and Water and also multiple-use water systems in the general sense.

Chapter 1

1. Improved access is defined as having one of the following: household connection, public standpipe, borehole, protected dug well, protected spring, or rainwater collection.
2. Computed using data from FAOSTAT; accessed by www.faostat.fao.org
3. Clarified (rendered) butter made by simmering unsalted butter until all water has boiled off and protein has settled to the bottom.
4. In the 1970s and '80s the World Bank loaned a great deal of money to the government of Nepal for rural water supply infrastructure. Due to mismanagement of funds by the government, the World Bank ultimately closed down all of these loans. In the 1990s the World Bank tried a new tactic with the Fund Board and began working with NGOs as implementers, using government line agencies for budgetary and regulatory functions. Because this was prior to government decentralization, there were no functioning VDCs or DDCs to work with directly at the time.
5. Dr. Prachanda Pradhan , e-mail message to author, May 27, 2007.

Chapter 2

1. SIMI divides each district into three "pockets" for project operation.
2. Local NGO implementing partner in Kaski District.
3. This amount is recommended by UNICEF and Nepal Department of Drinking Water Supply and Sanitation guidelines as the standard for domestic water systems.
4. GOs are government organizations including the various line agencies at the district level.

5. In Nepal they often refer to "local government" to represent the VDC and DDC.
6. A method of ensuring the plants receive their required nutrients.
7. Agricultural interventions include all of the production trainings provided in the trainings list in chapter 2 as well as the cost of social mobilization and training for input service providers on marketing.

Chapter 3

1. In the middle hills of Nepal it is common practice to eat two meals per day. Therefore, "food security" was defined in all three case studies as being able to produce enough food for two full meals per day for the whole household.
2. Through area microirrigation programs like SIMI, interest in obtaining technical knowledge has increased in the region, and Dal Bahadur Disa is now providing technical support on behalf of a local NGO called Social Resource Development Center.
3. In Nepali, *mul* means "spring."
4. As mentioned above, this particular household had a family member in the hospital, greatly increasing healthcare costs.

Chapter 4

1. A scholar, a teacher, particularly one skilled in Sanskrit and Hindu law, religion, and philosophy.
2. The Vedas are the main scriptural texts of Hinduism.
3. This includes income in-kind for religious workers. Exchange labor and other miscellaneous in-kind income was not measured.
4. Offtakes for irrigation were built closer to the agricultural land for both the households using the old domestic system and households using the domestic portion of the new MUS system so that they did not need to carry water from domestic tapstands for irrigation.
5. 600/250 = 2.4 liters/m2. Since 1 mm of water depth per m^2 area is 1 liter of water/m2 area, it results in the equivalent of 2.4 mm of water depth applied uniformly to a 1 m2 area. In practice the applied water is concentrated near the plant, increasing the percentage of applied water available to the root system.
6. Because of the landslide years back, they are not actually irrigating this land, but they believe they retain some right to the stream's use.
7. This figure was obtained from household interviews with 12 households in Senapuk and a focus-group discussion with the poorest households in the village.
8. The wage labor rate in the Senapuk area at the time of MUS construction was NPR 120/day for men and NPR 100/day for women. Therefore, using the women's wage labor rate, they are saving NPR 19/day for 1.5 female labor hours saved.

Chapter 5

1. According to the World Health Organization's 2005 Nepal Country Profile, the Insect Borne Disease Control Programme was launched in 1954, supported by USAID. In 1958, the government of Nepal launched a malaria-eradication program. It was realized in the 1970s that eradication was not possible, so the program reverted to malaria control in 1978.
2. Agricultural income includes sales of fruit, vegetables, livestock, and livestock products like ghee and milk.

3. Thick wool used to make shawls.
4. The *chokidar* is hired during the mass meeting where payment is discussed and the entire group of water users is involved. This democratic and transparent way of setting up group rules is one of the ways that farmer-managed irrigation systems gain compliance.
5. It was decided that since the primary water supply was surface water from the Karre Khola stream, it would not be used for drinking. If water is clean enough to drink, it is definitely clean enough for use with microirrigation systems. However, water that is clean enough for microirrigation may not actually be clean enough to drink. Bacteria and viruses as well as other contaminants could be present in acceptable microirrigation water. In the hills of Nepal, spring water is considered drinking water quality, and surface canal water is considered lower quality.
6. To flush a pour-flush toilet requires about four liters. Assuming it is used once/household member/day and in Krishnapur there are on average six members in a household, then about 24 liters/household/day are needed for toilet flushing. Hand washing requires around 1 liter/capita/day, so six liters/household/day. Therefore, each household requires roughly 30 liters per day at minimum for toilet flushing and hand washing.
7. The central government, with ADB funding, is expanding the water supply for small towns in Nepal. Birendranagar was selected as one of the pilot small towns. The new water supply system will pass through the Karre Khola Valley, and plans include provision of drinking water from the town system. This will greatly improve the quality and reliability of the domestic water supply for Krishnapur as well.

Chapter 6

1. In Nepal, water use for animal care is included in domestic water need.
2. During the time of household surveys in Krishnapur the community had only had one growing season. Production values from this growing season were multiplied by two to get a rough figure for comparison with Chhatiwan Tole and Senapuk, both having had two growing seasons when interviewed.
3. Information from field visit to Lele scheme in Lalitpur District on 2/27/07.
4. In the caste system, a Dalit, often called an Untouchable, or an outcaste, is a person who, according to traditional Hindu belief, does not have any *varnas*. Varna refers to the Hindu belief that most humans were supposedly created from different parts of the body of the divinity Purusha. The part from which a varna was supposedly created defines a person's social status with regard to issues such as who he or she may marry and what jobs he or she may do. Dalits are at the low end of the caste system.
5. As the liaison between the community and all other stakeholders, the Social Mobilizer/Community Mobilizer is truly the gateway to the community and the most keenly involved in conflict resolution throughout the process. Their role is critical to MUS success.
6. In-line flow-regulator technology is widely used in Nepal's rural drinking water programs where significant elevation difference between tapstands causes large discharge-rate differences. These have been incorporated in MUS projects where elevation is an issue to ensure equity in all distribution networks.
7. These are the same figures that were used in MUS demand calculation.

8. The cost for the most popular systems—small and very small—can be recovered in one agricultural season as evidenced by field observation of all IDE/SIMI programs.
9. This information came from the focus-group/meeting with IDE/SIMI Community Mobilizers and Social Mobilizers in Tansen on 3/22/07.
10. This is partly due to the large number of men working outside of the village and partly due to caste. There is stigma attached to a male Brahmin carrying a load of vegetables to market.
11. Janjati are a low-income ethnic group.

Chapter 7

1. For the case of Lalitpur district, the NITP within DoI was the major partner, mostly due to the proximity of Lalitpur to Kathmandu. There was no SIMI district team in Lalitpur; instead the central-level SIMI staff were entirely responsible for Lalitpur district schemes. Their close connection to the NITP led to this partnership.
2. As mentioned previously, water used for livestock care is generally considered to be one of the domestic water uses in Nepal.
3. The Poverty Alleviation Fund is a World Bank–funded autonomous project within Nepal that aims to improve access to income-generation projects and community infrastructure for the groups that have tended to be excluded by reasons of gender, ethnicity, and caste, as well as for the poorest groups in rural communities.
4. In the decentralization process, the Ministry of Local Development came out the winner because it held the purse strings at the district level. This was resented by other ministries.
5. As mentioned in chapter 1, DDCs receive technical support from the District Technical Office, which is overseen by DoLIDAR. DoLIDAR partners with other line agencies as needed.
6. DDCs and VDCs can plan their development activities autonomously once given funds from the central level based on decisions of the assembly; the assembly members are the participants of local political parties, government officials, etc. At the VDC level the community participates in the VDC assembly and can demand the development activities in their area; assemblies are held once a year, but right now it is difficult to organize them because those in the eight-party alliance tend to support only their party interests. The VDC secretary must call the planning assembly where all the VDC residents, party members, etc. meet. In some districts throughout 2007 they had no budget plan because they had not convened.
7. They saw the Women Development Department as key for social mobilization because they have a network of women Self Help Groups at the community level throughout the country, which has higher coverage than any other line agency.
8. In NITP's estimation, DoLIDAR should be responsible for the drinking water component instead of DWSS because of the size orientation of the two organizations, discussed below.
9. For more information about cognitive dissonance, please reference Cary Coglianese. "Is Satisfaction Success? Evaluating Public Participation in Regulatory Policymaking" 2002. John F. Kennedy School of Government. Harvard University. Research Working Paper 02-038.
10. Cash contribution includes money and nonlocal materials such as piping donated by government organizations. The cash is used to purchase any necessary external materials additional to those donated.

11. Manohari Development Institute is a local NGO of the Makwanpur District.
12. The Development Committee within the DDC integrates all district development activities under one umbrella committee.
13. The suggestion was for all cash contribution to be given directly to the WUC and be placed in the WUC bank account (discouraging material contributions and encouraging cash-only contributions.) The community (via the WUC) would then be responsible for material purchase, hiring of skilled labor if needed, etc. If the government agency prefers to give materials instead of cash, the community would work directly with the government instead of liaising through other partners. Helvetas-Palpa suggested that the community should be made responsible for purchasing the nonlocal materials instead of SIMI so that they would gain more technical knowledge. For example, if the community had a maintenance problem in the future and needed materials, they would then have had experience purchasing quality materials previously.
14, As mentioned before, the 1999 Local Self Governance Act in Nepal was an attempt to shift the government toward decentralization.

Part 2 Introduction

1. The initial idea was to link different water supply projects and sectors to integrate water resource management and planning on a microbasin scale comprising a group of villages. However, not much of this initial concept has come to fruition, and the project has ended up mostly as a domestic water project.

Chapter 8

1. A "habitation" is a cluster of families within a village with a total population of at least 100. An average of 20 families (with an average of five members) live in a habitation. In hilly areas a habitation can have a population of less than 100.
2. Generally, a Tehsil consists of a city or town that serves as its headquarters, possibly additional towns, and a number of villages. As an entity of local government, it exercises certain fiscal and administrative power over the villages and municipalities within its jurisdiction. It is the ultimate executive agency for land records and related administrative matters.

Chapter 9

1. Livestock water began being included in system design in 2003. Ahmadnagar district had a huge drought between 2000 and 2003, and the government was required to provide shelters for livestock to water and feed them. In order to prevent this from happening again, KfW suggested that they include a livestock requirement within the water supply schemes. The calculations are 40 liters per day for one bullock/cow/buffalo, 40 liters per day for 100 poultry, and 40 liters per day for 10 goats or lambs.
2. The Gram Sabha is the body that encompasses every voting individual in the village. It can also be used to refer to a meeting held with all villagers present.
3. A Sarpanch is the democratically elected head of the Gram Panchayat. He, together with other elected members, constitute the Gram Panchayat. The Sarpanch is the focal point of contact between government officers and the village community.

4. Scheduled Castes and Scheduled Tribes are Indian population groupings explicitly recognized by the Constitution of India as being previously "depressed."
5. Static lift is the vertical distance between the source and discharge levels in a pump installation.

Chapter 10

1. Using a conversion rate of 40.8 Indian Rupees per U.S. dollar.
2. The Nadep method of composting was developed by Shri N. D. Pandhari Pande from Maharashtra. The process facilitates aerobic decomposition of organic matter.
3. Interestingly, this SHG has the most tribal members. Eight are tribal women and two are nontribal.
4. Chikungunya is a relatively rare form of viral fever caused by an alphavirus that is spread by mosquito bites from *Aedes aegypti* mosquitoes.
5. Water often pools at public taps and can create mosquito breeding grounds.
6. SOs get paid INR 70 per person in the community for the entire project period regardless of how much they do. Some projects have been under construction for two years. And they get the money from the community in phases, making it difficult to regularly send field staff out to assist the community.

Chapter 11

1. Paan is a type of Indian digestive, which consists of fillings wrapped in a triangular package using leaves of the betel pepper and held together with a toothpick or clove.
2. The papad is a thin South Asian wafer, sometimes described as a cracker or flatbread. The recipe varies from region to region and in fact from home to home, but typically it is made from lentil, chickpea, black gram,or rice flour.
3. Using a conversion rate of 40.8 Indian Rupees per U.S. dollar.
4. The Industrial Technology Institute gives hands-on job training to students who have completed the tenth standard for various industrial skills such as mechanics, electronics, welding, etc
5. Nagli is an indigenous cereal grain.

Chapter 13

1. A project funded by the central government for selected districts in which they bring technologies to rural farmers and provide agriculture marketing information.
2. This project is funded by the World Bank and in a similar fashion to Jalswarajya. The focus is on community participation and the capacity building of Water User Associations.
3. 1000–2000 engineers from all sectors come to these conferences annually.
4. As mentioned in chapter 8, the District Collector is responsible for coordinating all government departments at the district level.
5. An adjoining district to Aurangabad where Dilasa is working.

Reference List—Nepal

Cooke, Priscilla A. May 2000. Changes in intrahousehold labor allocation to environmental goods collection: A case study from rural Nepal, 1982 and 1997, International Food Policy Research Institute. Food Consumption and Nutrition Division FCND Discussion Paper No. 87. http://www.ifpri.org/DIVS/FCND/dp/papers/fcndp87.pdf.

Do, Quy-Toan, and Lakshmi Iyer. 2007. Poverty, social divisions and conflict in Nepal. Harvard Business School Working Paper 07-065. http://www.hbs.edu/research/pdf/07-065.pdf.

Food and Agriculture Organization of the United Nations (FAO). 2001. Assessment of the world food security situation. Committee on World Food Security. Twenty-seventh session. May 28–June 1, held in Rome, Italy.

Gautam, Kamal Raj. 2006. An evaluation of existing legislation, policies, institutions, organizations and networks capacity and limitations, strength and weaknesses in scaling up innovations and the role of Leaning Alliance approaches into existing water sector in Nepal.

Government of Nepal [1]. Ministry of Health and Population. Fact Sheets: General Information. www.moh.gov.np/Home/FACT.ASP (accessed September 2007).

Government of Nepal [2]. Central Bureau of Statistics. National Sample Census of Agriculture 2001/2002. www.faorap-apcas.org/nepal/AgCen%202001–02%20 Nepal/index.htm (accessed September 2007).

Government of Nepal [3]. Central Bureau of Statistics, National Planning Commission Secretariat. Nepal Living Standards Survey 2003/04. Vol.1. December 2004. www.worldbank.org/html/prdph/lsms/country/nepal2/docs/NLSS%20II%20Report%20Vol%201.pdf.

Government of Nepal [4]. Ministry of Finance. Foreign Aid Coordination Division. 2004. Irrigation. Proceedings of Pre-Consultation Meeting of the 2004 Nepal Development Forum, March 31–April 16. www.ndf2004.gov.np/preconsultations.php.

The Kingdom of Nepal, Ministry of Local Development and The Republic of Finland, Ministry for Foreign Affairs, 2004. Rural Village Water Resources Management Project Nepal.

Macours, Karen. 2006. Relative deprivation and civil conflict in Nepal. Johns Hopkins University SAIS work in progress version March 15.

Pariyar, Dinesh. Country Pasture/Forage Resource Profiles: Nepal. Food and Agriculture Organization of the United Nations. www.fao.org/ag/AGP/AGPC/doc/Counprof/Nepal/nepal.htm#livestock (accessed September 2007).

Pradhan, Prachanda. 2005. Saga of farmer's contribution in irrigation development in Nepal. Kathmandu, Nepal.

Rimal, Geeta. 2006. Nepal District Profile 2006. Nepal Development Information Institute (Kathmandu, Nepal).

Schweithelm, Jim, Ramzy Kanaan, and Pralad Yonzon. Conflict over natural resources at the community level in Nepal, Prepared by ARD for USAID (May 2006).

Seale, James Jr., Anita Regmi, and Jason Bernstein. 2004. International evidence on food consumption patterns. U.S. Department of Agriculture. Economic Research Service Technical Bulletin No. 1904. October 2004. http://ers.usda.gov/publications/tb1904/tb1904.pdf.

Sharma, Shiva. 1999. Land tenure and poverty in Nepal. Paper presented in WDR-2000 consultation meeting organized by the World Bank, April 4–6, in Dhaka, Bangladesh.

Shrestha, Dr. Krishna B. Nepal smallholder irrigation marketing initiative drip irrigation adoption dudy. Submitted to IDE and Winrock International, May 2007.

U.S. Department of State. Bureau of South and Central Asian Affairs. Background Note: Nepal. www.state.gov/r/pa/ei/bgn/5283.htm (accessed August 2008).

Van Koppen, Barbara, Patrick Moriarty, and Eline Boelee. 2006. Multiple-use water services to advance the millennium development goals, Research Report 98 (Colombo, Sri Lanka: International Water Management Institute).

World Bank [1]. Nepal Country Fact Sheet. www.worldbank.org.np (accessed September 2007).

World Bank [2]. 2006. Resilience amidst conflict: An assessment of poverty in Nepal, 1995–96 and 2003–04. Poverty Reduction and Economic Management Sector Unit. South Asia Region. Report No. 43834-NP. June 26, 2006. www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/07/13/000090341_20060713084841/Rendered/PDF/348340NP.pdf.

World Bank [3]. Second rural water supply & sanitation project. www.worldbank.org (accessed September 2007).

World Bank [4]. Nepal transport sector. web.worldbank.org (accessed September 2007).

Yoder, Robert, Monique Mikahil, Kailash Sharma, and Deepak Adhikari, 2008. Technology adoption and adaptation for multiple use water services in the hills of Nepal. Paper presented in the Second International Forum on Water and Food organized by the Challenge Program on Water and Food, Novermber 10–14, in Addis Ababa, Ethiopia.

Reference List—India

Bavadam, Lyla. 2006. Bitter truth. *Frontline* 23, no. 17 (August 26–September 8, 2006). www.hinduonnet.com/fline/fl2317/stories/20060908006401600.htm.

Dhawale, Ashok. Neo-liberal policies lead to starvation deaths, peasant suicides, *People's Democracy* 28, no. 32 (August 2004). http://pd.cpim.org/2004/0808/08082004_ashok%20dhawale.htm.

D'Souza, Marcella, and Crispino Lobo. Watershed development, water management and the millennium development goals. Paper presented at the Watershed Summit, Chandigarh, Maharashtra, November 25–27, 2004. http://www.wotr.org/Articles/wsd_and_mdg.pdf.

Government of Maharashtra [1]. Water Supply and Sanitation Department. http://mahawssd.gov.in/home.html (accessed May 2007).

Government of Maharashtra [2]. Water Supply and Sanitation Department. Correspondence. http://mahawssd.gov.in/scripts/Downloads.asp (accessed May 2007).

Government of Maharashtra. 2008. Water Supply and Sanitation Department. Bharat Nirman. http://mahawssd.gov.in/scripts/bnirman.asp#Coverage.

Government of Maharashtra. 2006. Population. Chapter 3 in Economic Survey of Maharashtra 2005–06 (Mumbai: Directorate of Economics & Statistics, Planning Department, Government of Maharashtra, 2006).

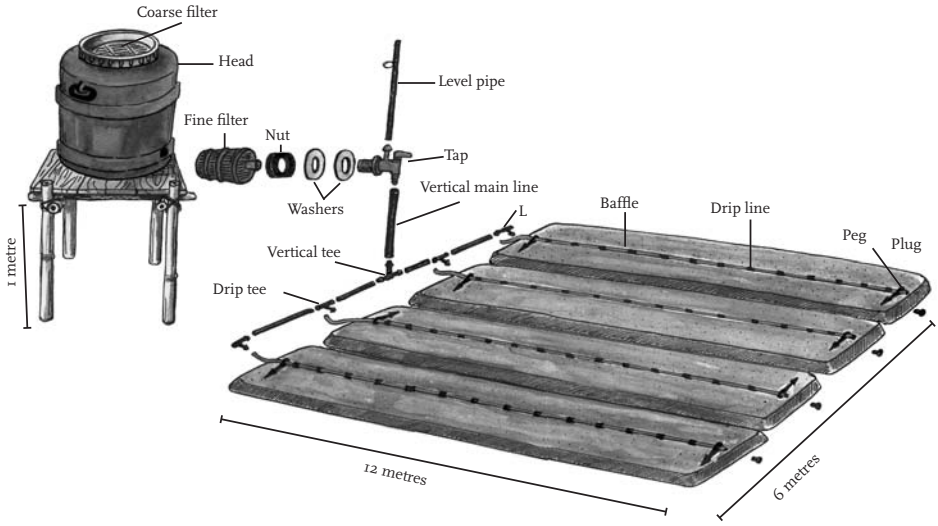
Pathak, M.D., A. D. Gadkari, and S. D. Ghate. 1999. Groundwater development in Maharashtra State, India. Paper presented at the 25th WEDC Conference "Integrated Development for Water Supply and Sanitation," in Addis Ababa, Ethiopia. http://www.lboro.ac.uk/wedc/papers/25/192.pdf.

Phadke, Roopali. 2002. Assessing water scarcity and watershed development in Maharashtra, India: A case study of the Baliraja Memorial Dam. *Science, Technology, & Human Values* 27, no. 2 (2002): 236–61. http://links.jstor.org/sici?sici=0162-2439%28200221%2927%3A2%3C236%3AAWSAWD%3E2.0.CO%3B2-2.

Renjit, C. S. 2003. Maharashtra rural water supply and sanitation project implementation plan, Water Supply and Sanitation Department, Government of Maharashtra, June 2003.

SIMPLE DRIP IRRIGATION SYSTEM

Appropriate irrigation technology for smallholder farmers



Components and specifications

Component	Size	Description
Head Tank	50-200 liters, depending on kit size	Water storage container
Filters - coarse, screen, and fine		The coarse filter removes particles greater than 2 mm; the screen filter is just underneath the coarse filter and catches particles smaller than 2 mm; the fine filter catches all remaining particles
Mainline	12-14 mm, depending on kit size	Runs water from the storage container to the submain line
Lateral drip pipes	O.D. 8 mm, 12 m long, 20 drippers per line	Perforated every 60 cm to make an orifice dripper
Level pipe		Small piece of transparent tube attached to the tank outlet that allows user to observe water level in head tank and helps air trapped in pipe network to escape

System features

- Available in different sizes
- Simple to install and use
- More crops irrigated with less water
- Reduced time spent irrigating
- Low investment with high returns
- Can be used for fertilizer application
- Reduced weed growth
- Expandable design

SIMPLE DRIP IRRIGATION SYSTEM

System benefits compared to traditional irrigation

- Water Efficient: Less water is required to irrigate the same area
- Higher Yield: Higher yields and better product quality can be achieved
- Fertilizer Savings: Soluble fertilizer can be passed through the drip kit, increasing application efficiency and evenness of distribution
- Cost Savings: There is no need to use an electric pump because the system uses gravity for pressure.
- Terrain Flexibility: It can be used on slopes where traditional irrigation is not possible.

Size and Technical Parameters

- All components are manufactured from high quality PVC and plastic for durability
- A row spacing of 1.2 m is used with in-line dripper spacing of 60 cm for continuous wetting of crops
- The average discharge is 2.25 liters per hour

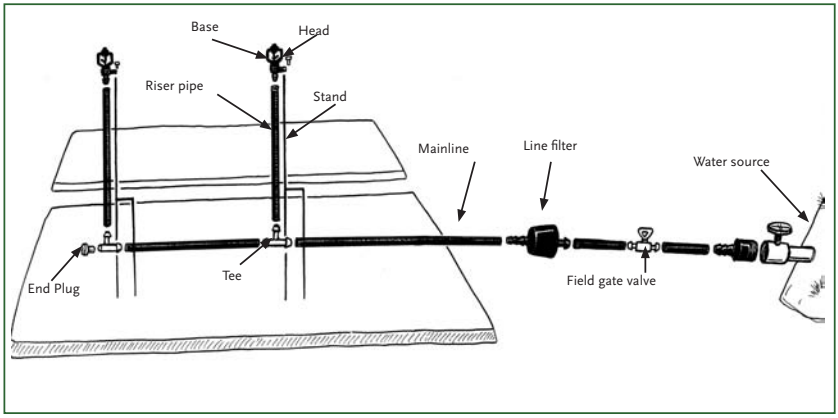
System Size	Very small	Small	Medium	Large	Very large
Command area (m^2)	90	125	250	500	1000
Number of drippers	80	120	240	480	960
Number of lateral pipes (each 12 m in length)	4	6	12	24	48
Size of head tank (ltr)	50	50	50	100	200
Pressure head (m above ground level)	1	1	1	1.5	2

Cost

Prices fluctuate according to region and date. Please see the price list at www.ide-international.org/library/techindex.php or call IDE/Nepal at Tel: 01-552-0943 for more information.

SPRINKLE IRRIGATION SYSTEM

Appropriate irrigation technology for smallholder farmers



Components

Component	Description
End plug	Plugs the end of the pipe to prevent water leakage
Tee	Used to distribute water to two different paths
Stand	Maintains the uniformity of water precipitation
Riser	Pipe that takes the water up to the sprinkler head
Base	Provides support to the sprinkler head
Sprinkler head	Sprays the water
Mainline	Supplies water to the head through the riser
Line filter	Filters the physical particles that can clog the sprinkler out of the water
Field gate valve	Used to regulate water pressure and control water flow through the pipeline

System features

- Fully pre-assembled technology
- Low-cost, durable, and shiftable in the field
- Easy to install, operate, and maintain
- Suitable for short, closely grown crops
- All components are manufactured from high quality PVC and plastic for durability
- Operates a greater number of sprinkler heads with lower pressure than other sprinkle systems on the market.
- Each sprinkler head has a discharge of 75 liters per hour
- The system comes with a one-year warranty

SPRINKLE IRRIGATION SYSTEM

System benefits compared to traditional irrigation

- **Water efficient:** Less water is used to irrigate the same area
- **Higher yield:** Higher yields and better quality products can be achieved
- **Terrain flexibility:** It can be used on slopes where traditional irrigation is not possible
- **Environmentally friendly:** Its use of light precipitation effectively reduces problems of soil erosion and plant damage

Sprinkler head specifications	Small Micro-Sprinkler System	Large Micro-Sprinkler System	Mini-Sprinkler System (choice of 3 types of sprinkler heads)		
Picture			 Triangle butterfly sprinkler	 Circular butterfly sprinkler	 Arm sprinkler
Nozzle diameter (mm)	1.2	1.2	2.2		
Pressure head minimum (m)	8	10	12		
Pressure head maximum (m)	15	15	20		
Wetting diameter at minimum head (m)	7	7	10		
Wetting diameter at maximum head (m)	9	8	12		
Discharge at minimum head (lps)	0.10	0.20	0.20		
Discharge at maximum head (lps)	0.15	0.28	0.30		
Number of sprinkler heads per set	4	8	12		
Avg. irrigation coverage with 3 shifts/day (m^2)	250	500	240		
Spacing between sprinklers (m)	4	4	5		
Water pressure (m)	8-15	10-15	12-20		
Average discharge (lps)	0.12	0.25	0.25		
Price of complete set in NRs (2007)*	881	1655	767		

** Price subject to change due to alterations in the price of raw materials and other input costs.*

Spare Parts List

If treated well, the system will last 3-4 years without component replacement. However, sometimes system problems do occur that require a spare part purchase.

System Problems	Spare Part Required	Cost (NRs)*
Head breakage	Sprinkler head (micro)	40.00
Tee breakage	Tee	5.00
Gate valve leakage	Gate Valve	7.00
Line filter clogging	Clean filter	--

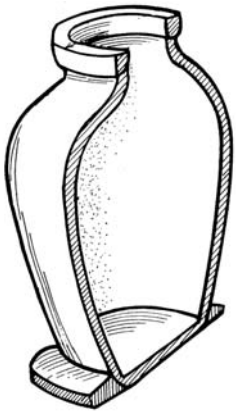
** Costs based on the 2007 market price. Prices subject to change due to alterations in the price of raw materials and other input costs.*

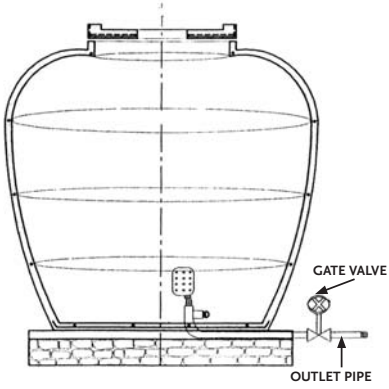
Cost

Prices fluctuate according to region and date. Please see the price list at www.ide-international.org/library/techindex.php or call IDE/Nepal at Tel: 01-552-0943 for more information.

MODIFIED THAI JAR

Appropriate water storage technology for rural households





Tank Components and Cost Estimates

Component	Unit	Rate (NRs)	1000 liter MTJ		1500 liter MTJ		3000 liter MTJ	
			Qty	Total	Qty	Total	Qty	Total
DIRECT CASH COMPONENT								
Cement	Bag	500	2	1000	4	2000	6	3000
White cement	Kg	20	2	40	3	60	4	80
7 mm steel rod	Kg	54	2	108	3	162	5	270
8# Gabion wire	Kg	61	1.5	91.5	2	122	4	244
Chicken wiremesh	m^2	45	1	45	2	90	4	180
Binding wire	Kg	55	1.5	82.5	2.5	138	4	220
Pipe fittings	Set	700	1	700	1	700	1	700
Filter	No.	150	1	150	1	150	1	150
Plastic sheet	m^2	320	0.35	112	0.55	176	1	320
Mason wage	NRs/ day	500	3	1500	4	2000	7	3500
Jute bags	No.	10	8	80	12	120	18	180
Tools	Lump sum	500	1	500	1	500	1	500
SUB TOTAL				**4409**		**6218**		**9344**
NON-CASH COMPONENT								
Stone	ft^3	22.7	2	45	3	68	4	91
Sand	ft^3	28.4	14	397	15	425	20	567
Gravel	ft^3	31.2	3	94	4	125	6	187
Unskilled labour	NRs/ day	200	4	800	4	800	9	1800
Bamboo, rope, water	Lump sum	125	1	125	1	125	1	125
SUB TOTAL				**1461**		**1543**		**2770**
GRAND TOTAL				**5870**		**7760**		**12114**

Note: Above material rates are based on the 2007 Kathmandu market price. Prices may vary regionally due to transportation costs.

System features

- Available in three sizes – 1,000; 1,500; 3,000 liter capacity
- Cheaper than commercial plastic and masonry tanks
- Simple to construct in 3-5 days with assistance of local trained mason
- Robust and easy to maintain
- Can be built above ground or partially buried
- It can be used to store water from any source for multiple applications

MODIFIED THAI JAR

System Benefits

- **Water Security:** It provides water security to meet all household needs – domestic and productive
- **Use with any source:** It can store harvested rainwater or water piped from other sources, depending on water availability and usage
- **Reduce Drudgery:** It can reduce women's water collection workload
- **Increase Income opportunity:** Use of water for productive purposes can generate income

Spare Parts

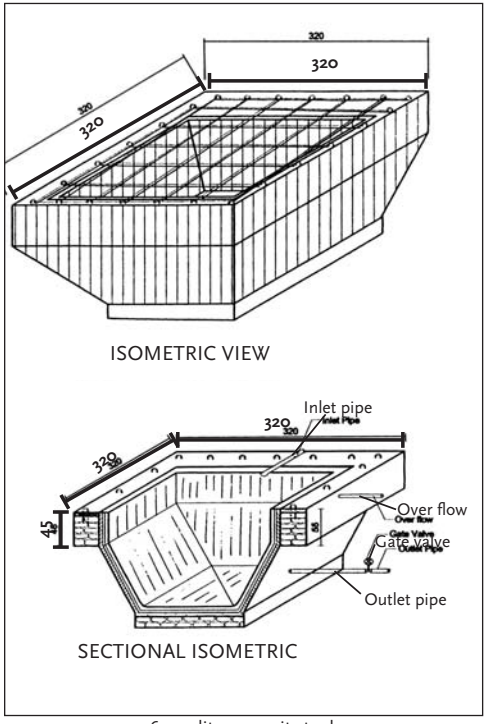
If treated well, the system will last several years without major problems. The only system problem that requires part replacement is gate valve leakage. If the gate valve begins to leak, it must be replaced. The cost range is NRs. 1500-4500 according to size (based on 2007 market prices.)

Cost

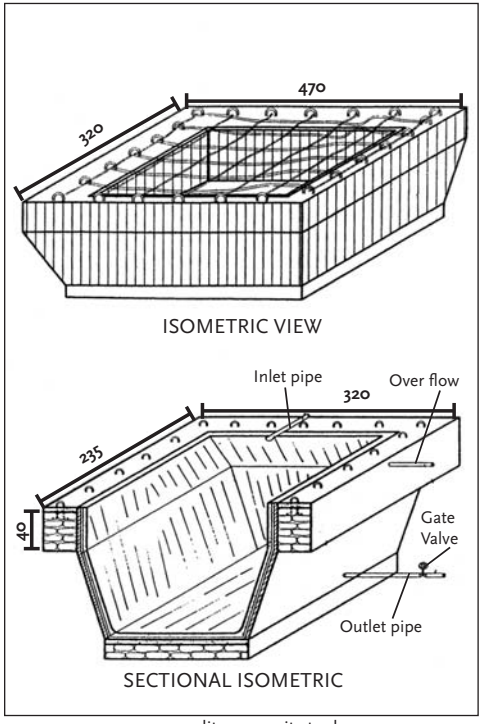
Prices fluctuate according to region and date. Please see the price list at www.ide-international.org/library/techindex.php or call IDE/Nepal at Tel: 01-552-0943 for more information.

FERRO-CEMENT LINED TANK

Appropriate water storage technology for rural households



6000-liter capacity tank



10,000-liter capacity tank

System features

- Available in two sizes – 6,000 and 10,000 liter capacity
- Cheaper than commercial plastic and masonry tanks
- Simple to construct in 7-10 days with assistance of local trained mason
- Robust and easy to maintain
- It can be used to store water from any source for multiple applications

FERRO-CEMENT LINED TANK

System Benefits

- **Water Security:** It provides water security to meet all household needs – domestic and productive
- **Use with any source:** It can store harvested rainwater or water piped from other sources, depending on water availability and usage
- **Reduce Drudgery:** It can reduce women's water collection workload
- **Increase Income opportunity:** Use of water for productive purposes can generate income

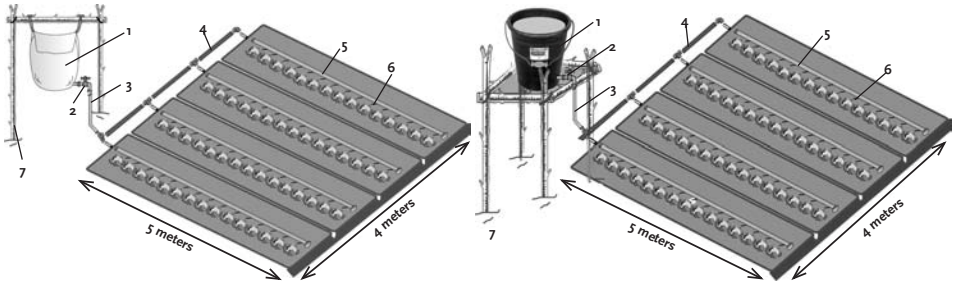
Spare Parts

If treated well, the system will last several years without major problems. The only system problem that requires part replacement is gate valve leakage. If the gate valve begins to leak, it must be replaced. The cost range is NRs. 2500-4500 according to size (based on 2007 market prices.)

Cost

Prices fluctuate according to region and date. Please see the price list at www.ide-international.org/library/techindex.php or call IDE/Nepal at Tel: 01-552-0943 for more information.

IDEal DRIP SYSTEM 20 m² (IDS20)



Components and specifications

No.	Component	Size	Description
1	Plastic Water Bag or Plastic Bucket	20 liters	Water storage container
2	Valve and Filter Assembly	16 mm	Valve regulates water pressure flow; filter removes particles that can clog the system
3	Mainline Lay Flat Tubing	15 mm diameter; 0.2 mm wall thickness	Runs water from the storage container to the submain line
4	Submain Line Lay Flat Tubing	15 mm diameter; 0.2 mm wall thickness	Supplies water to the lateral lines
5	Lateral Line Lay Flat Tubing	15 mm diameter; 0.2 mm wall thickness	Supplies water to the microtubes
6	Microtube	1.2 mm diameter; 25 cm length	Applies water directly to the plant root zone
7	Bamboo/Wooden Post or Platform	1 meter height	Used to hang or set storage container at a height of 1 meter

*Note: The standard design is 1 meter spacing between lateral lines and 40 cm spacing between microtubes for continuous wetting. The design is adjustable.

System features

- Components manufactured from high quality virgin plastic for strength and durability
- Component material is not harmful to the environment
- Kits are inclusive of all system components
- Row width and in-row spacing is adjustable during set-up to suit your needs
- Installation is quick and simple
- Choice of a plastic bag or bucket for water storage
- For closely spaced rows (less than 50 cm), one lateral line can be used for two rows
- Two kits can be combined at one water source to cover a larger area
- This low-pressure system uses gravity for water pressure

IDEal DRIP SYSTEM 20 m² (IDS20)

System benefits compared to traditional irrigation

- **More Crop per Drop:** Less water is required to irrigate the same area
- **Increased Yield:** Higher yields and better product quality can be achieved
- **Labour Savings:** Less labour is required for land preparation, irrigation, weeding, fertigation and crop protection
- **Fertilizer Savings:** Soluble fertilizer can be passed through the drip kit, increasing application efficiency and evenness of distribution
- **Energy Savings:** There is no need to use a pump because the system uses gravity for pressure
- **Terrain Flexibility:** It can be used on slopes where traditional irrigation is not possible

Spare Parts List

If treated well, the system will last 3-4 years without component replacement. However, sometimes system problems do occur that require a spare part purchase.

Major Component	Function	Possible Problem / Malfunction	Cost to replace (US$)
Poly Bag 20-liter	Stores water	It may leak	1.08
Adapter 32 x 16 mm	Connects main pipe to bag	It may break	0.13
Valve 16 mm (online)	Controls flow of water	It may break	0.13
Filter 16 mm flat screen	Filters out particulates from water	The screen may wear out	0.21
Easydrip Tape 15 mm O.D., 200 micron	Used as submain and lateral pipe	It may get cut and leak	0.028 per meter
Tee 16 mm with polytube sleeve 16 mm x 3 cm	Connects lateral pipe to submain pipe	It may break	0.039
Microtube 25 cm long x 1.2 mm I.D.	Delivers water as per required flow rate	It may get clogged due to dirty water	0.005

Cost

Prices fluctuate according to region and date. Please see the price list at www.ide-international.org/library/techindex.php or call +91 (253) 2575131 for more information.

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Monique Mikhail conducted the research and writing of this book in Nepal and Maharashtra, India as Technical Writer/Research Analyst with IDE (International Development Enterprises) of Denver, Colorado, USA. Concurrently, she synthesized media materials for the first comprehensive cataloging of IDE's appropriate technologies in Nepal and India. She received her Masters of Science from Tufts University, researching point of use water filtration and wheat production in rural Maharashtra. Prior to graduate school she worked as a political advocate in Washington, DC on agricultural, food safety, and environmental issues.

Dr. Robert Yoder is Technical Director, Water Technology with IDE. He is currently based in Addis Ababa, Ethiopia managing design and development of water control technologies for smallholder farmers. He was a Senior Associate with the consulting firm Associates in Rural Development of Vermont, USA and prior to that managed the International Water Management Institute's program in Nepal. His dissertation research investigated farmer-built-and -operated irrigation systems in the hills of Nepal. Dr. Yoder traveled extensively in Nepal and India to design and install micro-hydropower systems while employed by the Development and Consulting Services of Butwal, Nepal.