CHAPTER 3

CHHATIWAN: ABUNDANT WATER

Photograph by Monique Mikhail.

Chhatiwan Tole cluster of the Chirtungdhara VDC in Palpa District was chosen as a case study to represent a community with an abundant water supply. It was the very first MUS system constructed. The background information for this case study came from an earlier review of MUS called Nepal Process and Impact Study of the Multiple Use (Hybrid) Gravity Water Supply Schemes in Palpa and Syangja Districts of West Nepal conducted by Eco-Tech Consult Ltd. in October 2004. A visit to Chhatiwan in October 2006 was conducted by IDE international staff and a consultant from the Monitoring and Evaluation Section of the Department of Agriculture. It included a group interview of five out of the ten households and then individual household interviews of the same five households in the presence of the whole group. Another visit in March 2007 of both international IDE staff and national SIMI staff included an interview with six of the ten households, an interview with Dal Bahadur Disa, and interviews with local SIMI staff.

SITUATION ANALYSIS

COMMUNITY SETTING

As discussed in Chapter 2, the Chhatiwan MUS system was the first constructed and was a single-tank, one-line system. A similar system solely for microirrigation was built in the neighboring village of Gaptung and the results of the two systems were compared.

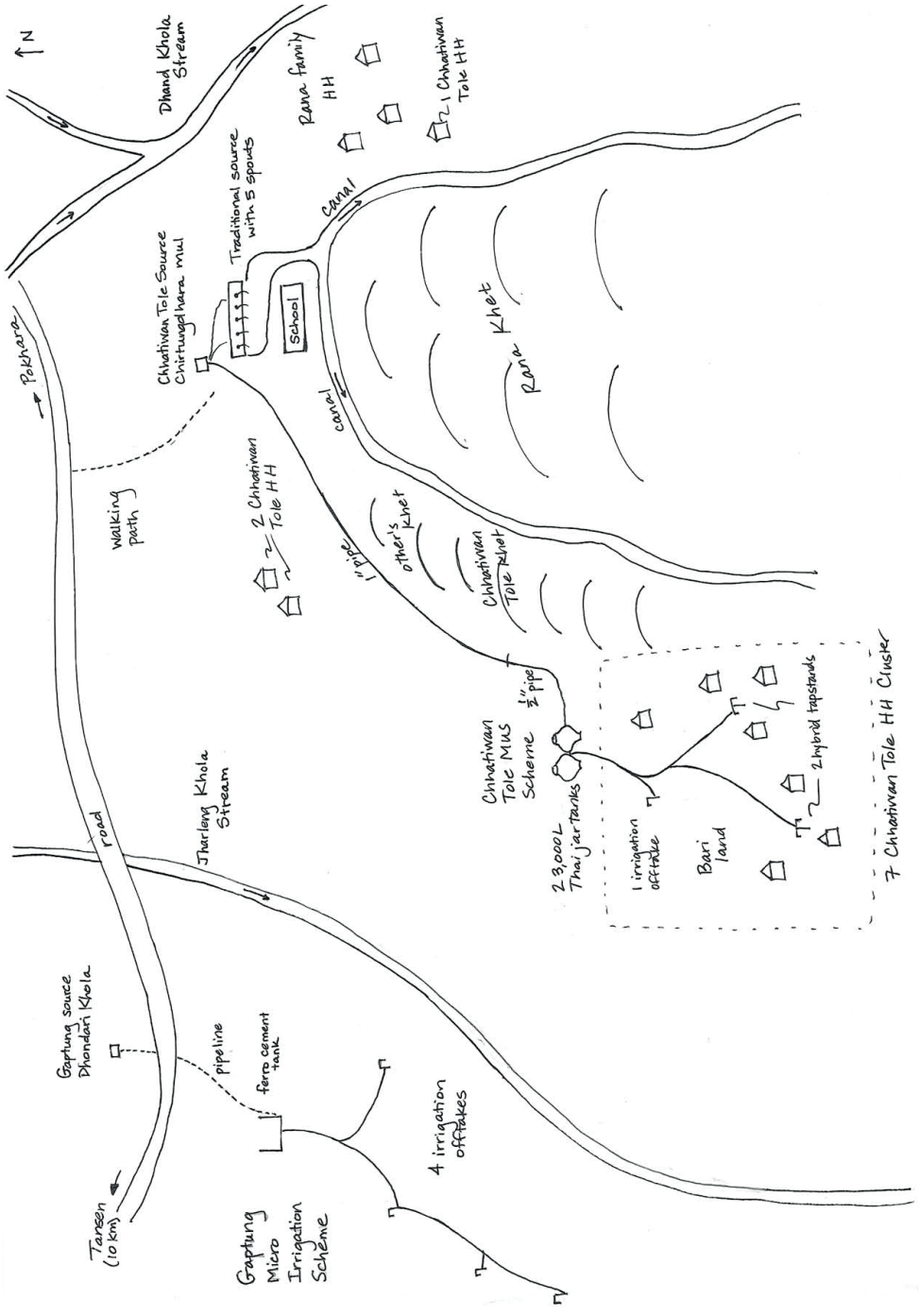
Location and Climate

Chirtungdhara VDC is in the middle hills of Nepal. The Chhatiwan Tole group lives within the Chirtungdhara VDC about a one-hour walk southeast of Tansen municipality at an elevation of just under 1,000 m (see Plates 1 and 2). Chhatiwan Tole members can reach Siddharth highway connecting the Indian border to Pokhara with a 20-minute uphill walk and then access the nearest market in Tansen by traveling ten km on an all-weather road (see Figure 3.1). The area receives an annual rainfall of about 1800 mm. Rainfall distribution, temperature range, and evapotranspiration rates are shown in Table 1.2 in chapter 1.

Population Demographics

Chirtungdhara is a Magar community of Tibeto/Burmese ethnicity that migrated to Palpa from Eastern Nepal over seven generations ago. The Magar ethnic group has historically been heavily employed in the military—Indian, British, and Nepali—so many households have pensions. The resident population of the nine wards of Chirtungdhara VDC is just under 900 households, and the average family size in Palpa District is five or six members.

Figure 3.1 Schematic of Chhatiwan Tole and Gaptung



Courtesy of Monique Mikhail.

The Chhatiwan Tole cluster consists of ten households in the fifth ward of Chirtungdhara VDC. Seven households live in the same cluster, while three additional households only have their bari land near that cluster, but their homes are located elsewhere. The average family size of the Chhatiwan Tole group is nearly eight members; however, due to family members living and working abroad, there were only 40 residents during the project construction. Just over 80 percent of the household members who are between school age and fifty are literate, nearly double the Nepal country average.

Socioeconomic and Food-Security Situation[1]

As a result of the close proximity to the district headquarters of Tansen, there is opportunity for day-labor work for Chhatiwan members. However, during the time of the field survey none of the households utilized this option, probably due to lack of ease in transport. Thus, agriculture remains the only economic activity in the community. Nonetheless, every household has a member either receiving a pension from the Indian Army (eight households) or having employment in India (three members) or the Middle East (six members).

Because of the pensions and remittances, Chhatiwan Tole is a reasonably wealthy community compared to other communities in the middle hills. Each household has a toilet, and most have biogas plants that provide much of their cooking energy. They do have electricity but no telephone system. Most households have a television, and all have radios, which aid in information flow.

Owing largely to their external income, only one of the five households interviewed reported a deficit budget for the previous year, which had been caused by serious illness of a family member. One has a food deficit for one to two months in most years. That household is now using income from vegetable sales to purchase cereal.

The average landholding in the community is about 1.5 ha with almost equal size bari and khet (see Table 3.1). Some of the bari and khet is nearby the cluster, while some of it is further away. From greatest to least in size, the designations are nearby bari, nearby khet (only three households), far-away khet, and far-away bari. Landholding size has actually increased over the past few decades because Chhatiwan Tole farmers have invested their income in the purchase of khet land within the VDC but outside of the Chhatiwan Tole area from farmers who are migrating out of the area. Because family sizes in Chhatiwan are increasing, they feel that they need more khet land in order to be self sufficient in grain. Three of the cluster households rent land from the Rana family on a 50/50 sharing basis, which means that they give 50 percent of the production as rent. Some households also reported investing in gold jewelry as another way to secure their wealth.

Table 3.1: Landholding sizes of surveyed households in Chhatiwan Tole

Land Type	Ownership	Sampled Household Landholding (ha)						
		# 1	# 2	# 3	# 4	# 5	Total	Average
Khet	Owned	0.74	1.48	0.54	0.46	0.27	3.48	0.70
	Leased	0.40	0.00	0.00	0.00	0.00	0.40	0.08
Bari	Owned	0.34	0.27	0.20	0.40	2.00	3.21	0.64
	Leased	0.27	0.00	0.00	0.00	0.00	0.27	0.05
Kharibari	Owned	0.17	0.00	0.00	0.08	0.00	0.24	0.05
Total		1.91	1.75	0.74	0.94	2.27	7.60	1.52

Source: Household interviews with five out of the ten households — October 2006.

Pre-project Agriculture

In addition to field crops grown according to the cropping patterns described in chapter 1, all households in Chhatiwan Tole have some fruit trees: guava, citrus, papaya, mango, apricot, pear, and jackfruit. Some households have annual sales of mango and jackfruit of up to NPR 600 ($8.60). Most farmers have similar soil types and use fertilizer, pesticides, manure, and compost as inputs for their crops. Purchase of improved and hybrid seeds, pesticides, and chemical fertilizers has also increased in recent years.

Livestock provide meat, milk, and manure, with poultry and goats comprising the two largest animal-production activities in the village. On average, households have four oxen, three cows, five goats, one pig, and six chickens.

INITIATION OF THE MUS SCHEME IN CHHATIWAN

In 1998 IDE, in partnership with an INGO called Helvetas, carried out a program in Palpa District for expanding the use of microirrigation for market crops. They met with the Palpa Feeder Grass Development Group, an association of smaller groups from each VDC in Palpa. They set up ten demonstration plots and held a farmer-visiting tour to demonstrate and market the use of microirrigation equipment. When farmers purchased the microirrigation kits, IDE also provided extension services for vegetable-crop production and marketing. Unfortunately, many farmers in Palpa only had their domestic water supply as an irrigation water source, so they were under-irrigating their crops. Subsequently, IDE began receiving requests from villagers to help them plan and develop their limited water resources for more effective utilization.

As part of the joint IDE-Helvetas project, a farmer named Dal Bahadur Disa in a village named Gaptung was chosen to be trained as a leader farmer.

He was given 51 days of training and then in turn became a trainer for other farmers, which included assisting in the microirrigation demonstrations and farmer-visiting tours mentioned above. Not only did he provide training to assist in uptake of microirrigation technologies and vegetable production, but he helped communities to establish local vegetable production groups. Most important, he provided a link for other communities in disseminating important information about IDE's work in developing small water resources like springs for vegetable production.

Dal Bahadur's first lobbying effort for source development was for his own village of Gaptung. The community already had an adequate domestic water source but was limited in its production due to a lack of adequate irrigation water supply. Dal Bahadur arranged for IDE technical staff to meet with his community to discuss construction of a storage tank and pipe system to supply them with additional irrigation water. As IDE began working with the Gaptung community to develop a nearby spring for irrigation, Dal Bahadur continued his trainings,[2] and shared information about IDE's work in Gaptung with the nearby Chhatiwan Tole cluster of Chirtungdhara village. The ten households of Chhatiwan Tole had previously organized themselves with the help of Dal Bahadur into the Chhatiwan Tole Vegetable Production Group, and two of the households had purchased microirrigation kits as a result of the earlier demonstration project. This had positioned them as a well-organized community ready to lobby on their own behalf. And while they had access to a very large spring for all their water needs, they found it difficult to carry all of the necessary water for both their domestic needs and the drip irrigation systems they had recently purchased. They realized that if IDE could help them develop their water source like Gaptung's, they would have easier access to water for all their needs.

As a result of the interest shown by the Chhatiwan Tole farmers and encouragement from the Chirtungdhara VDC officials, the SIMI project staff visited Chhatiwan Tole and held a meeting with all stakeholders. Discussion quickly centered on the community's interest in upgrading the domestic water supply system so that they could more effectively apply the excess water for vegetable production on their bari land (the overflow from the domestic system already supplied gravity-fed canals to some of their khet land as described in detail below). At this meeting SIMI staff clarified conditions necessary for partnering on the project (the same as those listed in the Project Implementation section of chapter 2), which included a requirement for written confirmation that they had permission to use the source of water for both domestic and irrigation purposes. The Chhatiwan Tole farmers were able to show that they had permission to use a portion of the water through a prior agreement made between a previous Chhatiwan leader and Mr. Kul Bahadur Rana, the registered owner of the Chirtungdhara *mul*[3] water source (explained in detail below). The agreement included assurance that the Chhatiwan Tole farmers would not interrupt the water supply during rainy-season paddy cultivation.

WATER ACCESS PRIOR TO PROJECT IMPLEMENTATION

The source used for the MUS scheme is the large perennial Chirtungdhara mul spring which emerges in a gully that is dry except during the rainy season. The Chirtungdhara mul has been used for domestic and irrigation purposes for decades. It was protected in 1989 by the local VDC with a covered masonry structure, and five water spouts were installed to provide easy access for the community. Water flows continuously from these spouts (see Plate 3). Although the spring is licensed to the descendents of Mr. Rana, several nearby communities (totaling about 50 households) come to this source to collect water for their domestic needs. These communities have arranged use of the spring water by ensuring sufficient water allocation to the Rana family for their paddy cultivation. Prior to MUS construction, Chhatiwan Tole farmers had to walk 15 minutes each way to collect water from the spring.

When Mr. Rana registered the source with the VDC decades back, he constructed several hectares of terraced paddy fields and developed two small gravity canals that follow the contour away from the stream on the right and left banks, flanking his khet land on each side (see Figure 3.1). The excess water from the five spouts flows into the canals. Previous Chhatiwan Tole members had signed a written agreement with Mr. Rana in the presence of the VDC Chairman at the time to use some of this water for both domestic purpose and paddy cultivation. One member, Mr. Jue Dhar Disa, extended a part of the western canal to deliver water to the khet owned by Chhatiwan Tole members. As per the agreement, water only flows down one branch of the canal at a time and is blocked from the other branch. The canal water runs for seven to ten days on one side and then is diverted to the other side for use. This system is still in place, and the Chhatiwan Tole farmers use it solely for the nearby khet they own and rent from the Rana family. Mr. Rana is now deceased and his land has been divided among four family members who retain the right to the spring. However, canal management is run by a water user association for the whole canal area. Khet land that Chhatiwan Tole farmers own outside of this canal area is irrigated by other canal systems.

In 2002, after the Chhatiwan Tole Vegetable Production Group was established and microirrigation kits were being used by some of the farmers, but prior to the initiation of the MUS project, 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. This system was only in use for two months before conversations with IDE led to the construction of the MUS system in 2003. The half-inch pipe was later used as part of the MUS system.

PROJECT PLANNING AND IMPLEMENTATION

CONSTRUCTION COMMITTEE/WATER USER COMMITTEE

Chhatiwan Tole farmers had previously been—and continue to be—participants in the Chirtungdhara Feeder Grass Development Group in the VDC, which was established in 1994 as one component committee of the larger Palpa Feeder Grass Development Group in the district. As mentioned above, in 2000 the Chhatiwan Tole farmers formed their own Chhatiwan Tole Vegetable Production Group with the help of Dal Bahadur Disa. They had monthly meetings to discuss problems with seeds and marketing and collected NPR 5/month/household as a revolving fund for the group.

In 2003 when conversations began with SIMI for MUS construction, the Chhatiwan Tole Vegetable Production Group transitioned into the Chhatiwan Tole Construction Committee. Like the vegetable group, the 11-member Construction Committee had two female and nine male representatives led by a chairperson, secretary, and treasurer. The committee, along with SIMI staff, created an action plan for system design and construction. Once the scheme was constructed, the committee again transitioned into the Chhatiwan Tole Water User Committee (WUC), maintaining the same structure and committee composition.

SYSTEM DESIGN

Water Resource Assessment

Upon investigation of the water resource situation, SIMI's Palpa District team concluded they could work with the Chhatiwan Tole farmers to improve the existing water supply system to make it more useful for microirrigation and at the same time more accessible for the cluster's domestic needs. The source has good quality water with a large flow volume and is located reasonably close to the community. And the fact that the Chhatiwan Tole farmers already had a written agreement allowing them to use a portion of the Chirtungdhara mul water for domestic and productive needs was an important factor. However, even with the previous agreement for access to the spring, the other surrounding communities using the Chirtungdhara mul were hesitant to allow Chhatiwan Tole to directly attach a pipe at the spring. Chhatiwan farmers negotiated with the surrounding communities to allow them to build the scheme, agreeing to take just a small portion of the flow and then direct overflow water from the MUS scheme tanks back to the public system.

In September 2006 it was estimated that 0.3 liters per second was being supplied to the Chhatiwan Tole community on a continuous (24/7) basis. The combined discharge from the five spouts, not including the water piped to Chhatiwan Tole, was measured in September 2007 as 1.7 liters per second. September is the end of the rainy season when the spring is at its peak dis-

charge, so these flow rates indicate the high-flow season. However, all Chhatiwan Tole community members interviewed stated that the spring has only a slight reduction in discharge during the dry season. Thus, the Chirtungdhara mul is providing Chhatiwan Tole with an abundant quantity of water throughout the year.

Projected Water Needs

Once the source was deemed appropriate and negotiations for the right to use a portion of the water were concluded, a detailed engineering survey was conducted to determine the most effective design for the system. The 40 residents in the ten families of Chhatiwan Tole at the time of project design were projected to increase to 45 within the design period of ten years. A design standard of 45 liters/capita/day was used to estimate the domestic water demand of 2,025 liters per day. Since the water supply is abundant, an additional 700 liters/household/day were allocated to all ten households for productive needs, resulting in an additional 7,000 liters per day demand. The design requirement totaled just over 9,000 liters per day. It was concluded that 6,000 liters of storage was adequate since the water from the spring is available continuously even in the dry season. Given that Chhatiwan was the first MUS scheme constructed, IDE was still in the development phase of several new water storage containers, and the largest completed design had a 3,000-liter capacity. Hence, the system design included two of these containers.

Figure 3.2 Positioning of intake in relation to traditional structure. Photograph by Monique Mikhail.

SYSTEM CONSTRUCTION

Once the need was determined and the design established, the MUS system in Chhatiwan Tole was constructed in just 17 days. Each household contributed one person to provide labor, and a mason from outside the community was hired to build all of the masonry structures; women contributed 60 percent of the total labor requirement. The system intake, located just above the traditional spouts (see Figure 3.2), consists of a masonry connecting box (see Figure 3.3) at the spring with a shutoff valve that connects to a 32 mm HDPE transmission pipe. The 500 m long transmission pipe is buried for protection and terminates at two Thai Jar storage tanks, each holding 3,000 liters (see Figure 3.4).

Figure 3.3 System intake

Photograph by Monique Mikhail.

Figure 3.4 Two 3,000 liter Thai jar storage tanks

Photograph by Robert Yoder.

SYSTEM OPERATION

The outlet from the storage tanks is controlled by a valve that connects to the single distribution line leading to two hybrid tapstands (see Figure 3.5a/Plate 4). These hybrid tapstands provide domestic water for the seven households with houses located in the cluster, one stand for four nearby households, and the other for three households. They take turns using these taps to fill up their individual 200-liter drums that were purchased independently prior to the MUS project for domestic purposes. The hybrid tapstands also provide the water for productive use, with the households' rotating filling their drip system "header" tanks. As part of the MUS project, each household purchased a 20 m long flexible PVC hose to deliver water from their hybrid tapstand or offtake to their microirrigation system "header" tank. One additional irrigation-only offtake (hose connection) is located near the fields further from the house cluster (see Figure 3.5b/Plate 5). This offtake provides water solely for irrigation of bari land to the three households with homes located too far away to collect domestic water at the Chhatiwan Tole tapstands. For domestic water they have another domestic system closer to them. For productive water, these three households take turns connecting their hoses to the offtake to water their crops as needed (see Plate 6).

System operation was originally planned to deliver water for four and a half hours in the morning with distribution at the Thai Jars shut off to let them refill for six hours followed by another four and a half hours of distribution in the evening. However, since the supply from the spring is continuously delivering water at a rate of about 0.3 lps (26,000 liters per day), the two 3,000-liter storage tanks are never empty. With such an abundant water supply for ten households, they do not need to closely regulate the water distribution from the storage tanks and in practice the valve from the storage tank to the distribution line is kept continuously open. Any farmer has access at all times to use water according to their need. They simply turn the tap on at the hybrid tapstand or offtake and then turn it off when finished filling their 200-liter household storage containers or irrigation "header" tanks. Because Chhatiwan Tole is a water rich community and there is more than enough water on demand at all times, there is little need for a robust management committee, so the WUC never appointed someone to oversee system operation. Their major remaining function is maintenance of the system when problems occur. However, since the members of the WUC are the same as the original Chhatiwan Tole Vegetable Production Group, they still meet to share information about vegetable production.

Each of the ten households also purchased and installed a 125 m^2 drip kit for applying water to their vegetable gardens, and one household purchased a sprinkle set in addition to the drip kit. Purchase of the microirrigation kits was not considered in the MUS project costs, but a separate purchase at full cost by the households. Even with such an abundant water supply, Chhatiwan

Figure 3.5a Chhatiwan WUC member standing by hybrid tapstand

Photograph by Monique Mikhail.

Figure 3.5b Farmer kneeling beside irrigation offtake

Photograph by Monique Mikhail.

farmers recognized the significant advantages of using drip irrigation—reduced labor costs, weed growth, and required fertilizer as well as increased production and quality (The explanation of the benefits of microirrigation can be found in the System Components section of chapter 2.)

Two households have since added additional drip kits and several others mentioned plans to expand their drip systems. However, despite the benefits of microirrigation, all households already grow vegetables on a larger area by applying water directly to the plants from the connecting hose or by bucket. Allowing 500 liters for domestic use by seven households there is still 2,250 liters/household/day available for productive use by the ten Chhatiwan Tole households. This is enough for vegetable production on about 1,125 m^2 area per household. Reviewing table 3.1, the smallest owned bari land area of the surveyed households was 2,000 m^2, indicating that the farmers have ample irrigable land available to use all of the productive-use water and will be expanding their production to fit available household labor.

Unfortunately, system care has been somewhat of an issue for a few households. One woman's drip kit was damaged by a mouse that chewed through her lines. Some of the community drip tanks were also slightly damaged by hailstones.

SYSTEM COST

Contributions for financing the Chhatiwan Tole MUS scheme can be seen in Table 3.2.

Table 3.2: Financial contributions for Chhatiwan Tole MUS scheme

Organization	NPR	$	Percentage
IDE Nepal	27,924	387	36%
Helvetas LIPS Project	27,924	387	36%
Chirtungdhara VDC	4,000	55	5%
Chhatiwan Tole Construction(Labor and local materials equivalent amount. Microirrigation kits not included)	17,433	242	23%
Total	77,281	1,071	100%

Source: SIMI detailed survey report.

The microirrigation kits were not part of the MUS scheme financing but were purchased by individual households at full cost. So in addition to the above costs, the farmers were responsible for purchasing their own microirrigation technology at a cost of around NPR 1,025 ($14) per household from their own

savings. They also decided to purchase their own hoses to connect to the offtake and fill their header tanks for their irrigation kits. Depending on the length of the hose, it cost NPR 400–NPR 1,800 ($6–$26). An NPR 3,500 ($49.00) fund remains from the amount collected for construction. This acts as a revolving loan fund, with the interest being used for repair and maintenance.

CAPACITY BUILDING

Although the residents of Chhatiwan Tole had grown a few vegetable plants each year in the past, it was an ad hoc endeavor for household consumption with little labor input and no use of other inputs. Since production of high-value crops for sale was a much different undertaking, the skill set of the farmers needed broadening to ensure the greatest outcome possible from the productive portion of the MUS project. As mentioned above, SIMI staff led many training sessions as part of the MUS project: nursery raising; transplantation; crop-sowing methods, timing, and health; pesticide and fertilizer management; harvesting and post-harvesting; microirrigation system operation; pipe assembly and maintenance; MUS system management (including safeguarding of water tanks); and repair and maintenance. Trainings specifically for women focused on production cycles, postharvest handling, agro-processing techniques, and developing sustainable rural institutions.

MARKETING

Just like assistance in vegetable production, connection with markets is one of the pillars of IDE's poverty-alleviation approach. As part of the SIMI project, formation of marketing committees to assist farmers in selling their new high-value crops was a key element of the project. The main market for Chhatiwan Tole is the district headquarters of Tansen, which is nearly ten km away. Tansen is home to the regional army, police, hospital, and government offices. As the regional hub, the demand for fresh vegetables is high.

As part of the SIMI project, in 2003 many newly formed vegetable production groups from the Chirtungdhara VDC and surrounding VDCs started a marketing group to share a collection center for sale of vegetables, electing a collection committee to run the operation, with Dal Bahadur Disa as acting chair. The committee was responsible for collecting and weighing the vegetables and taking them to the Tansen market for sale (see Plate 7). To cover the cost of operating the collection center and transportation to Tansen, NPR 1 per kg was collected from each farmer. The vegetable collection center was about a 45-minute walk up the hill from the settlement.

Not long after the initiation of the marketing center, they started having problems. The farmers wanted payment upon deposit of their vegetables, while the collectors could not pay them until after they sold the vegetables. The committee members would take the vegetables to the wholesale market where the wholesalers would weigh the vegetables and the traders were sup-

posed to purchase their products. Since the traders all tried to bargain down the prices, it took a great deal of time and effort for the committee members to determine which trader would give them the highest price. The prices for vegetables also fluctuated dramatically from day to day. The committee members would promise the farmers a price based on the previous day's prices, but often the current day's price would fall well below that, causing conflict with the farmers who wanted to receive the amount they had been promised. Committee members had to pay the remainder out of the marketing committee funds, which rapidly depleted them. The farmers did not fully realize that the prices were fluctuating so dramatically and felt that the committee was keeping a sales margin for themselves. Eventually the committee went bankrupt and lost the support of the community, so the collection center was disbanded in 2006.

Sometimes one farmer still collects the vegetables and sell them for the community, depending on the types of vegetables produced at that time and the volume of production. However, this is only on an ad hoc basis, and most of the time farmers take the vegetables individually to the Tansen market. Many of them sell their vegetables along the way and are completely sold out by the time they reach the market.

OUTCOMES

VEGETABLE CULTIVATION AND INCREASED INCOME

With project implementation, all ten households are now growing vegetables both on- and off-season with cultivation being done by both men and women. In one household the woman is running the farming operation. While men tend to be in charge, women have a lot of input in decision making for the household, including vegetable production. And other than plowing, it is women who are responsible for most of the work with vegetable cultivation.

Farmers have started using hybrid seeds for tomato, cauliflower, cabbage, cucumber, and bitter gourd and improved varieties for beans and radish. They continue to use local varieties for leafy greens. The improved yield of these seed varieties led one farmer to adopt a hybrid variety for her maize cultivation. She was pleased with the results and was saving some seed for next year's crop. This shows that education has improved the situation in Chhatiwan but is still not complete. There needs to be more education about what hybrid seeds actually are and their possibilities.

The good quality vegetables are taken to market, but the rest are consumed by the household. It was estimated that about one third of the vegetables grown were consumed or given away to family and neighbors free of charge. The remaining produce was sold as shown in Table 3.3.

Table 3.3: Average value of vegetable sales in the cluster using MUS (two crop seasons)

Vegetable grown	Average Production per Household (kg)	Sales Price(NPR/kg)	Average Gross Income per Household from Sales (NPR)	Average Gross Income per Household from Sales ($)
Radish	350	13	4,550	65.00
Cauliflower	190	23	4,370	62.43
Pole bean	150	29	4,350	62.14
Cabbage	130	7.5	975	13.93
Tomato	110	20	2,200	31.43
Cucumber	110	25	2,750	39.29
Bitter guard	50	28	1,400	20.00
Bean	50	23	1,150	16.43
Green leafy vegetables	38	35	1,344	19.20
Average annual gross income per household from vegetable sales			23,089	329.84

Source: Five of the ten Chhatiwan households were interviewed as a group in October 2006 to get a sense of vegetable sales over the past year (two crop cycles). The production of the five was totaled and used to calculate the average income from sales. There was no opportunity to cross-check to verify their recall responses.

Households were earning on average NPR 2,900 ($40) from vegetable sales—cauliflower, cabbage, cucumber, tomato, and bitter guard prior to MUS. While this is not an insignificant amount, with implementation of the MUS scheme, the area under vegetable cultivation, quantity and variety of vegetables, and income all increased. Income from vegetable sales after one year of project implementation averaged NPR 23,089 ($330) per household, a major increase. However, it is important to note that although this increase is large and the income change is significant, the portion of total household income that vegetable sales represents is small (on average 27 percent), with pensions and remittances making up the lion's share of their net income. It is also important to consider the economic value of the vegetables consumed, which averaged NPR 7,696 ($110) per household.

The post-project average household gross income including vegetables was nearly NPR 109,270 ($1,561), 38 percent of which came from agricultural sales. The minimum household income from agriculture was just over NPR

3,000 ($43) per year and averaged at about NPR 18,000 ($257). See Table 3.4. After project implementation, annual household expenditures were NPR 30,000–NPR 43,370 ($417–$620). Vegetable sales average $73 per household greater income than cereal crops. Profits from vegetable sales are largely spent to purchase salt, cooking oil, and kerosene.

Table 3.4: Household income and expenditure post-project

	Sampled Household Income ($)						
	# 1	# 2	# 3	# 4	# 5	All	Average
Source of Income							
Cereal crops	47	571	571	53	43	1,286	257
Pensions/ Remittances	1,543	1,200	669	857	600	4,869	974
Total Income	**1,590**	**1,771**	**1,240**	**910**	**643**	**6,154**	**1,231**
Expenditure							
Education	343	0	6	0	179	527	105
Health	6	0	107	157	643[4]	913	183
Social obligations (marriages, funerals, festivals, etc.)	71	214	214	129	79	707	141
Agriculture (cereal crops)	7	114	171	157	14	464	93
Other: clothing, salt,cooking oil, spices, etc.	86	114	65	114	107	486	97
Total Expenditure	**513**	**443**	**564**	**557**	**1,021**	**3,098**	**620**
Net income/deficit	1,077	1,329	676	353	-379	3,056	611
Net income/ deficit from cereal crops	40	457	400	-104	29	821	164

Source: A sample of five households was interviewed in October 2006 to get a sense of annual cash income and expenditures. There was no opportunity to cross-check to verify their recall responses. All of the households grow grain and raise animals for subsistence consumption. Some have excess for sale. It was not possible to quantify the overall agriculture production, consumption, and exchange (sale and barter).

HEALTH AND NUTRITION

Although food security was not a major issue for this community prior to the project, villagers did say that the major change in their lives from MUS was an overall increase in the quality and quantity of all foods consumed, particularly fresh vegetables. Prior, they bought most of their vegetables, whereas now they consume their own produce. They stated that this gave them an overall feeling of improved health and points to a raised awareness about consumption of a variety of fresh vegetables for enhanced nutrition. At a group meeting, the villagers spoke about the value of vegetables in their diet, saying it was worthwhile to grow vegetables simply for consumption to improve their health, and the extra income was an added benefit.

The MUS system has also increased the quantity of water use for sanitation, bathing, and washing and raised knowledge about the links between hygiene and health. Prior to MUS they carried 75–90 liters/household/day whereas they now have access to 500 liters/household/day. During their interview, one household described the change in hygiene in the community: "Before the water system was built, it was difficult to get the children to wash and keep clean. But now if they go to school dirty, they are ridiculed by friends, which motivates them to wash themselves more regularly."

TIME SAVINGS

One major change noted by the communities was the time saved in water collection. Before MUS they had to spend 15 minutes walking each way and go to the source five times per day for their daily water needs, adding up to around two and a half hours for water collection daily. Since each household has a 200-liter drum for storage and can access the taps at all times, both men and women collect water whenever the drum needs refilling.

SKILL BUILDING

A major benefit of participation in the MUS project was the skill building of community members. This was accomplished not only through multiple trainings, but also through planning, construction, maintenance, evolution of the user group, off-season vegetable production, etc. Farmers stated that one of the best outcomes of the project was the increase in their capacity for demanding new technologies for their village through being organized together. They also now understand the importance of accessing line agency district offices like DADO for production assistance.

SUSTAINABILITY

Although there is little oversight of system operation, it is perceived that the community will sustain it due to its benefits. With the history of social mobilization in Chhatiwan and the cohesion that the project process has brought, it is likely that they will find a way to work together in the future to ensure

continued system success. They indicated that once the current maintenance fund is depleted, they will use a portion of vegetable profits to contribute to future maintenance costs.

However, when speaking with the WUC, there were a few suggestions for potential system improvements that should be mentioned, particularly considering that this was the first MUS scheme in Nepal and provides important lessons for future systems. They suggested underground storage (perhaps in the same Thai Jar containers, but buried) in order to keep the water cooler and keep children from damaging the tanks. They also felt that one larger tank would perhaps have been cheaper and more useful than the smaller Thai Jars. Since the implementation of this system, IDE has designed larger storage tanks which are now being used in other MUS schemes and are buried. Additionally, since flow is continuous, the community felt that they could have used a smaller pipe to bring the source water to the tanks, which would have been a cheaper alternative. However, if population growth is higher than anticipated, the current pipe could prove useful.

Despite the likelihood of sustained successful system operation, a couple of factors could affect its future sustainability. Although the spring source provides ample water now, if the flow were to diminish in the future, it would require a greater level of water resource management and group collaboration than the current system function. Likewise, if population growth in the area puts far greater constraint on the source than the current situation, it will require much more intercommunity negotiation on the quantity of water allocated per community.

CONCLUSIONS AND LESSONS

The MUS system provided a host of benefits—increased income, health improvements, social cohesion, time savings in water collection, increased knowledge and awareness of a variety of issues, and increased access to resources. The health impacts of MUS, particularly in increased hygiene and improved nutritional status through vegetable consumption should not be understated.

The role that the leader farmer, Dal Bahadur Disa, played in both Gaptung and Chhatiwan Tole was crucial. He was essential for information flow between the communities in the district as well as between the communities and organizations like IDE and line agencies. His motivation kept the group moving forward and mobilized them to lobby IDE and local agencies on their own behalf. And the intensive trainings he received allowed Chhatiwan Tole better access to knowledge than the district offices of the line agencies can provide. His role in the MUS process points to the importance of developing these leader farmers and continuing their training so they can build the

capacity of other farmers and provide much-needed extension services.

Yet, even with the information transfer through Dal Bahadur Disa and the trainings provided by SIMI, one of the greatest lessons from Chhatiwan is the need for even more education and follow-up with the communities on a variety of issues. In order to prevent problems with microirrigation systems like mice chewing the drip line or hailstone damage that were mentioned above, better storage-and maintenance procedures need to be communicated more fully. Additionally, knowledge of the ability to purchase spare parts and where farmers can go to obtain them would be useful.

Furthermore, even though the farmers know that they get much more money from vegetable cultivation, they are opting to purchase khet land and grow rice instead of purchasing extensions to their microirrigation kits to cultivate more vegetables on the bari land they already own with the excess water the MUS system is already providing. This shows the entrenched importance of cereals in the community and the potential for educational activities about financial management at the household level. Financial education would help them logically work through the cost-benefit of growing more vegetables versus more cereals, the sales of which could then be used to purchase cereals with a net profit above what they would make from just cereals.

Ultimately, no matter how much the community produces, improved marketing is essential. Despite SIMI efforts, there were several reasons the marketing scheme was rejected by Chhatiwan farmers. The collection center was 45 minutes away, as opposed to the market itself, which was one hour away. That slight distance alone does not make the marketing center much more convenient for the farmers, particularly considering that there is a delay in payment if they take the produce to the collection center but immediate payment if they take it to market themselves. When reflecting upon their experience with the marketing committee, the major issue mentioned was access to market information. Due to the results of the marketing committee efforts like those of Chhatiwan, SIMI has strengthened the provision of market information to the communities it works with. Price information is collected from each market center by SIMI, DADO, or AEC staff (depending on the capacity of those agencies in the particular district) and provided to local FM radio to broadcast. Farmers are also encouraged to tune in to the daily Kalimati Wholesale Market Board broadcast from Kathmandu. Moreover, SIMI has also begun creating district apex marketing committees that represent the smaller district committees to government agencies and other organizations and helps them market produce beyond the district.

As the first MUS scheme in Nepal, Chhatiwan proved a learning tool for SIMI staff, influencing their next MUS endeavor in Senapuk and all those proceeding. SIMI staff realized that they could successfully develop a water source for multiple uses, providing greater accessibility to domestic water and multiplying the benefits of microirrigation and marketing efforts.