Chapter 4
Adoption of Technologies

Introduction

Following the training sessions conducted for members of the women's group to increase their awareness, positive attitude, self-belief, and skills, the women selected and adopted a variety of technologies to address their water and energy needs and utilised the time saved for productive income-generating activities. The technologies selected in the first phase differed in the different countries and project sites reflecting the different needs and situation of the women. The technologies implemented at the project sites can be grouped broadly into those related to energy, those related to water, and those related to income-generating activities. Details of the technologies adopted and the enabling mechanisms (revolving fund, group savings, and credit micro-finance schemes) used to support adoption are described in the following sections. Approximate conversion tables for local currency costs are given at the end of the 'Abbreviations and Acronyms' list at the front of the book.

Bhutan

In Bhutan the construction of a drinking water supply scheme in Phobjikha (Kumbu and Haal) fulfilled the water needs of 17 households. To address their energy needs, training was provided on a variety of energy technologies, including solar driers, solar lanterns, improved cooking stoves (ICS) with metallic chimney and back boiler, and the development and management of an LPG depot (*see* Chapter 3) . In both Phobjikha and Limukha, the women selected the improved one hole stoves for livestock feed and water harvesting plastic tanks for implementation. Women in Phobjikha also selected improved mud/metal stoves, and those in Limukha, solar driers and sprinklers.

India

In Uttaranchal the major water and energy technologies implemented to address the needs of women were an infiltration well, water recharging on mountain slopes through the plantation of saplings and the construction of micro-reservoirs/ponds, and the distribution of pressure cookers and solar lanterns. The main energy- and water-related technologies adopted by women in HP to address their needs were rainwater harvesting, the renovation of traditional water harvesting structures and drinking water tanks, ICS, pressure cookers, and solar lanterns (*see* Table 4.1).

Nepal

The major energy- and water-related technologies implemented in the Palpa and Dhankuta project sites included the installation of ICS with an improved kitchen environment, solar driers, drip and sprinkler irrigation systems, vegetable nurseries for fresh vegetable farming, and the renovation of traditional water wells (*see* Table 4.2).

Technology / Activity	Himachal Pradesh	Uttaranchal
Improved cook stove	25	
Rainwater harvesting tank	22	25
Water tank repair (community system)	1	
Solar lantern	8	11
NADEP composting pit	2	16
Vermicomposting (and NADEP pits)	16	
Pressure cooker	30	100
Plantation (trees)		2500
Micro-reservoirs		14
Pit digging for plantation		5000
Grass sowing		0.4ha
Seed sowing (pits)		2 ha
Rambans plantation		1000
Infiltration well		2
Check dam		3

	Dhankuta	Palpa	Overall
Improved cook stove (ICS)	72	108	180
Solar drier	7	1	8
Low cost solar drier	5		5
Solar lantern	8	1	2
Biogas		1	1
Rainwater harvesting tank	1	1	2
Irrigation tank	1		1
Plastic pond		1	1
Well rehabilitation	2	2	4
Maize opening machine		1	1
Packaging machine		1	1
Honey extractor		1	1
Drip irrigation	11	73	84
Sprinkler irrigation	10		10
Waste water management	10		8
Group nursery	1	6	7
Plastic green house	1	1	2
Beekeeping	23	29	52
Modern toilet		48	48
Total	152	275	418

Energy-related Technologies

Improved cooking stoves (ICS)

Bhutan

The most common type of stove used at the project sites in Bhutan is a modified version of the traditional cooking stove (the 'bhukhari' type, Figure 4.1), which was promoted by the National Women's Association of Bhutan (NWAB). In this type of stove, all the components are constructed out of metal; the stove can be used for both cooking and space heating. While the stove is good from the point of view of being smokeless, it is inefficient in terms of saving fuelwood. Livestock feed is still cooked on a traditional stove with three stones, which requires large quantities of fuelwood. The project introduced two different forms of ICS: a) an improved mud cooking stove with a back boiler to heat water (the top part of the stove body, the GI pipe for the back boiler system, and the chimney pipe are made of metal, while the combustion chamber and side walls are made of mud and mulch block); and b) a one pothole mud stove for preparing livestock feed (Figure 4.2). These were installed in a household in Kumbu for demonstration purposes. The ICS for cooking livestock feed was adopted by most women, but not the ICS for cooking meals. The latter was less popular both because of its high cost and because of its incompatibility with the local housing structures. The cost of the stove (Nu 4300, with the backboiler being Nu 2500) was many times higher than the cost of the previously used bhukhari improved stove (Nu 700). In addition, the mud stoves are not suited for installation inside homes in this area because the kitchen is generally located on the second floor; the ground floor is used as a livestock shed. The wooden floors are also not suitable for constructing mud stoves. Furthermore, many of these communities are located at high altitudes and have cold winters, but the stoves promoted by the project were not suitable for space heating. The traditional stoves allow family members to come together and have meals

Figure 4.1: Modified bhukhari type stove in Bhutan

Figure 4.2: One pothole stove for livestock feed, Bhutan

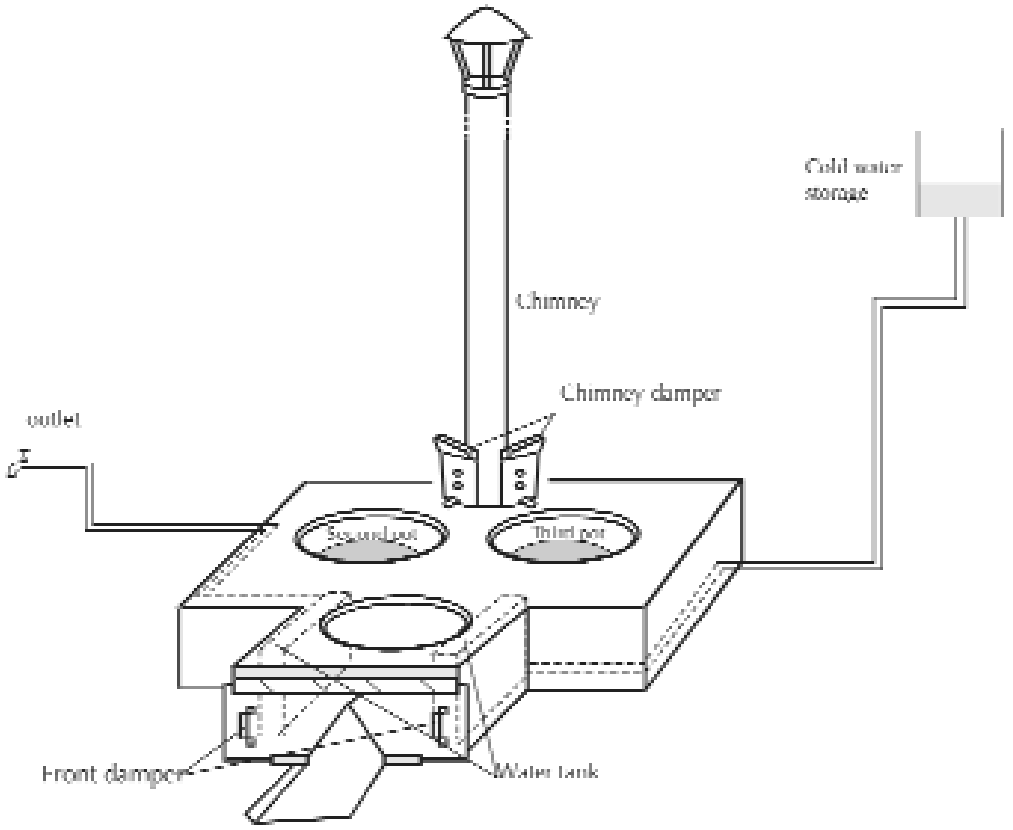
near the fire, and are convenient for roasting maize and potatoes. The area around the stove used to be the place for important household meetings, discussions, and the sharing of stories and community myths. Such socioemotional occasions are what many seem to miss after having installed improved stoves.

Himachal Pradesh, India

The ICS promoted in HP was an all metal stove with a chimney and water heating system (Figure 4.3, 4.4). The stove proved very popular among the women's groups (Nager and Kotla sites) as did other energy-saving devices that reduced their heavy workload. These areas already face a scarcity of firewood and women have to travel long distances (three hours a day) to collect firewood. The traditional mud stoves also give off a great deal of smoke. The needs identification, motivation, awareness campaign, and demonstration convinced many women of the multiple benefits arising from the installation of an ICS with a built-in water heating system – savings in fuelwood, the provision of hot water without using extra wood, a smoke-free kitchen, and a reduction in drudgery. The cost of the ICS was IRs 2350, of which the women paid about 40% with the rest being subsidised. Altogether 25 women at these project sites installed the multifunctional ICSs promoted by DEEP, the local NGO partner. Women were also trained to construct, use, and repair the ICS.

Nepal

The ICS promoted in Nepal was a two hole mud stove (for two pots), with an enclosed fire and chimney. This was the first time that people at the Dhankuta project site had been introduced to ICS. The stove reduces indoor smoke and helps improve health, especially that of women and children. It also reduces fuelwood consumption and cooking time. When the project began, it was very difficult to convince the ethnic Rai and Limbu communities in the project area of the advantages of ICS. However, the intense efforts of the field staff and the trained women motivators, led to 72 households installing the ICS within the first two years. Others are in the process of installing an ICS in their homes. Some women from outside the



This improved cooking stove has two embedded water tanks (combined capacity 12 litres) one on each side of the firebox. These two tanks are connected to each other, and get their cold water supply from an overhead tank, the hot water can be drawn from a tap provided in the kitchen or the bathroom. Heat is conducted to the water tanks from the firebox, and hot water is available after igniting the stove. The tanks are covered with mud on the outside to reduce heat loss. Usually, a steam pipe is fitted to the overhead tank to vent the system. A chimney channels the smoke outside. A front damper maintains the temperature in the stove and water pipes.

Figure 4.3: Layout of the ICS promoted in Himachal Pradesh

project area have already installed an ICS, and many more women from neighbouring areas have already expressed a desire to install one. In Palpa most of the women in the group installed an ICS in their homes during the project period. The women who received training on ICS construction are busy selling their services to other villagers; they charge from NRs 100 to NRs 150 for the construction of an ICS (Figure 4.5). In total, 108 ICSs were constructed in the homes of the project beneficiaries (see Table 4.2). Box 4.1 illustrates how women can be successful energy entrepreneurs provided they are given the opportunity. The construction of kitchen racks and 'juthyanj' (a place for washing utensils and hands after meals) has also helped women to improve hygiene and sanitation in their kitchens.

Pressure cookers

Pressure cookers, an energy saving end-use device, were requested by the women in both Uttaranchal and HP. Women took up 100 pressure cookers in Uttaranchal and 30 in HP. One pressure cooker costs about IRs 565, of which the project provided a 50% subsidy as an incentive for 'pump priming' – the initial dissemination of this energy-saving cooking device.

Figure 4.4: Mud covered three-hole metal ICS in HP, India

Figure 4.5: Women constructing an ICS in Nepal

Box 4.1: ICS for income generation

Thirty-four-year-old Narisara Marsangi, a resident of Humin village in Palpa, is a widow from a very poor background and is her family's sole wage earner. After the introduction of the Women in Energy and Water Management Project in her village, she became a member of the Saujanya Women's Group and received training in the construction of improved cooking stoves (ICS). This skill has provided her with a new source of income. Narisara charges NRs 120 for the construction of an ICS in the homes of her women's group members, and NRs 200 for non-group members. Awareness about the effectiveness and efficiency of the ICS is increasing in the community leading to increased demand for their construction. Narisara receives invitations to construct ICS in other villages too, and has already installed 17 ICSs in villages other than her own. Some women have been so happy with the performance of the ICS that they even paid Narisara as much as NRs 300 for her service. She has already earned NRs 5100 from the construction of ICSs.

Source: District Coordinator, Palpa

Solar lanterns

A number of women's groups (especially in India, and Nepal) adopted solar lanterns. The price per solar lantern is IRs 3000 of which the project provided a 90% subsidy. In Nepal, this technology is promoted for demonstration purposes; so far eight women in Dhankuta and one in Palpa have taken up solar lanterns.

Solar driers

Solar drier production business in Limukha, Bhutan

The solar drier technology attracted the women of Limukha in Bhutan (Figure 4.6 and Box 4.2). The women realised that the solar drier was a safe technology that could be used to dry meat, chillies, and other vegetables in a hygienic manner. Training in construction and maintenance of solar driers was provided by RSPN. Two local carpenters were also hired to make the solar driers in front of the women. After the training and the demonstration, the women's group became interested in starting up a solar drier production venture. The project provided the seed money while RSPN provided the women's group with the raw materials for 20 solar driers. In consideration of the transportation problem, women set up their production outlet down the hill in a house on the bank of the Punakha river, which is close to the market.

The group has already produced nine driers for sale to interested customers. RSPN is planning to help them market this product through the media and exhibitions; the women themselves are displaying their solar driers at various vegetable markets as an advertisement. Women have fixed the price at Nu 3000 per system. The profit made from the sale of the solar driers will be retained as their community fund, which will then be used to provide small loans to members for income-generating activities.

Box 4.2: Solar drier technology: how it works

Solar drier technology is used to dry food by extracting the moisture from the food placed inside the drier. Sunlight passes into the drier through a glass sheet and the heat is trapped inside. The bottom plate of the drier is painted black, absorbing more heat. The drier is placed in a slanting position so that the hot moist air, rises and goes out and cool air enters from the bottom. The temperature and the airflow inside the drier are controlled by regulating the inlet and outlet vents.

Figure 4.6: Solar dryer produced by women's group in Limukha, Bhutan

Solar driers in Dhankuta

In Nepal, solar driers were mostly of interest to the women in Dhankuta. Seven solar driers of the type described above were taken up. A low cost solar drier constructed mainly of mud with a plastic roof was also installed to demonstrate the operational procedures and the use for drying fruit (amala). So far, five low-cost solar driers have been adopted by women in Dhankuta. The project provided a 75% subsidy. The dried amala is marketed by SOLVE (a local NGO partner) in the Kathmandu market. SOLVE is also looking at the possibility of producing dried vegetables so that the solar drier can be utilised effectively in the near future.

LPG depot in Phobjikha

The women's group of Phobjikha in Bhutan proposed establishing a gas depot. The Phobjikha valley is the wintering ground of the protected black-necked crane and development interventions in this valley are thoroughly scrutinised before they can start. The valley has no grid electricity because the high voltage wires could hinder the flight of this rare and endangered species. Equally, the ICS introduced in the TOT was not suitable for use in the local houses. People here already use LPG, but have to travel a long way (half a day) to purchase cylinders.

In this valley, where conservation takes priority, women saw many advantages in LPG and decided to open an LPG depot. The project supported the venture as LPG was the most suitable energy option available; it did not have any negative effect on the conservation efforts being made in the valley and also helped reduce pressure on the forests. Having a depot close by helped reduce the time and effort put in by women to obtain gas cylinders.

The LPG depot in Phobjikha was established after obtaining the necessary approval from the Ministry of Trade and Industry. The LPG distributors from Tashi Commercial Corporation agreed to supply the cylinders, as per the issue ordered by the Ministry of Trade and Industry. The capacity of the LPG depot in Phobjikha is 340 cylinders, of which 240 cylinders were contributed by the end users at a rate of Nu 1400 per person. The remaining 100 cylinders were provided by the project. The project also paid for the transportation of the cylinders from Phuentsholing to Phobjikha. The 240 cylinders were distributed among the three blocks (Bjena, Gangtey, and Phobji). The remaining 100 cylinders are kept as a reserve to provide refilling facilities for the whole of the Phobjikha community. The process of getting approval from the government for the construction of a permanent house on public land is underway; until this is approved, the gas depot has been set up safely in a private house.

Income from the sale of each cylinder will be distributed as follows: a) Nu 3 for PCAP community fund; b) Nu 10 per cylinder for the sales person; and c) Nu 2 per cylinder for house rent. The income from the gas depot benefits all the women in terms of providing easy access to loans for income-generating activities.

The Phobjikha women's group is responsible for the management of the depot. A board of committee members (executive committee) comprising the chairperson, secretary, treasurer, member representative, and a messenger was formed to oversee the day-to-day management of the group, in close consultation with the members. The treasurer of the group volunteered to be the salesperson; she is responsible for the overall management of the depot (including travel costs, loading and unloading charges, and dialogue with Bhutan Oil Distributors, Wangdi, from where the 100 cylinders in the reserve will be refilled). The allocated Nu 10 per cylinder sold covers the management costs as well as a nominal salary. The members of the women's group have responsibilities at home and opening the depot everyday would be difficult, thus it opens twice a week, in the morning.

The LPG depot in the Phobjikha valley has helped reduce the time and effort for many women besides reducing pressure on the forests. Women can undertake other activities with the time saved. Use of LPG also improves the kitchen environment and has health benefits. Besides promoting the energy needs of the women, the case of the LPG gas depot demonstrates how women can be successful energy entrepreneurs (Figure 4.7).

Water-related Interventions

Women are usually responsible for collecting water for cooking, cleaning, health and hygiene, and often spend long hours (4 to 5 hours per day) carrying heavy containers and suffering acute physical problems. Lack of clean water is a major problem. The World Health Organization estimates that 80% of all sickness in the world is attributable to unsafe water and sanitation, with water-borne diseases killing 3.4 million people, mostly children, annually. Women are likely to be at a disadvantage in situations where there are competing claims for water, particularly in water-scarce areas. Some of the water-related technologies implemented in the project areas of each country to address this need are highlighted below.

Construction of a water supply scheme in Phobjikha, Bhutan

A water supply scheme was constructed in Phobjikha which fulfills the water needs of 17 households in Kumbu and Haal villages. This scheme was initiated in September 2003 in

Figure 4.7: LPG depot run by the women's group in Phobjikha, Bhutan

close collaboration with the Dzongkhag Engineering Cell of Wangdue at a cost of US$ 6000, with labour being contributed by the beneficiaries. An intake tank and storage tank were installed, together with six water taps each in Haal and Kumbu (Figure 4.8). One tap was also installed at the cremation ground, which benefits the whole community of Phobjikha valley. The women formed a three-member committee for the operation and maintenance (OM) of the scheme. Each member contributed Nu 100 to the O&M fund. One person has been employed for the repair and maintenance of the scheme; he receives Nu 20 per month from each household for his services.

Water technologies in India

The project sites in the Indian hills of HP and Uttaranchal also suffer from water scarcity, especially during the dry seasons. This scarcity is increasing as deforestation continues and the vegetation on mountain slopes becomes more degraded, both of which accelerate erosion. The women at both sites have to travel long distances – 6 kms per day – to collect water. Over time, traditional water sources such as rivulets and springs have mostly dried up. Water infrastructure constructed by various agencies has also failed to function due to faulty schemes. The main interventions selected to address the water crisis faced by women in the project areas were the installation of rainwater harvesting tanks, the repair of naula (traditional wells), the construction of infiltration wells, and the recharging of natural water springs. These were designed to meet the prioritised needs of the women.

Recharging the traditional water spring in Bajeena, Uttaranchal

There are two sources of drinking water in Bajeena: a naula and a water tap. The naula, is the most important source as it is located close to the village. Over time the source has dried up and is not able to meet the water demand of the village. The situation is worst during the dry

Figure 4.8: Water supply scheme constructed in Phobjikha, Bhutan

season. The water tap is located in another village and the water supply is not adequate even for that village. The tap water comes for only half an hour a day and its supply is highly erratic. Thus the water problem is almost a water crisis for the women of Bajeena. The women's group decided that recharging the traditional water spring was a viable option as part of the task of finding a sustainable source of water.

A site was selected in a micro-watershed located above the traditional water spring. Except for a small patch of forest at the top of the hill, the slope was entirely barren and did not have the capacity to retain any water during the heavy monsoon downpour. It was decided that if water could be allowed to seep inside the ground it might be possible to recharge the traditional water spring. However, the slopes were hard and barren after many years of soil erosion. To facilitate seepage, it was essential that micro-reservoirs be constructed to trap the water flowing down the slopes. Once trapped, the accumulated water, would gradually percolate into the soil and be able to gradually recharge the spring. Fourteen micro-reservoirs ($20m^2$ to $30m^2$ each) were constructed (Figure 4.9). The women also decided to plant the hill slope with multiple species of trees, selecting different varieties including medicinal plants that could provide income earning opportunities later, as well as firewood and fodder species. Thus the trees were useful in themselves and also enhanced the water absorption properties of the soil and strengthened slope stability. The women controlled grazing through social fencing. The water collected in the micro-reservoirs is used to irrigate the planted saplings and has also reduced the burden of having to carry water up the hill slopes.

The result of this work has been encouraging, water discharge increased notably within six months (Figure 4.10). During the monsoon, when the downpour is heavy, the water discharge from the spring increases significantly but the flow reduces once the downpour stops. The

Figure 4.9: A micro-reservoir for recharging the traditional spring in Bajeena, Uttaranchal

Figure 4.10: Tank and water outlet of the recharged traditional spring in Bajeena, Uttaranchal

relationship between the downpour and flow of water from the spring is obvious, say the villagers, but they also maintain that the overall flow of water from the spring has increased. The actual discharge is shown in Table 4.3. Box 4.3 shows how this innovative method of water recharging can go a long way to providing a permanent solution to water scarcity problems in many parts of the Himalayas.

	Time of measurement	Discharge l/hr	Total discharge	Requirement*
Before treatment	July 2003	211	5064	15,840
After 3 months of treatment	November, 2003	514	12,336	15,840
After 4 months of treatment	December, 2003	327	7848	15,840
* Taken as 30 litres per person per day				

Box 4.3: Recharging the traditional spring in Bajeena

Women have found an innovative way to recharge traditional water sources on a mountain slope in Uttaranchal. Due to the acute shortage of water, women spent a large part of the day collecting water. To overcome this problem, the women constructed 14 micro-reservoirs spread spatially on slopes to trap/store rainwater, which then percolates inside the slope and recharges the traditional village water source. Women also planted 2500 saplings on 5 hectares of the slope using horticulture, fodder, and fuelwood species, to ensure slope stability, to generate income, and to ensure the availability of firewood and fodder. They have controlled grazing through social fencing. The women manage a small fund for operation and maintenance. The full impact of this innovation is only likely to be felt after a few years, but the women report that water availability has already doubled and that this has reduced their water collection time as well as reducing drudgery. Women are making productive use of their saved time and have begun taking loans from revolving funds to initiate income-generating activities.

Construction of infiltration well technology in Naila

Naila, the other project site in Uttaranchal, was also facing a water crisis for similar reasons to Bajeena village. According to local views, the chir and pine trees near the village were also responsible for the decreasing water table in the area. According to the baseline survey estimate, the water availability from the existing water sources (475 litres/day from two naula located 500m from the village) was much lower than the water requirement of the total population (3660 litres/day assuming a per capita daily consumption of 30 litres).

After a preliminarily visit to the village and a subsequent meeting with the villagers, infiltration well technology was identified by the national partner TERI as the only feasible option for meeting the water requirements of the village. TERI was able to mobilise the whole community and enlist their active participation in constructing the infiltration well. The water is lifted through a hand pump installed inside the covered well (see Box 4.4). A woman contributed the land on which the well is built and each household contributed IRs 200 for well construction. The money was deposited in the bank in the name of the village water ('jal') committee. As per the decision of the committee, each household contributes a token amount per month for operation and maintenance. The women's group has introduced an innovative way of managing the system – the responsibility for opening and closing the hand pump is rotated each day from one member to another. The pump is opened for two hours in the morning and the evening, and is closed with an iron chain and lock at other times (Figure 4.11).

Box 4.4: **Success story from Naila, Uttaranchal – infiltration well technology**

Naila, a small village in the Tarikhet block in Almora district, lies 12 km from Raniket. The twenty-four families in this village face an acute scarcity of drinking water all year. Past efforts to provide water have failed. When TERI visited the area, women had to travel 6 kms every day during the summer months to collect 40 litres of water. People had also been forced to sell their cattle at lower prices due to the lack of adequate water for livestock. People travelled 10 km from the village twice a week for washing clothes and bathing purposes. There is only one water source in the village whose discharge was so low that women had to wait 45 minutes to fill a 15 litre bucket. Women are busy filling their vessels with water even late at night. In this situation, it is not uncommon to see conflict among women over water and related issues.

A meeting was organised among the villagers to discuss the infiltration well technology and the need for the women's and the community's participation. The villagers agreed with the proposal and formed a committee that would be responsible for implementing the scheme. It was decided that each family would contribute IRs 200 for the basic land. Two respected people from the village (Mr. Madan Singh and Ms. Prema Devi) were nominated to collect the funds which were deposited in a savings account in the village post office in the name of the water committee. Mrs. Deviki Devi donated land to construct the well.

The infiltration well took one month to complete. A skilled mason was hired and was also able to train one man and one woman in masonry work. Now each family is able to collect 4-6 vessels of water per day with ease. Although this amount is still not sufficient, at least the drudgery and tension associated with collecting water is considerably less than before. Women do not have to line up late in the night to collect water. The women evolved a system whereby each household is assigned the responsibility on a rotatonal basis of opening and closing the well in the morning and evening for two hours. All the families, worked together irrespective of their economic status.

Source: Rakesh Prasad, TERI

Rainwater harvesting tanks in Uttaranchal and HP

Rainwater harvesting is a practical method for collecting and storing rainwater. The water can be used to irrigate kitchen gardens and reduces the drudgery of transporting water. Under this system, rainwater collected from the roof pass through a pipe to a small, multi-layered filtering tank attached to the top of a main tank where the water is ultimately stored. Twenty-five roof rainwater-harvesting tanks were constructed in Uttaranchal (mainly in Bajeena) and 22 in HP (Figure 4.12).

Locally available materials were used to construct the tanks. The whole set-up costs about IRs 9900, of which the beneficiaries paid 25% on average. The capacity of the promoted tanks was 5000 litres. Most of the women use the water to irrigate vegetables, the water is adequate for this for about two months. Initially women were faced with problems of water seepage and clogging of the outlet pipe, but these problems were resolved. The women benefited both from having better quality meals with vegetables and also from income from the sale of vegetables.

Construction of community water tank in HP

A water tank was constructed/repaired at the site of a traditional pond near the road head at Ghagar-Sayawan in HP and has benefited 38 households in the village. Before the tank was constructed, the water source was very small and provided no water during the dry season as there was no means for retention. Women had to travel some 3 km to collect water. The new tank for the well is now deep enough to allow water to be retained even during the dry season and it is properly designed with cement steps down to the water level in the well (Figure 4.13). The water tank area has been enclosed by barbed wire and there are plans to develop the

Figure 4.11: Infiltration well constructed in Naula, Uttaranchal

Figure 4.12: Harvesting tank for rooftop rainwater in India

space as a community park in collaboration with the village panchayat. The easier availability of water even during dry season has reduced the drudgery of women

Water technologies in Nepal

Construction of a traditional well in Dhankuta

The project supported the women beneficiaries of Cheribote Kuwa in the construction and management of a traditional water well. This is the sole source of drinking water for 11 households at the project site. The local people provided in-kind contributions and labour, while the project provided the necessary materials. A users committee was formed and is functional and active. Women have benefited as they have to spend less time waiting to collect water. The quality of the water has also improved.

Construction of an irrigation tank in Dhankuta

A small pond for multi-purpose use was constructed in the Tangkhuwa area of Dhankuta. This area suffers from acute water scarcity during the dry season (March to June) and women have to travel more than two hours to fetch a bucket of drinking water. The water shortage meant there was no possibility to use water to cultivate vegetables during the dry season. The irrigation pond was constructed to collect rainwater in the rainy season and store it for use during the dry period for vegetable cultivation and for cattle (Figure 4.14).

Improved sanitation in Palpa

The information and orientation provided by the women facilitators who received the TOT training was effective in creating awareness about health and sanitation among the Magar ethnic community at the Palpa site. As a result, 48 modern toilets and 10 pit latrines were constructed in the community. Although this activity was not part of the intended project interventions, increased awareness about water and sanitation issues led to the outcome.

Technologies for income-generation

Construction of organic and vermicomposting pits

At the two project sites in India, women adopted two different types of composting techniques – the organic compost pit (called NADEP, after the name of the promoter) and vermicomposting (Figure 4.15). Sixteen women in Uttaranchal (NADEP) and eighteen women in HP (16 vermicomposting, 2 NADEP) constructed such pits near their cowsheds. Women now have to walk less far to deposit the heavy raw dung. The cost of producing the compost is low (IRs 0.5 to IRs 0.7 per kg) and its nutrient content is satisfactory (0.5% – 1.5% N, 0.5% – 0.9% P, 1.2% – 1.4% K). The use of the compost (especially the vermicompost) has resulted in higher crop productivity (40% higher) particularly of vegetables. The reliance of some women on chemical fertiliser was reduced. After witnessing the multiple benefits of the compost pits, other women in the village have shown an interest in constructing such pits on their farms.

Drip and sprinkler irrigation technologies for vegetable farming

Drip irrigation technology has become very popular among women at the project sites and beyond in Nepal. The technology is very simple and uses water very efficiently – even wastewater from household use can be used for irrigation through this technology. In Palpa and Dhankuta, drip irrigation has helped women cultivate vegetables for the first time in their lives (Figure 4.16). In Palpa, 73 women installed the technology during the project phase and

Figure 4.13: Newly-constructed retention tank for traditional pond at Ghagar-Sayawan in HP, India

Figure 4.14: Irrigation pond constructed in Dhankuta, Nepal

Figure 4.15: Vermicomposting pit in HP, India

Figure 4.16: Drip irrigation for vegetables in Nepal

are operating it successfully, backed up by the training provided by the project. In Dhankuta, 11 women adopted the drip irrigation system and a further 10 adopted a sprinkler irrigation system for vegetable farming. Use of the techniques is now spreading.

Wastewater management in Dhankuta

To address the water problem in Dhankuta, where water scarcity is pronounced, ten wastewater systems were constructed to collect and store wastewater from the kitchen to be used in drip irrigation. This enabled women to cultivate vegetables and earn some additional income (see Box 4.5). More women have now shown an interest in managing the wastewater from their homes for use in vegetable farming.

Box 4.5: Harvesting wastewater brings money

Mrs. Sita Chaulagain, a member of the women's group in Tankhuwa, has been successful in using wastewater. As she said "Our village has severe water shortages and drinking water is always insufficient, making activities such as vegetable farming out of the question. I found out about drip irrigation technology through this project and have also come to know that wastewater can be used for vegetable farming. I bought a drip irrigation system with a 50% discount with support from the project and installed it on my land. I planted tomatoes, cauliflower, coriander, and carrots after receiving technical advice. The wastewater collected in a drum was sufficient to irrigate over 7000 vegetable plants. Other members of my family also helped me in this endeavour. The drip irrigation system and use of wastewater enabled us to cultivate vegetables and I was also able to earn NRs 8000 from selling the vegetables. I used part of this money to pay off some of my parent's debt, some I spent on the home, and some I have saved with my group savings fund."

Group nursery in Palpa

Members of six of the women's groups in Palpa and one in Dhankuta established group nurseries to increase the supply of off-season vegetables and cash crops. The members decide which vegetables to plant in the nursery and then collect money from among themselves to buy the seeds. When the seedlings are ready for transplantation, the women distribute them equally among themselves and transfer them to their own fields. Some of the vegetables produced are eaten and some are sold, providing additional income (Figure 4.17).

Beekeeping in Nepal

In both Palpa and Dhankuta, the interest in beekeeping has grown considerably owing to the training provided to the group members (17 each in Palpa and Dhankuta) and the potential of beekeeping as a source of income. Many of those who received training have already started to earn an income from the sale of honey from their hives and have shown interest in follow-up training (see Box 4.6). In Palpa one local resident began constructing new frame hives for sale. Twenty-nine women established beehives in their backyards in Palpa and 23 in Dhankuta. Many women from both project sites have shown an interest in receiving beekeeping training so they can use it for income generation.

Figure 4.17: Growing vegetables for sale

Box 4.6: **Surendra wants to be a bee entrepreneur**

Surendra Limbu, resident of Tankhuwa VDC, was selected to participate in the beekeeping training programme. He has this to say, "Beekeeping has been in practice in the village for a long time but we did not know how to raise them in the proper way. After the training I know many new things about beekeeping – e.g. the advantages and disadvantages of bees, their diseases, their susceptibility to diseases, and disease prevention. Beekeeping is easier in modern beehives than in the traditional ones. I also know now that to be a good beekeeper it is equally important to know about plantation of vegetables and fruit trees that attract bees. Beekeeping combined with improved plant management also helps increase pollination. Bees are very helpful and beneficial insects and it would be very good if all the villagers began keeping bees. I have already bought one hive and I am planning to buy more hives and gradually become a bee entrepreneur.

Compiled by: District Coordinator, Dhankuta

Establishment of a Technology Demonstration Village at Project Sites in Nepal

A technology demonstration village (TDV) was created at both the project sites in Dhankuta and Palpa, in order to promote and demonstrate the application of various field-tested water- and energy-related technologies. The main idea was to encourage the creation of a pilot village that people could visit to learn about technologies that meet women's needs (see Table 4.4).

Technologies	Palpa	Dhankuta
Number of households in cluster	12	12
Improved cook stove	12	12
Solar lantern	1	1
Waste water management	-	1
Rainwater harvesting jar	-	1
Low-cost solar drier	-	1
Greenhouse	-	1
Drip irrigation	1	1
Bee hives	1	4
Honey extractor	-	1
Resource centre*	1	1
Biogas	1	-
Kitchen rack with 'juthyan' & 'machyan'	1	-
Plastic pond	1	-
Packaging machine	1	-
Maize opening machine	1	-
Solar drier	1	-
*The resource centre contains 20 documents and posters in Palpa and 32 documents and posters in Dhankuta		

At the end of the project, 12 households each in Palpa and Dhankuta were participating in the TDV, with participation expected to grow. These villages are operated by the women. The households demonstrate different kinds of water, energy, and income-generating technologies and the women explain the technologies they have adopted to visitors. A management committee made up of members of the volunteer households decides the minimum rental fee structure. In each village, one woman was been nominated as the manager and interpreter for the TDV.

Only a few months after inception, the number of visitors was increasing markedly. Six households in Palpa ordered solar lanterns after seeing the technology at the Palpa TDV. The Centre in Dhankuta is being frequented by villagers, and the Dhankuta District Development Committee planned to replicate the idea in other areas of the district after realising the effectiveness of the TDV in generating a flow of information and awareness. Even one person can be pivotal in convincing others through demonstration (Box 4.7).

Support Mechanisms for the Dissemination and Adoption of Technologies

While specific technological interventions can bring about improvements in the lives of women, it is clear that in the long run, the dissemination and adoption of interventions can be successful only if they are accompanied by mechanisms that enable the women to make use of the opportunities. Given the poverty prevailing at the project sites and women's lack of access to formal credit, it was not possible for most women to take up the technologies

Box 4.7: **Devi Darlami becomes a role model**

Devi Darlami, a 20-year-old girl, has become a role model for all the members of her women's group. After the inception of the pilot project in her community, Bhumika Mahila Group was established at her initiation and with the support of NRCS, Palpa. She recalls the days six months back when she ran away so as not to have to introduce herself to the project coordinator from NRCS, when she visited the project site. However, after undertaking group empowerment and a series of other training sessions, she has developed the skills and confidence to guide and manage her group so well that no one can resist praising her leadership qualities and her desire to do something for her fellow group members from the ethnic indigenous Limbu community.

Apart from the group empowerment training, she also benefited from the beekeeping and food processing training after the introduction of the project. Immediately after participating in the beekeeping training, Devi Darlami started modern beekeeping with the provision of a loan from NRCS. Now the honey is ready in her hive and she will harvest it as soon as the honey extractor is available.

Within 15 days of her participation in the food processing training, she produced a number of processed items of 'lapsi', which she also taught the women of her community how to make. She says that she is confident about being able to generating the maximum amount of income by utilising her beekeeping and food processing skills, provided she gets further capacity building training on packaging, quality control, and other marketing aspects. Devi Darlami was also one of the visiting members in the study exchange visit programme. When one visits her household, it is clear how worthwhile the exchange visit was. She learned the technique of growing vegetables in a sack filled with soil and nutrients during her visit to the ICIMOD Demonstration and Training Centre site, which she now practices and has shown her community just a few days after returning home.

She also taught and illustrated to her group members how to produce green manure. She had learnt this during her visit to the Dhankuta pilot project site. She also cooks food on an ICS in her kitchen and irrigates her cultivated land with drip and sprinkler irrigation. It seems as though her household has become a tiny technology demonstration centre. Being modest, she delivers all this credit to NRCS for introducing the project in her area and she desperately appeals for further training and project activities so that every woman not only from her community but also within and outside the entire village can benefit and become like her in the foreseeable future. She has been instrumental in initiating new technologies within a short time, succeeded in serving as a young 'role model' with a vision of empowering the local community. She deserves a lot of credit.

Compiled by: the District Coordinator, Palpa

demonstrated unaided. For the pilot demonstration, enabling support mechanisms were created to allow the women to adopt the technologies. These support mechanisms included the creation of a revolving fund and encouraging women to save money.

The project provided support for pilot demonstrations in the form of seed money. The 'seed fund' was used to meet the immediate funding requirements as a 'start-up' financing mechanism to finance water- and energy-related technologies. Part of the seed money was used as a zero interest loan to create a revolving fund managed by the women. The revolving fund provides loans to members of the women's group at low interest for the purchase and maintenance of technologies and to start productive income-generating activities based on the training acquired from the project.

All the members of the women's groups at the project sites were encouraged to save a nominal amount of money every month to form a group saving fund of their own. The rules and regulations formulated by the women members to run the saving and credit groups differed somewhat in the different countries.

The need for 'start up' financing is expected to reduce gradually over time as women use the time saved from water and energy activities to generate income, which will improve the affordability of the technologies.

Revolving funds

The project adopted a flexible approach to the creation and management of revolving funds. However, creation of an exclusive women's self-help group (SHG) was a prerequisite for provision of credit from a revolving fund. The size of the revolving fund created varied at the different sites. In HP, it was IRs 10,000 (IRs 5000 for each of two women's groups formed in Kotla and Arti Nager villages); in Uttaranchal, it was IRs 13,100 for three women's groups; in Nepal, it was NRs 159,000 in Palpa and NRs 50,000 in Dhankuta; and in Bhutan, it was Nu 5000 for each of the two sites in Phobjikha and the site in Limukha.

The members of the women's groups generally decide by consensus on the rules and regulations regarding the use of the revolving fund. A loan management committee with members from the women's group and in some cases (Nepal) the local NGO partner, was formed in each country. Women were provided with managerial and record keeping/accountancy training for operation of the micro-finance activities. The committee appraises loan applications, recommends loans to members for the purchase of different water, energy, and income-generation technologies, fixes lending terms, and monitors the utilisation of loans.

The funds were strengthened by group savings created through monthly savings from each group member. Through such group savings, women at some project sites (e.g. HP) were able to link to financial institutions (banks) to strengthen the financing mechanism established with support from the project. Women are able to use their group savings as collateral to obtain larger loans from the banks (as much as IRs 80,000 in Kotla). Women's groups are maintaining the revolving fund and group savings with the assistance of local NGO partners.

The nature and extent of use for income-generating activities of the group revolving funds varied across the countries, and in general was still in its infancy at the end of the project. In Bhutan, the group saving fund had reached Nu 10,400 in Phobjikha and Nu 9800 in Limukha, but had not been used for loan disbursement.

In HP, the women's groups had already disbursed loans (exceeding IRs 100,000) for various purposes among their group members at 2% interest. Loans were used for such diverse proposes as buying seed, animals, and ICSs; setting-up different types of shops; constructing houses; and a daughter's marriage. Women are just beginning to use their saved time for productive income-generating activities.

In Palpa, the revolving fund has been used to procure water and energy related technologies and to initiate small-scale enterprises. The women are currently charging 10% interest, with

loans given for 1-2 years. Installments have to be paid every 3 months. By 2004, 23 women had taken loans to procure drip irrigation systems and another 20 had taken loans for beekeeping. A part of the fund had already been reimbursed.

In Dhankuta, NRs 50,000 was deposited in a separate bank account for the revolving fund. Rules and regulations have been developed to manage the fund effectively. Only group members who have received training are eligible to take loans. The first loan amount cannot exceed NRs 3000. The interest rate is fixed at 18% and the loan repayment period is 6 months. Loans that cannot be paid back within the stipulated time have to pay a 24% interest rate. In Dhankuta, loans from the revolving fund have been provided for raising goats (NRs 24,000), for beekeeping (NRs 18,000), and for horticulture (NRs 9000).

Group savings fund, credit and micro-finance schemes

In Bhutan, the community fund was only created towards the end of the implementation period. The groups' constitution, which describes the management of the community fund, was drafted. It specifies a membership fee of Nu 500 and a monthly compulsory savings of Nu 100 per member. A new member wanting to join the group must pay an amount equal to the total savings of the group to date, including the interest earned from lending, divided by the number of members plus Nu 500 as a membership fee. The profit generated through the enterprises (gas depot and solar drier) in Phobjikha and Limukha will also be put into the community fund. The women's groups are required to meet twice a month to monitor and update the fund. In Phobjikha the group's savings has reached Nu 35,000. The women's group in Phobjikha developed a methodical record keeping system. The savings are kept in an iron safe with the chairman, treasurer, and a women member representative keeping one key each. The group was planning to initiate the disbursement of this saving fund to meet their credit needs soon after project completion.

In India the group rules mainly include, a) not more than 20 members per group; b) collection of IRs 20 from each member at a regular monthly meeting; and c) allocation of the group saving fund to income-generating activities by taking loans from the bank. For instance, using group fund as collateral, women's groups in Artinager and Shitla-Kotla, HP, have taken IRs 18,000 and IRs 80,000 as loans provided by a bank loan at an annual interest rate of 12%.

In Nepal, too, the rules and regulations of the group saving funds are decided by the women's group members. According to the group rules, a minimum of NRs 10 and maximum of NRs 500 can be deposited in the group savings fund by the group members at their regular monthly meeting. In Palpa the group's saving was NRs 121,000. The women's group invested NRs 10,000 to connect the village to the national electricity grid and now has electricity. In Dhankuta the group savings was NRs 120,000. Here the women's group in Dhankuta is in the process of registering itself as a cooperative but is facing constraints due to problems in the district government body, which has postponed the registration process until a new policy regulation is announce. All the sites where women have begun to save report reduced reliance, albeit small, on external sources of credit.

Coordination and linkages with different organisations

Coordination and linkages with various line agencies and NGOs have been quite good. Various organisations have provided different types of support to the programme and have

also helped to leverage funds and make incentives available with the line agencies into the programme. This has also motivated some line agencies to incorporate the project activities into their own programmes.

In Dhankuta and Palpa districts in Nepal, the collaborating partner NGO developed good linkages and received institutional support from different government agencies and NGOs (Box 4.8).

Box 4.8: **Example of coordination and linkages with district line agencies in Palpa and Dhankuta**

Palpa

- One woman from Humin VDC received training on fodder grass production from the District Livestock Office, Palpa. The District Livestock Office distributed fodder grass seed free of cost.
- The District Agricultural Office distributed different types of fruit plants and provided a subsidy (25%) for drip irrigation tanks.
- One woman from Humin received TOT training in ginger production from the Rural Economic Development Association (REDA), Palpa. After the training she transferred her acquired skills and knowledge to other members.
- The Cottage and Small Industry Office and ICIMOD supported the beekeeping training.
- One man received a 35-day village health worker (VHW) training from the District Livestock Office.
- The DDC and PDDP programme helped to solve the drinking water problem in Humin.
- Five women received a subsidy from the District Agricultural Office to initiate a bee enterprise.
- Both the DDC and the District Livestock Office signed an agreement to provide training on goat raising for 25 families in Palpa.
- Two people from the community bought drip irrigation tanks with a 25% subsidy from the District Agriculture Office.
- The District Education Office allocated seats to two participants from the Palpa project site in their TOT on informal education.
- DDC and HELVETAS provided financial support to women with low incomes from the Jalpa Devi Women's Group for the purchase of 50 goats. The District Livestock Office provided technical support.
- SIMI Nepal provided support to establish an off-season vegetable nursery in Palpa.

Dhankuta

- The District Agricultural Office provided 5 women with a 50% subsidy to purchase beehive frames and 2 swarms of bees. The total subsidy was NRs 2700. Some women also received a subsidy (25%) for the purchase of fruit plants and drip irrigation tanks.
- The District Livestock Office provided support for training in the production of fodder grass and seedlings, veterinary health, and raising goats.
- International Development Enterprise (IDE), Nepal, gave training in drip irrigation technology.
- REDA provided ginger production technology training (TOT).
- The Cottage and Small Industry Office and ICIMOD gave beekeeping training.
- UNDP/PDDP provided answers to the drinking water problem.

In Summary

The training provided during the project implementation period and the technologies disseminated responded to the needs of women in water and energy management and income generation. The adoption of technologies such as ICS and drip irrigation resulted in some reduction in the work time and effort of the women beneficiaries and led to an improvement in their health and economic condition. Before adopting ICS, women complained about the unhealthy kitchen environments and suffered from various smoke-related diseases. With the use of ICS together with better kitchen management, kitchen environments have improved considerably along with women's health; significant cooking time has been saved, and the use of fuelwood reduced. Moreover, the ICS promoters trained by the project have a new avenue of income generation in the form of ICS construction to sustain their livelihoods. The demand for ICS is increasing in rural communities, so these promoters are moving out of the project area for ICS construction.

Drip irrigation along with wastewater management has reduced the problems of fetching water for irrigation, and with the increased information on off-season vegetable farming beneficiaries have learnt about systematic and effective methods of farming and have been generating considerable amount of income from higher productivity. There have been many cases like that of Ms. Shreemaya Sunari of Palpa who was able to generate more than NRs 5000 in just six-months of cultivating vegetables after adopting drip irrigation. Similarly, the women who have initiated beekeeping enterprises and food processing with solar driers have started generating an income which is likely to increase in the future.