UN-HABITAT

Siddhipur Integrated Water and Sanitation Project

Solid Waste Management in Siddhipur

Final Report

ENPHO
Creating Eco Societies

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Summary

Siddhipur is a small peri-urban community with 1308 households located approximately 6 km east of Lalitpur in Kathmandu Valley. Siddhipur Integrated Water and Sanitation Project (SIWSP) is being implemented by the Siddhipur Water and Sanitation Users Committee with support from UNHABITAT, Water Aid and ENPHO to demonstrate an environmentally sound, effective and sustainable integrated water and sanitation system with full community participation.

As effective solid waste management (SWM) is an integral part of improving overall sanitation in Siddhipur, the overall programme included a SWM component which provided training and support to local people to manage their waste in an environment friendly manner. In this process, SIWSP worked closely with the local community to assess the existing situation regarding SWM in Siddhipur, design improvements and implement them in a participatory manner. The main objective of the solid waste management related activities was to improve the state of sanitation and environment in Siddhipur in a participatory manner through household based waste management. This was done under the leadership of the Siddhipur Sanitation and Hygiene Education (SHE) Team within SIWSP.

A waste generation survey conducted by the SHE Team showed that the average waste generation rate in Siddhipur ws 0.221 kg per person per day during the straw mat (*sukul*) weaving season (December to April). As the total population of Siddhipur is 6046, the total waste generated in Siddhipur is estimated to be 1366 kg per day. The waste generation rate, excluding *sukul* weaving waste is estimated to be 0.117 per person per day. Therefore the total waste generated in Siddhipur during the off-season of *sukul* weaving is estimated to be 705 kg per day. Of the total household waste generated in Siddhipur, 81 percent is organic in nature. Out of this, the bulk of the waste is straw waste from "*sukul*" weaving. However, even if the straw waste is excluded from the analysis, 64 percent of the household waste is organic in nature.

Siddhipur does not have an organized or central solid waste management system. However, approximately 85 percent of the households compost their waste within their homes or courtyards. In most cases this is done either in traditional *Saaga* and *Nauga* (Compost pits) or in piles. The main problem with the traditional composting system is the lack of aeration and moisture control. As a result, many of the Saagas were not hygienic and the time for composting was very long.

The SIWSP adopted a strategy for SWM improvement in Siddhipur based on the following principles:

- Effective waste management at the household level
- Active participation of women through capacity building and community mobilization.
- Focus on organic waste management

- Build on the existing system and introduce appropriate composting systems.

Based on these principles the following activities were implemented for improving SWM:

- Mobilize local SHE Team through effective training, field exercises, participatory planning and monitoring.
- Train women's groups and other community members on household level solid waste management, particularly composting.
- Develop and demonste appropriate composting systems such as compost bins, compost barrels, concrete ring composting, compost cambers and vermi composting.
- Distribute composting systems at subsidized rates
- Encourage and assist local people to improve traditional saaga, naugaa and compost piles
- Initiate "*suiro*" program for collection and recycling of plastics
- Public awareness campaign

The main achievements of the programme are as follows:

- The SHE team is fully capable of providing training and technical support on household SWM and some of the members have also served as resource persons for training in other communities. Besides SWM, the SHE Team members have received training on plastic weaving, household water treatment, community led total sanitation, team building and leadership. The number of SHE Team members has also been expanded.

- About 800 women have received training on SWM and composting and many of them have started improved composting and plastic recycling system. They have also received dust bins and dust pans.

- 144 composting systems, including 73 compost bins and 47 compost barrels have been sold to households at subsidized rates.

- A survey of 100 users of composting system indicated that most of the systems are being used properly and most users are satisfied with the performance of these systems.

- The SHE team has sold a total of 892 litres of Effective Microorganism (EM) solution, which is used to enhance the composting process.

- A plastic recycling system has been initiated involving 847 households. These households have been provided with *Suiros* (metal hooks) to collect the waste plastics, all the waste plastic is collected on the 15th day of each month and sold to scrap dealers. Some women are also involved in plastic weaving to make various

products such as trays, bags, and key rings from waste plastics. As of February 2007, 184 kg of waste plastics have been collected and sold to scrap dealers.

Overall, the SWM component of the SIWSP has been successful in raising awareness and empowering the local community, particularly women, on issues related to SWM and it has made significant improvements in household centric SWM system in Siddhipur. Because the process was led by the local SHE Team who have provided each household with adequate training and follow up support on waste management, and the operation and maintenance cost is minimal, the chances for sustaining these improvements are high. However, the Siddhipur WATSAN User Committee and the SHE Team needs to regularly monitor the system and continue providing technical support where necessary to ensure that the waste continues to be properly managed in the future as well. Later as the settlement grows, there may be a need for a central waste collection and treatment system. This can also be done by the local SHE team using a similar approach.

1. Background

Siddhipur is a small peri-urban community with 1308 households located approximately 6 km east of Lalitpur in Kathmandu Valley. It is a traditional Newar settlement with compact houses around courtyards. The settlement is surrounded by agricultural fields. It is connected to Lalitpur by a paved road and several buses ply on this road. Although the settlement is expanding rapidly along the main road, the old town still retains its traditional characteristics.

Photo 1: Open piles of solid waste near is a common site

The total population of Siddhipur is 6046, out of which 51.3 percent are women and 23.4 percent are children below the age of 15. The average household size is 4.6, which is slightly lower than the national average.

Siddhipur Integrated Water and Sanitation Project (SIWSP) is being implemented by the Siddhipur Water and Sanitation Users Committee with support from UNHABITAT, Water Aid and ENPHO. The project aims to establish an environmentally sound, effective and sustainable integrated water and sanitation system with full community participation. It includes several activities including improving the water supply system, improving sanitation, capacity building and raising awareness on water and sanitation.

As effective solid waste management (SWM) is an integral part of improving overall sanitation in Siddhipur, the SIWSP worked closely with the local community to assess the existing situation regarding SWM in Siddhipur, design improvements and implement them in a participatory manner. This report summarizes the findings of this process and achievements made in improving Solid Waste Management in Siddhipur.

1.1 Objectives

The main objective of the solid waste management improvement component of SIWSP is to improve the state of sanitation and environment in Siddhipur in a participatory manner. The specific objectives are as follows:

- Encourage local community in Siddhipur to manage their waste properly
- Promote effective waste management at the household and community level
- Improve the household composting practices
- Recycle waste to the extent possible
- Build the capacity of the local community, particularly women, in SWM

2. Solid Waste Generation in Siddhipur

A waste generation and composition study was conducted to assess the average household waste generation rate and the characteristics of waste in Siddhipur. The following methodology was utilized for the waste generation study:

Photo 2: Community members conducting Waste Survey

- Training of waste surveyors – Twelve local women who had previously received training on waste management were trained to conduct the waste generation and composition study.
- Distribution of waste collection bags to households – Each of the twelve trained waste surveyors distributed plastic bags to about 10 households and instructed them to store all their waste in the bags for the next two days. As many households weave straw mats in their houses, people were asked to collect waste generated from this activity in a separate bag.
- Collection of waste and related information – After two days, the surveyors collected the waste from each of the households and also collected information on the number of waste generators in each household.
- Analysis of the collected waste – The collected waste was weighed and segregated into various components.

2.1 Waste Generation Rate

A survey of waste collected from 117 households, consisting 592 people indicated that the average waste generation rate was calculated to be 0.221 kg per person per day. As the total population of Siddhipur is 6046, the total amount of waste generated in Siddhipur at the time of the survey is estimated to be 1366 kg per day.

Out of the total 117 households surveyed, 91 households (78 percent) were involved in making straw mattresses, *Sukul*. According to information provided by the local people, *sukul* weaving is mainly done during the winter/spring months of *Paush, Magh, Falgun* and *Chaitra* (December to April). Because the survey was done during the peak season of *sukul* weaving, the percentage people involved in *sukul* weaving and the weight of waste from *sukul* weaving is quite high.

Out of the total waste collected during the survey, the weight of household and straw waste is 69.0 kg and 61.7 kg respectively. Total generation of household waste, excluding straw waste, was found to be 0.117 kg per person per day. As the total population of Siddhipur is 6046, the total amount of household waste, excluding straw waste, or total waste generated in Siddhipur during the off season is estimated to be 705 kg per day. Total amount of straw waste generated from each household involved in *sukul* weaving was found to be 0.678 kg per day. Assuming 78 percent of the 1306 households in Siddhipur are involved in *sukul* weaving, the total amount of straw mattress weaving waste generated in Siddhipur during the sukul weaving season is found to be 691 kg per day.

2.2 Waste Composition

The survey indicated that 81 percent of waste generated in households in Siddhipur is organic in nature. Out of this, the bulk of the waste is straw waste from "*sukul*" weaving, which a seasonal activity is done in the majority of the households. However, even if the straw waste is excluded from the analysis, 64 percent of the household waste is organic in nature. Most of this waste is kitchen waste. Therefore, even though the waste characteristic in Siddhipur varies significantly depending on the season, the waste is primarily organic. During *sukul* weaving season, approximately 81 percent of the total waste is organic and during the off-season, organic waste makes up 64 percent of the regular household waste.

As most of the houses and courtyard are not cemented, the percentage of inert materials is found to be quite high. The amount of inert materials is more than 14 percent, if straw waste is included and 26.7 percent if it is excluded out of the total waste. The total amount of inert waste generated is 0.031 kg per person per day or 195.3 kg per day.

Photo 3: Large amounts of waste is generated from straw mattress (*sukul*) weaving is a major problem. It clogs drains and burning creates air pollution

Compared to organic waste and inert materials, the amount of other inorganic waste generated is very low. The amount of plastics, paper and glass is 1.7 percent, 1.3 percent and 1.1 percent respectively when straw waste is included and 3.1 percent and 2.3 percent and 2.1 percent in case of straw waste is excluded. This means that the total amount of plastics, paper and glass generated in Siddhipur each day is approximately 23.2 kg, 17.8 kg and 15 kg per day respectively. In addition very small amounts of metal and textile waste is also generated. Most of this waste can be recycled. Out of the plastic generated only 0.38 percent is found to be non-recyclable, which is a negligible amount. So most of the plastics generated in

Siddhipur can be kept separately and send for recycling. Distribution of metal hook "*suiro*" from SWSUC under waste management program can make a significant contribution in managing plastic waste. The collected plastics, along with some of the paper, metal, glass and textile can be sold to recyclers. The remaining waste can be burned or buried.

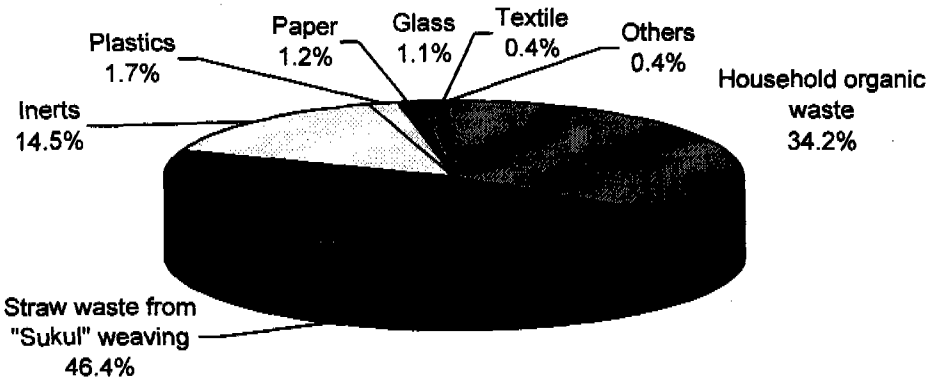
The survey also indicated the presence of a small amount of hazardous waste (0.3 percent) such as batteries and medicines.

Table 1: Findings of Waste Characterization Study in Siddhipur

S.N.	ITEM	WEIGHT (KG)	% (INCLUDING STRAW WASTE)	% (EXCLUDING STRAW WASTE)
1	Organic fm Household	44.7	34.2	63.9
2	Organic fm Straw Matt	60.7	46.4	0
3	Inert Material	19.0	14.5	27.1
4	Plastic	2.2	1.7	3.1
5	Paper	1.6	1.2	2.3
6	Metal	0.1	0.1	0.1
7	Glass	1.5	1.1	2.1
8	Cloth	0.5	0.4	0.7
9	Hazardous	0.4	0.3	0.6
	Total	130.7		

Source: Field Survey, March 2006

Figure 1: Characteristics of Waste in Siddhipur



Source: Field Survey, March 2006

3. Solid Waste Management Practices

Siddhipur does not have an organized or central solid waste management system. However, approximately 85 percent of the households compost their waste within their homes or courtyards. In most cases this is done either in traditional *Saaga* and *Nauga* or in piles. Some people burn their waste while others dispose it in haphazard manner.

Photo 4: "*Saaga*", a traditional compost pit also being used to manage grey water

The term "*Saaga*" literally means compost pit in Newari language. It is a pit that is usually in a courtyard or between houses and used for composting waste. The pit is either below the ground level or on the ground with stone or brick walls. While the sizes of the *Saagas* vary depending on available space and family preferences, generally the pits are about 2 feet deep at least 4 square feet in area. The waste management survey indicated that 59 percent of the households have saagas.

The term "*Nauga*" literally means ash pit in the Newari language. Most traditional houses have small pits in the ground floor, often below the stairs where urine and ash is collected. Usually some ash is first put in the *Nauga* and then people either directly urinate in the *Nauga* or put urine collected separately in the pit. Urine is put in the *Nauga* for about 3 to 4 months after which it is harvested and the process is restarted. The waste management survey indicated that 29 percent of the houses in Siddhipur have *Naugas*. However, many people indicated that they wanted to stop this practice because of the smell it creates in the house.

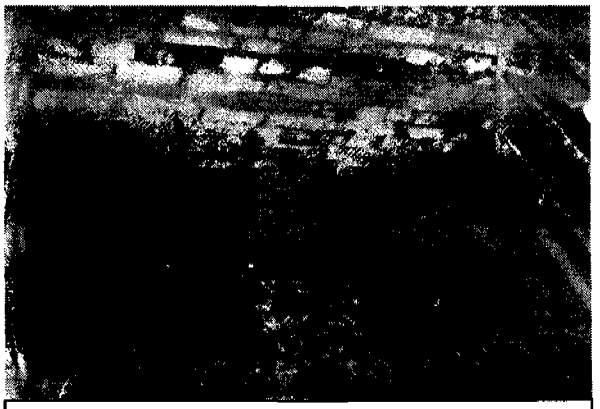


Photo 5: Traditional "*Naugaa*"

The survey also indicated that 34 percent of the people practice pile composting. In this system, waste is simply piled up and allowed to compost. In some cases, the pile is covered by straw or plastics, which is a good practice to avoid the loss of moisture,

Photo 6: Pile compost covered with plastic

temperature and nutrients. The size of the pile varies according to available spaces and the amount of waste.

Although the widespread use of *Saagas and Naugas* indicates the presence of a traditional system for waste management in each household, there are several technical problems with the traditional *Saagas* and *Naugas*.

Some of the main problems observed in the case of *Saagas* are as follows:

- As *saagas* do not have any system for aeration, the waste degradation process is slow and smell is often a problem
- Most *saagas* suffer from high moisture content because grey water from households are allowed to drain in to the *saagas* and the *saagas* often do not have proper drainage outlets.
- In many cases the *saagas* are not covered, resulting in loss of nutrients and exposure to rain.
- Most *saagas* are not managed properly resulting in unhealthy environment.
- In some cases compost from *saagas* is dried directly under open sunlight resulting in loss of nutrients.
- In many communal *saagas* no one takes the responsibility of managing it and in some cases waste is left in there for several years. This results in very unhygienic environment.

Photo 7: Moisture problem in a *Saagaa* because of grey water disposal

Some of the main problems observed in the case of *Naugas* are as follows:

- *Naugas* do not have any system for aeration.
- Because most *Naugas* are not covered, they do not look good they cause bad smell and there is also loss of nutrients.
- The decomposition rate in the *Naugas* is very slow because of poor aeration and improper mix of waste.
- As there is no system for moisture control the moisture is often very high.
- Most people complain of smell.

4. Strategy for Improving Solid Waste Management System

Based on the information on current waste management practices and discussions with local people, the following strategies have been adopted to improve the waste management system for Siddhipur.

Household Based Waste Management

As centralized waste management systems are often complicated and expensive to establish and operate and as most Siddhipur residents already practice some form of household waste management system, improvement in solid waste management system in Siddhipur needs to focus on effective waste management at the household level. This will make the system effective, inexpensive and environment-friendly.

Focus on organic waste management, including management of straw waste

As more than 80 percent of the waste generated in Siddhipur consists of organic waste, the focus of improved waste management system should focus primarily on the organic waste management system in households. Organic waste management is also important because most of the residents are farmers who need compost regularly. The traditional system for composting waste will be studied and improved upon.

Build the capacity of local women

Photo 8: Explaining temperature increase

As women are more involved in waste management than men, they will be trained and involved in designing and implementing waste improvement plans for Siddhipu. A SWM Committee with 12 women has already been formed. Similarly, as there are several women's groups already existing in Siddhipur, these groups will be mobilized for solid waste management as well.

Build on existing systems and introduce appropriate technologies

As most households practice some form of waste management, the strategy build on the existing system and improve on them. Saagas and Naugaas and compost piles will be improved where possible and new systems for composting that are appropriate for local conditions will also be introduced. The following considerations will be made while developing these systems:

- As most people in Siddhipur are poor, they cannot afford expensive systems.
- As straw mattresses waste makes up a large portion of the waste stream and straw usually does not degrade quickly systems should be able to accommodate fairly large amounts of waste.
- Because of the dense settlement pattern, systems should be designed to so that they can fit even in small spaces.
- As there is already a tradition of composting household waste, the traditional knowledge and practices should be adopted to the extent possible.
- The systems should be effective and environmentally sound.

5 Activities

The following activities were conducted as part of the Siddhipur Integrated Water Supply and Sanitation Programme to improve solid waste management in Siddhipur.

5.1 Mobilize Local SWM Committee

As households and individuals will be extensively involved in improving the solid waste management system, maximum community participation and ownership is necessary to make the program successful. Therefore, all activities related to SWM improvement were be led by a local committee named Sanitation and Hygiene Education (SHE) Team, consisting of 12 active women from various parts of Siddhipur, with the support of external experts where required. The local committee was trained to assess the problem of solid waste management, identify appropriate solutions, plan and design improvement measures, implement improvements and monitor the progress. The following activities were conducted in this process:

- Training on solid waste management and community mobilization
- Field observations together with experts
- Field surveys and group exercises
- Participatory planning and decision making
- Two-day Team Building Workshop
- Refresher courses
- Regular monitoring

5.2 Training to Women's Groups and Other Community Members

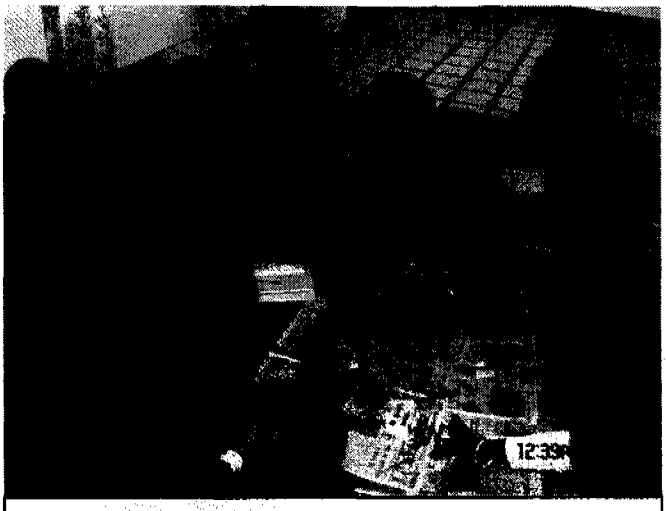


Photo 9: Women participating in SWM training

Initially, a training of trainers was provided to the 12 members of the SHE Team. This was a three-day training where the participants learnt about solid waste management as well as training skills. The trained women, with the support of experts where necessary, then provided one-day SWM training to about 800 women from various women's groups in the community. These training sessions focused on household waste management, particularly composting. Once the training was completed, the SHE Team members followed-up with the participants and provided composting systems at

subsidized rates as well as technical assistance to encourage them to manage their waste effectively in their homes.

5.3 Development and Demonstration of Appropriate Composting Systems

The project worked closely with local communities to develop appropriate systems for composting and these systems were initially demonstrated at selected households or public places. These systems were designed to be effective to manage the local waste in an inexpensive manner. The following types of composting systems were promoted in Siddhipur:

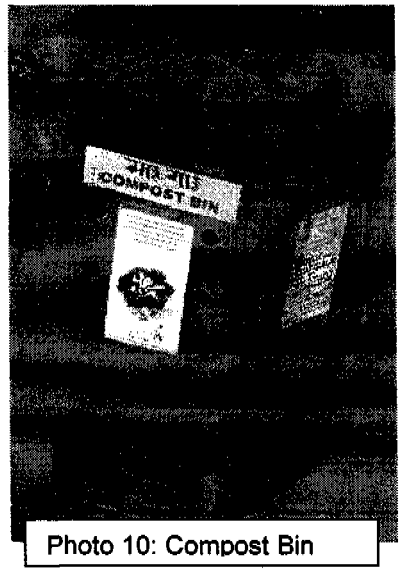


Photo 10: Compost Bin

- ***Compost Bin*** – This consists of a 100 litre plastic bin with two compartments separated by a steel grill. The system has been used successfully in Kathmandu and several other municipalities. The cost of the bin together with its accessories is estimated to be Rs. 1000.

- ***Compost Barrel*** – This system is similar to the compost bin, except the container is larger (180 to 200 litres) and the shape is cylindrical. The compost barrel can accommodate more waste than the compost bin without taking up any additional space. The Barrel is actually a container for chemicals that has been recycled to make a composting system. Therefore, the number of compost barrels depends on the availability of containers and mass production is not possible. The cost of the compost barrel is estimated to be Rs. 1200.

Photo 11: Compost Barrel

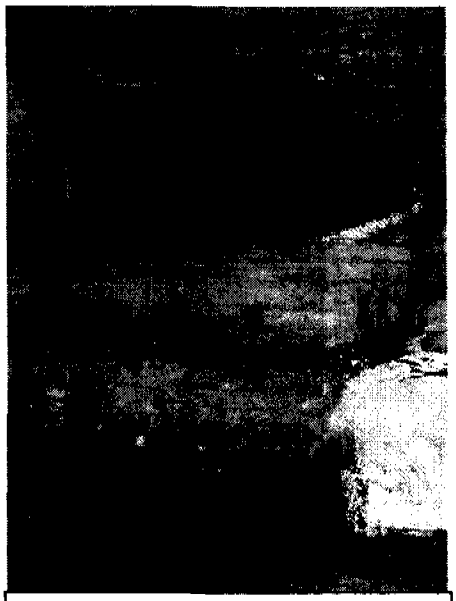


Photo 12: Compost Chamber

- ***Compost Chamber*** – Currently there are three compost chambers in Siddhipur that were constructed several years ago. These chambers are stationary structures made of brick and cement and have two compartments and a cover. The size of the chambers is 4 feet in length, 3 feet in width and 4 feet in height, and they can accommodate approximately 0.5 m^3 of waste. The cost of the compost chamber is estimated to be Rs. 3000.

Concrete Rings – This is a more inexpensive version of the compost chambers that exist in Siddhipur to accommodate large amounts of waste. This is made up of four concrete rings piled one on top of another. The rings are a modified version of rings that are normally used to make wells. The rings have holes in them for aeration and the system also has grills made of steel reinforcement rods on top of the first ring at the bottom to create two different compartments and also allow aeration. Each ring has a diameter of 36 inches and a height of 10 inches. The system can accommodate approximately 0.5 m^3 (500 litres) of waste. The cost of the concrete ring system is estimated to be Rs. 2000.

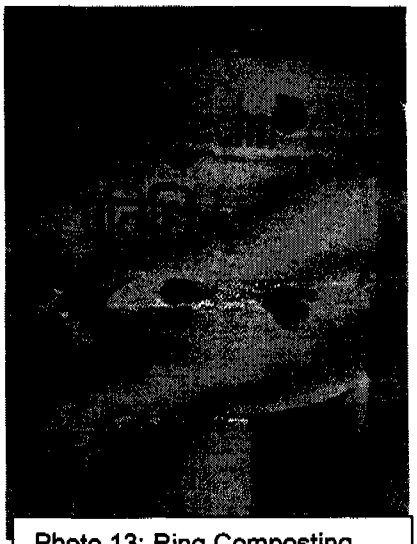


Photo 13: Ring Composting

Photo 14: Vermi Composting

- ***Vermi Composting*** – Vermi composting using special worms (*Eisenia foetida*) can useful for people who generate small quantities of waste and want to produce high quality fertilizer. Vermi composting may not be appropriate for households who generate large amounts of straw waste but it may be useful for other households. The cost of a vermi composting system with a plastic tub and about 400 worms is Rs. 500.

5.4 Distribute Composting Systems at Subsidized Rates

Photo 15: Woman takes home a compost bin

The trained households received composting systems of their choice at a subsidized rate. The Siddhipur Water and Sanitation User Committee provided 60 percent subsidy on the composting systems. All households were encouraged to set up an appropriate composting system and the SHE Team provided technical assistance as well as monitoring support. The numbers of composting systems that were distributed with subsidy are listed below. The compost chamber because it was a bit expensive and it was not a mobile system. Vermi composting was not very popular because of the problem of rats.

Compost Bin:	73
Compost Barrel:	47
Composting Rings:	20
Compost Chamber:	0
Vermi Composting:	4
Total	144

5.5 Improve *Saagas*, *Naugas* and Compost Piles

People, especially those who do not prefer to or cannot afford to invest in one of the composting systems being promoted by the project, were encouraged to improve their *saagas*, *naugas* or compost piles through better aeration, moisture control and mix of materials. Experts together with the local SHE Team members examined the *saaga*, *nauga* or compost pile and suggested improvements. Several households have improved their systems based on the suggestions provided.

Photo 16: *Saaga* measurement to design improvements

5.6 "*Suiro*" Program for Plastic Waste Collection and Recycling

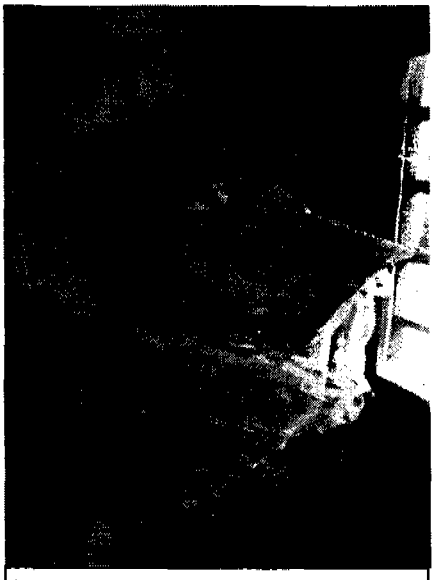


Photo 17: Plastic collection in "*Suiro*"

In order to facilitate plastic recycling "*Suiro*" a metal hook to collect plastics has been distributed to 847 households in Siddhipur. The Suiro, which is used to collect plastic waste in the house, was sold to each household for Rs. 5 each and all households were encouraged to collect their recyclable plastic waste such as milk bags and polyethylene bags in the hook on a regular basis.

A system for collecting the plastics at one location once a month has also been established that they can be sent for recycling. For this purpose, plastic collection sacks have been distributed to each group and arrangements have been made to sell the collected plastics to a scrap dealer. As of February 2007, the SHE Team had collected 184 kg of plastic waste from households.

5.7 Awareness Campaign

The following activities were conducted to raise awareness of the local people on solid waste management:

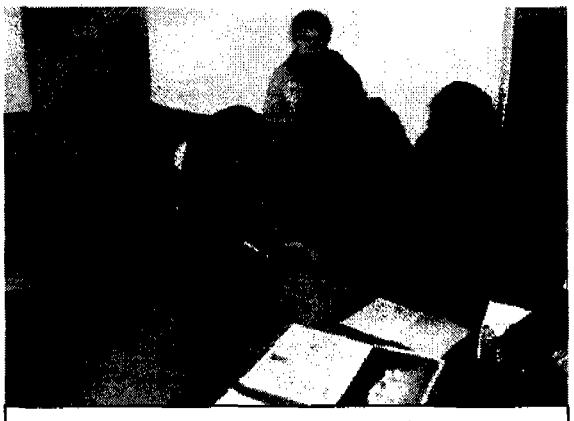


Photo 18: Participatory Planning by SWM Committee

- Publication and distribution of a brochure on solid waste management and composting
- Publication of flex posters
- Public exhibitions
- Message boards
- Street drama
- Demonstration
- Door-to-door visits by SHE Team members
- Public meetings

The brochures and posters were used during the training and follow up visits, while the message boards and public exhibitions have been used as tools for mass education.

6 Conclusions

The main achievements of the programme are as follows:

- The SHE team is fully capable of providing training and technical support on household SWM and some of the members have also served as resource persons for training in other communities. Besides SWM, the SHE Team members have received training on plastic weaving, household water treatment, community led total sanitation, team building and leadership. The number of SHE Team members has also been expanded.

- About 800 women have received training on SWM and composting and many of them have started improved composting and plastic recycling system. They have also received dust bins and dust pans.

- 144 composting systems, including 73 compost bins and 47 compost barrels have been sold to households at subsidized rates.

- A survey of 100 users of composting system indicated that most of the systems are being used properly and most users are satisfied with the performance of these systems.

- The SHE team has sold a total of 892 litres of Effective Microorganism (EM) solution, which is used to enhance the composting process.

- A plastic recycling system has been initiated involving 847 households. These households have been provided with *Suiros* (metal hooks) to collect the waste plastics, all the waste plastic is collected on the 15th day of each month and sold to scrap dealers. Some women are also involved in plastic weaving to make various products such as trays, bags, and key rings from waste plastics. As of February 2007, 184 kg of waste plastics have been collected and sold to scrap dealers.

Overall, the SWM component of the SIWSP has been successful in raising awareness and empowering the local community, particularly women, on issues related to SWM and it has made significant improvements in household centric SWM system in Siddhipur. Because the process was led by the local SHE Team who have provided each household with adequate training and follow up support on waste management, and the operation and maintenance cost is minimal, the chances for sustaining these improvements are high. However, the Siddhipur WATSAN User Committee and the SHE Team needs to regularly monitor the system and continue providing technical support where necessary to ensure that the waste continues to be properly managed in the future as well. Later as the settlement grows, there may be a need for a central waste collection and treatment system. This can also be done by the local SHE team using a similar approach.