Setting Up Community Based Water and Sanitation Facilities

A protocol manual based on field experience

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Contents

Executive Summary

A number of simple steps can ensure that community based water and sanitation projects have a higher likelihood of success. This manual is based on a collection of field experiences from Tamil Nadu and is a practitioners diary of lessons learnt. Most of these experiences are from work done under a project entitled "Community-based Water and Sanitation Facilities and Capacity Building of Local Residents for Adaptation to the Calamity in Coastal Areas in Cuddalore District, Tamil Nadu, India". This project was supported by the UN-HABITAT and involved sixteen villages in the Cuddalore district of Tamil Nadu. During the course of the project, the field teams had to overcome a range of obstacles and challenges. Given this was a community based project, many of these were of a non-technical nature but equally important as any purely physical activity that we undertook.

This manual tries to address both the social and technical components of the project and attempts to present what we believe are best practices for project attempting a similar intervention. Further, it discusses the logistic and accounting systems that were used to ensure the project functioned smoothly and transparently. It is written for any individual or group interested in implementing water and sanitation programmes across fifteen to twenty villages. While the lessons presented here can be used to design larger projects, the logistic arrangements discussed here would not be entirely applicable.

This is a practitioners manual and while it presents a protocol for implementing similar projects, it is not meant to be prescriptive. Field conditions vary across regions and we expect the reader to make adequate allowances for local situations.

Chapter 1 Introduction

Protocol Outline

1.1. Background

This manual is an outcome of a three year project supported by the UN-Habitat as part of its Water for Asian Cities (WAC) Programme. The WAC programme is a collaborative initiative between the United Nations Human Settlements Programme (UN-HABITAT), the Asian Development Bank (ADB) and Governments of Asia. To further the activities undertaken for the WAC Programme and UN-HABITAT's experience in post-disaster mitigation, it was decided to support the rehabilitation and improved access to water and sanitation to the tsunami disaster-affected population both in urban and peri-urban areas. UN-HABITAT joined forces with the BASF Social Foundation to this end and funded the project entitled "Community-based Water and Sanitation Facilities and Capacity Building of Local Residents for Adaptation to the Calamity in Coastal Areas in Cuddalore District, Tamil Nadu, India ".

The overall goal of the project is to promote adaptation of communities living in natural calamity prone coastal areas of Cuddalore District in Tamil Nadu. Its key objectives were to increase access of a minimum of 13,500 people, including children, women, girls men and people with disabilities to 'community owned and managed water and sanitation fa-

Figure 1.1.: Map of the project area. The state of Tamil Nadu is the southern most in the mainland and Cuddalore district lies along the east coast. The Killai block is the south-eastern block of Cuddalore.

cilities in urban and peri-urban areas of Cuddalore District'.

The project site

The Cuddalore district of Tamil Nadu is among the more vulnerable regions of the state. The district, particularly its backwater regions lying east of the temple town of Chidambram in the Killai block and are particularly prone to floods and occasional cyclones. The Killai region was also devastated by the tsunami of December 2004, leaving many hundreds dead and homeless in its wake.

The decision to work in the Cuddalore district and around the Killai block was made based on the propensity of the region to flooding, its economically and socially backward population and the unique challenges of working in the region owing to its low-lying regions prone to water logging and having saline ground water. This was a site where "conventional" flush type sanitation systems were not suitable and where deep bore wells could not provide potable water. These challenges provided us with an opportunity to propose the use of dry toilets, popularly known as "eco-san" or ecological sanitation toilets. Further, water supply had to either be based on shallow hand-pumps or strategically placed bore-wells so they tapped fresh, unpolluted aquifers.

Stakeholders

This project was conceived to reach out to the most vulnerable sections. We selected women-headed households, households with disabled persons and villages which had high percentage of scheduled caste communities. The district authorities facilitated the selection process by providing a list of flood prone villages where water and sanitation facilities were either lacking or short of requirements. Thus the project consciously targeted socially vulnerable sections from physically vulnerable villages in the district.

Women, who have a central role in managing water and sanitation and are highly vulnerable. Yet they have little or no say in the way these infrastructure are maintained or operated. Recognising this, the project interventions had a specific focus on women and ensured their participation during planning sessions and during the capacity building and awareness sessions.

1.2. Organisation of the manual

This manual is divided into six sections which deal with an overview of the project so that the reader has a context in mind (this chapter). The second chapter covers the community mobilisation and capacity building strategy, more specifically the methods used to select villages for the project and ensure the primary stakeholders were not just aware of the benefits but also capable of rectifying and maintaining the infrastructure being set up. It also covers the protocols used to select villages and households to maximise the likelihood that they would use and maintain the infrastructure created. The third chapter covers the water infrastructure, starting with the location of sites for various infrastructure to issues of maintenance and construction. Sanitation facilities are the fourth chapter which is also organised into site selection, choice of materials and management and maintenance of facilities created. The fifth chapter covers the logistics and accounting systems used to ensure transparency and quality and timely implementation of project activities. This is often overlooked in protocol and lessons learnt manuals but remains an important component of any field intensive project which involves procurement of materials and creation of infrastructure. The sixth chapter of this manual describes the frameworks put in place to ensure the sustainability of the project, linkages with government agencies and schemes and the monitoring system used to track project outcomes and use them to constantly adapt to local conditions and events. The manual ends with a summary of lessons learnt during this project.

Protocol Outline

2.1. Introduction

Here we cover the procedures used to create a conducive environment for the implementation and handover of the project to the primary stakeholders. There were two levels of mobilisation required, one at the individual household and the other at the level of the entire community. In addition, capacity building was required at both levels to ensure the utilities and infrastructure set up by the project was used and maintained over extended periods.

2.2. Selection of villages and partner communities

Preliminary assessments through field surveys to identify and finalize villages in Cuddalore district for implementation of water and eco-san infrastructure was completed in 26 Tsunami-affected and disaster-prone villages. Participatory methods such as Focused Group Discussion (FGD) with village representatives, preparation of inventory of existing water and sanitation infrastructure and measurements on basic water quality parameters were completed. The villages for the assessment were selected based on discussions with the District Collector of Cuddalore and various reports that mentioned areas with higher vulnerability[1].

Participation of the community in the project has been solicited from the beginning by getting written permissions from the Panchayat Leaders for conducting detailed assessments on water and eco-san and implementing activities based on technical solutions.

The first step was to collect relevant information from the community on various water and eco-san issues and mapping the relevant sites with a GPS unit. FGDs, household surveys and detailed discussions with people who are disabled helped in identifying gaps in water supply and sanitation for various stakeholders in the selected villages.

Villages were selected on four set of criteria:

1. Status of existing water facilities
2. Status of existing sanitation facilities
3. Issues with drainage, water logging and flooding and
4. Social and economic status of the population.

Surveys were conducted in the villages short listed by the DRDA which used methods such as focussed group discussions and physical surveys of water and sanitation infrastructure. Group discussions engaged elected and traditional leaders and representatives, further we ensured that women were consulted separately through interactions with active women self help groups (SHGs). Further we met and consulted faculty at local schools such as headmistresses and headmasters.

All this data was compiled and analysed by scoring the villages based on their need for interventions. Villages with the highest scores were given preference over others. Once a village had been selected, a discussion to identify the most vulnerable households was held with Panchayat representatives. Economically backward women headed households and households with physically challenged and elderly persons were given a priority.

Schools with girl children were specifically targeted for both water and sanitation facilities. Only government schools were selected where com-

[1] Bhalla, R.S., Ram, S., and V. Srinivas, eds. 2008. Studies on Vulnerability and Habitat Restoration along the Coromandel Coast. 1st ed. Pondicherry, India: FERAL, UNDP-UNTRS.

prehensive revival of their water and sanitation facilities was required. Boys schools and buildings with suitable facilities were excluded from the project. This was done because sanitation facilities often plays a role in deciding whether girl children continue in school. Poor facilities are known to result in higher drop-out rates for girls.

2.3. Capacity building and awareness

A four stage awareness strategy was adopted which started with broad scale street play based campaigns. This was followed by more focussed awareness raising which targeted schools, individual houses, youth and SHGs. The latter two have formal linkages with the village Panchayat which was asked to facilitate these programmes.

Schools

Video shows, campaigns such as global hand-washing day and field trips involving water quality testing in the village were conducted. These activities were selected not just for their content, but also presented so they coincided with existing school curricula and programmes. A great deal of effort was spent in these programmes as children were the "agents of change" for this project. They were more open to adopting personal hygiene habits and use foot-ware, toilets and other infrastructure and less encumbered by norms and practices such as open defecation which are prevalent in these villages.

Communities

We adopted a range of awareness activities that were spread out for the entire project duration. These included specific awareness programmes as well as implementation activities designed to repeatedly engage with the community on water and sanitation issues.

Street plays were the primary mode of awareness raising at the village level. These were supplemented by programmes run with schools such as campaigns for hand washing and passive awareness through wall

Figure 2.1.: *School children participating in the 'Global Hand Washing Day' march.*

paintings, posters and signboards. The consultations made with the community also added to the awareness raising as the field teams regularly discussed issues of planning village water, sanitation and drainage. Results of water quality surveys were also shared with the community which was engaged in putting up signboards indicating whether water sources were potable or not. Finally, we ensured active participation of the community in all construction and other physical activities such as sand filling and clearing of weeds and contaminants from recharge ponds.

Individuals

Bulk of the efforts in individual capacity building and awareness was spent on popularisation of eco-san toilets. These toilets, while uniquely adapted to this region, are not always accepted by individuals for various reasons. Primary among these is the habit of open defecation which is prevalent in all the project villages and fairly common in most of rural India. Furthermore, flush toilets have long been promoted as the standard sanitation model. These are unsuitable for regions with high water tables and those prone to water logging. Elevated dry toilets such as the eco-san units promoted by this project overcome most of these limitations. Fur-

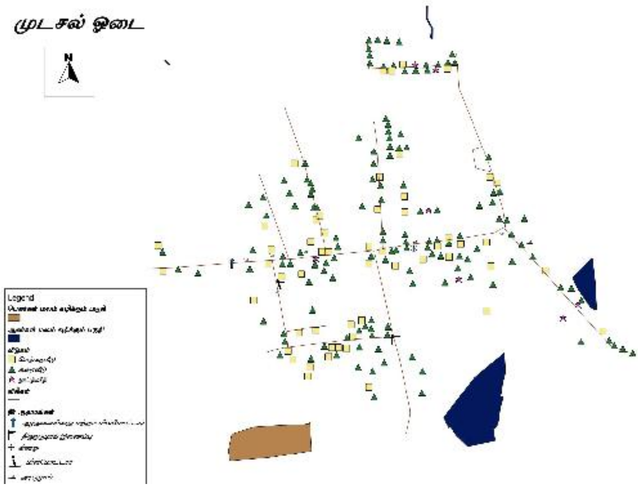


Figure 2.2.: *A geo-referenced micro-plan showing defecation areas, location of houses, streets and various kinds water sources in the village.*

ther, they utilise far less water than their traditional counterparts which is a major advantage in water scarce regions.

Convincing individual beneficiaries to adopt eco-san toilets required a series of meetings and discussions to convince them of their advantages. Further, instructions on use, maintenance and recycling of composted materials had to be provided both verbally and through illustrated posters. Many demonstrations on toilet use were held in each household and training programmes were conducted.

2.4. Micro-planning

An important component that ensures the participation and ownership of interventions is the use of participatory planning in project design. This project utilised micro-plans at various levels and through various techniques which included:

1. Street mapping exercises which were geo-referenced and digitised on a GIS framework.

2. Identification and mapping of existing water sources, their categorisation based on water quality.
3. Identification of areas used for open defecation, those prone to water logging and those used for solid waste disposal.

All this information was collated on a series of maps which were used as backgrounds for deciding interventions with the participants. This entire process was completed in the first six months of the project and provided detailed guidelines for the field teams, as well as the village representatives. The discussions held on the basis of these micro-plans were minuted and recorded as official meetings. In essence the micro-plans served as unofficial contracts between the communities and the implementing agency.

One of the important roles the micro-plans played was the identification of vulnerable individuals in the village. This was taken into consideration while deciding the location of community hand pumps and prioritising persons for individual toilets and water facilities.

Summary of protocol for community mobilisation.

- Pre-select villages based on district administration data and ranking.
- Conduct meetings and discussions with village representatives and leaders to determine levels of interest and willingness to participate. Short-list villages based on these and as per project requirements.
- Awareness and training programmes should continue throughout the project period and not just be limited to initial months.
  - Conduct awareness programmes such as street plays and video shows in villages.
  - Conduct programmes and workshops specifically targeting school children (water quality surveys, hand washing day) and youth (hand-pump assembly and maintenance).
  - Put up awareness materials such as wall paintings, posters and pamphlets to sustain the awareness activities.
- Identify participants in selected villages based on pre-defined priorities such as women headed households and households with differently abled persons in this case. Methods that can be adopted include focussed group discussions and street mapping.
- Assess the requirement and likely usage of water and sanitation infrastructure at the household, cluster and group level. Use micro-planning to develop detailed village level plans.
- Elicit participation of primary stakeholders through material, labour and cash in the creation of infrastructure both at the village/community and at the individual household level.

Protocol Outline

3.1. Introduction

The broad strategy followed for creating and restoring drinking and domestic water facilities was to tap into available resources using technologies and techniques which were low cost and easy to replicate, maintain and replace when necessary.

Drinking water facilities created and restored during this project covered a range of locally appropriate options available. These included hand pumps, shallow bore wells with electric motors for extraction and recharge wells and local storage of rain-water.

Considerable effort was spent in conducting surveys, including water quality and quantity for shallow aquifers as well as hydrological investigations to identify likely sources of deeper aquifers. Harvesting of water, both from roof-top as well as from overground flows to store and recharge respectively, was also done.

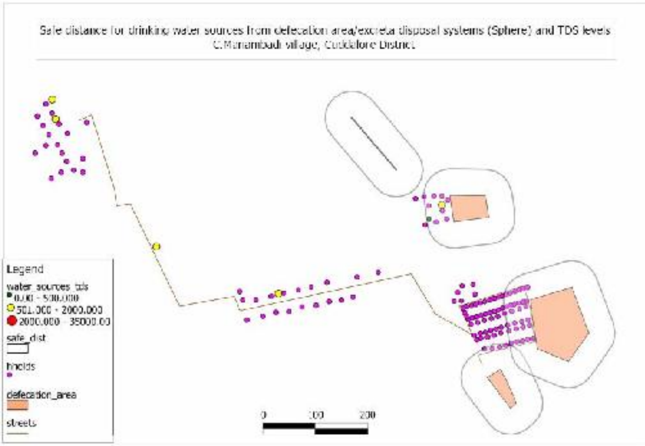


Figure 3.1.: *Safe distance for water sources from excreta disposal systems / defecation area as per Sphere standards.*

3.2. Site selection

Maps of all the villages were prepared showing the water sources, water availability, TDS, pH and bacterial contamination. A preliminary study by a geologist was conducted wherein all the villages were assessed. This was followed by a detailed hydro-geological investigation in the selected villages. A note on the same has been provided in Appendix A. Discussions with the village communities and the elected representatives led to the decision of site selection for hand pumps and shallow motorised bore wells. The integration of this local knowledge had various advantages, first, it ensured that each water source was publicly accessible. Secondly, the period and quantum of yield was known to the community. This was further verified through scientific investigations in water quality and pumping tests to estimate yields. Drilling activity was initiated only after written consent was received from elected village representatives.

Schools and community buildings were prioritised for rainwater harvesting and improvement of drainage. These were selected based on area available for setting up catchment and storage structures. Buildings in villages experiencing high water shortages and those with large number of users (students) were given priority.

Existing water recharge ponds were selected for cleaning to enhance natural ground water recharge from overland drainage. Overflows from roof-top rain water harvesting structures were re-directed to small recharge wells constructed on the premises.

3.3. Choice of materials and equipment

Low cost, ease of procurement, use, maintenance and replacement were the guiding principals behind the selection of materials and equipment. This was to ensure the infrastructure created during the project could be managed by the communities and individuals, particularly women, for extended periods. Locally available construction materials such as bricks and sand were used extensively and much of the in-kind participation of the community was in the form of labour.

Handpumps

Primarily, the selection of a hand pumps will depend on type of aquifer and depth. Figure 3.2 provides the operation depths of various public domain hand-pump types.

Within this project, the choice of hand-pump was based on its cost, depth of the water source, availability of materials and technical support for repairs and maintenance. Further, an innovation in terms of dismantle-able raised aprons and platforms was made, the materials used and type of which is described below. The raised platforms provided better access to the pumps during flooding and together with the soak pits (2 m^3 volume with brick bats and gravel), they helped in reducing contamination due to washing and cleaning near the hand pumps. The latter being a normal practice in the villages. The design of the platform (figure 3.3) ensures it can be easily dismantled and re-used in case the hand-pump needs to be repaired. This is unlike the present platforms which need to be broken and discarded in case of hand-pump breakdown.

Technical details of the shallow wells with hand pumps are as follows:

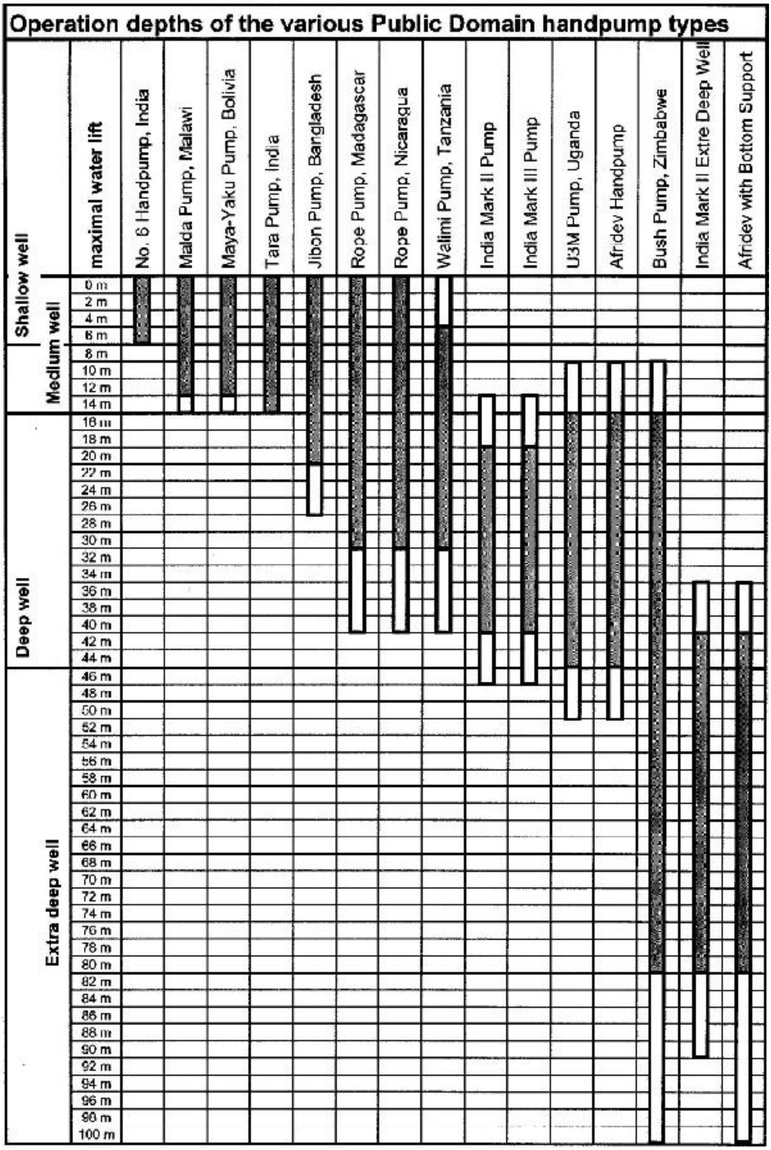


Figure 3.2.: *Depths of various types of public domain hand-pumps. Source:`http://www.rwsn.ch/documentation/skatdocumentation.2005-11-15.8791610507`.*

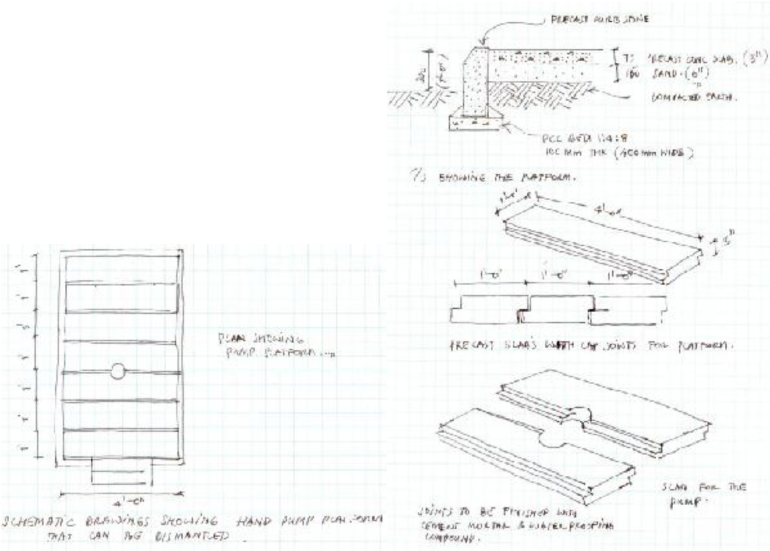


Figure 3.3.: *Design of pump platform.*

- Depth: 12 to 25 feet Type of pump – rotary action with down pressure augers (Figure 3.4).
- 3″ PVC pipe to the bottom most depth of the well
- Nylon mesh filters provided to avoid influx of suspended solids
- Height of pump handle at lowest point from the platform – 1.5 feet and highest point is 3.2 feet
- Cost of hand pump with raised platform ~ ₹13,000/-.

The advantages of this configuration is that it requires limited and simple equipment to drill the bore, usually employing locally available skilled labour for the drilling and fitting of the pumps. The pumps and bores are efficient for shallow wells in coastal areas and provide a flow rate of approximately 15 to 18 litres per minute. The installation and equipment is less expensive than alternatives, is easy to maintain even by women and the parts of the pump are available locally. The pumps do not require electrical motors and provide reasonably quality of water for sustained periods as the aquifers recharge easily. The Singur pump is particularly

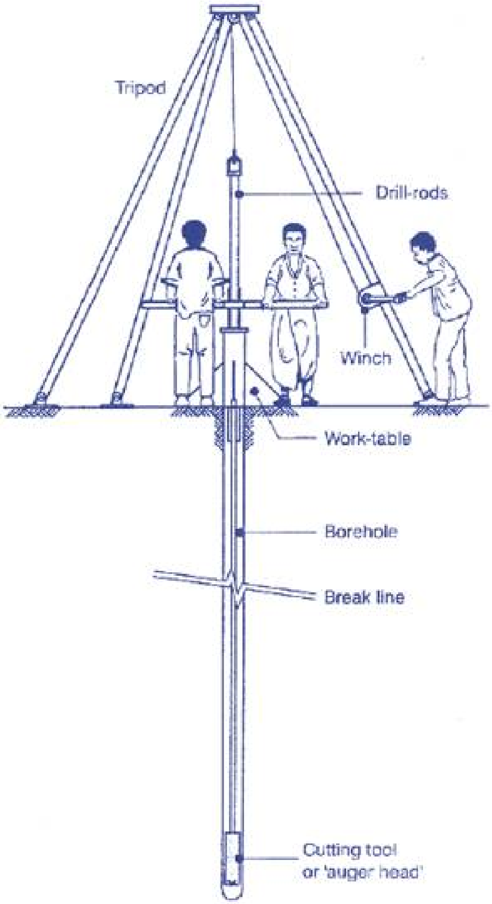


Figure 3.4.: *Manual drilling of handpump, source Wateraid.*

well suited to these requirements as presented in figure 3.5.

On the downside, there is a possibility of contamination of the shallow aquifer, particularly if there is improper hygiene around the hand pumps. Also the pumps must be located at least 30 metres aware from a potential polluting sources such as sewage or a solid waste dump. This space requirement is occasionally overlooked by villages where common area is scarce and the resultant water is therefore not potable.

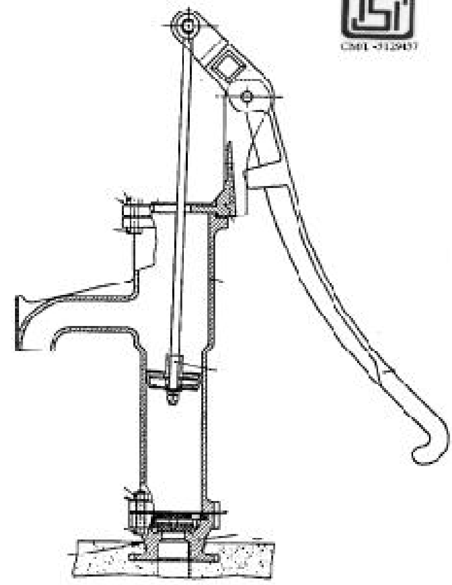
Shallow tube wells with electric motors

In some of the villages there was a need to provide storage structures near the habitations. The shallow wells therefore had electric pumps through which water was pumped to a storage tank close to the habitations. Details are as follows:

- Depth: 12 to 35 feet
- Type of pump – Air compressor pump (0.5 to 2 hp depending on depth)
- Storage – Plastic tanks of 2000 to 5000 Litres capacity depending on requirement
- Provision of brass taps for collection
- Mesh filters provided to avoid influx of suspended solids
- 3″ PVC pipe to the bottom most depth of the well
- Electric pumps (0.5 HP). This was used so that the volume of water extracted is optimal. Since the permeability of sub-surface water sources is very high, larger capacity pumps have the ability to draw too much water and increase possibility of contamination.
- Cost of unit including a 2,000 litre tank, tube well and electric motor ~ ₹45,000/-.

Advantages of this set up include the limited equipment needed to drill the bore wells as described earlier. The flow rate ranges from 40 to 75 litres per minute for a sustainable yield of reasonable quality water. The set up is costs efficient and all the parts are locally available. On the downside, the pumps are driven by electricity which can cause prolonged periods of non-operation, particularly during disasters and during the frequent power cuts. The electric pump also requires regular maintenance and

SINGUR SHALLOWELL HANDPUMP



The shallowell Handpump is a simple and robust suction pump constructed almost entirely of cast iron. This pump is basically The New No. 6 pump designed by UNICEF with a major modification to address the earlier shortcomings. The plunger is a uses a moulded PVC cup seal with two 3mm sheet (hiot dip Galv.) and the check-valve is a floating valve system of nitrile rubber with M.S. weight. Repairs are simple to carry out and require only basic tools.

The suction handpump is generally used for lifting water from a depth not exceeding 7 m. The principle components of the pump are :

a. Pump base with floating valve (To be fixed in concrete) .
b. Pump body, i.e. barrel
c. Pump head with ful crum
d. Handle
e. Plunger rod assembly with bucket

The pump body is made of cast iron. The piston rod is made of bright bar, electro-galvanised. The total weight of the complete suction pump is approximately 30 kg.
In October 2000 , SKI became the first organization in India to be granted the BIS License for this Handpump (IS: 8035 1999).

Advantages of Singur Shallowell Handpump

- A Low cost pump
- Extremely sturdy and capable of withstanding rough usage
- Suitable for community water supply
- Very reliable valve system and durable PVC cup seals
- Maintenance is very simple and requires only basic tools
- A sliding plate has been provided on the top of the head to prevent water contamination
- Much Higher discharge than any comparable pump

Figure 3.5.: *The Singur pump (Source: UNICEF).*

improper hygiene around the pumps can result in contamination of the shallow aquifers.

Rainwater harvesting

For designing an appropriate rainwater harvesting system (rooftop or surface), it is important to have a knowledge on the following factors:

- Average annual rainfall
- Number of rainy days
- Type of soil/aquifer (to determine recharge)
- Use (volume and type; determines storage and filtration technique)
- Cost, this should be to tune of ₹65,000/- for a the piping and a 5,000 litre storage unit.

Cuddalore District has copious annual rain of approximately 1200 mm, which fall during the months of October and November. The only problem though is that most of this rain fall in approximately 20 to 25 days every year. Appropriate recharge structures can be designed to harvest this rain and reduce the salt water content in the sub-surface and deep aquifers. The recharge structures range from simple recharge wells to large recharge ponds. Community and school buildings are best suited for harvesting roof top rainwater in villages. Rainwater harvesting through surface runoff is best designed based on hydrogeological studies, including topography and type of soil types. Recharge locations can be located near drinking water sources (ground water sources).

Readily available PVC pipes and tanks were procured from nearby towns and transported to the sites. Bricks, sand and other construction material was locally organised where possible, labour for the activity was also organised locally. Rooftop water harvesting structures were installed using full-gutter or half-gutter PVC pipes ranging from 3 to 5 inches, depending on the surface area of the roof. It was ensured that the first rain was not harvested by removing a "dummy" cap which was re-installed after the first shower. This reduced the amount of debris and mud transported to the storage tanks. The volume of the storage tank ranged from 500 to 5000 litres, based on the number of users and surface areas of the roof.

Drainage Improvement

Water logging prevents people from using existing water supply and sanitation systems and creates a conducive environment for breeding of various vectors. It is important to map areas of flooding through consultation with the community and if possible through topographical studies. The type of drainage systems (concrete or earthen) need to be constructed to reduce water logging. Whether it needs to be pucca (lined with cement) or kuccha (unlined drainage) will primarily depend on type of soil and volume of water the drain receives. However, a principal consideration will be that of cost and in many cases, kuccha drains are constructed in places which need pucca ones, due to lack of available funds. This limits the ability of the drain and if regular maintenance (de-silting) activity is not carried out, it will end up in water logging again. In some areas, sand filling itself can be a viable cost-effective option; however, these can be carried out in only very small areas, like within schools, around water points and defecation areas.

Locally available materials with local labour was used to re-direct water from areas prone to stagnation to village ponds. Sand filling was done in areas falling within public spaces such as schools[1], community halls and water collection points. This ensured water was not allowed to stagnate and contaminate the shallow ground water. It further reduced mosquitoes and flies, the major carriers of vector borne diseases. Moreover, the filling of sand enabled children and teachers to access school buildings, the the local community to reach water collection points during the monsoon.

[1]Costs for sand filling vary greatly based on availability of materials and local labour rates. It cost about ₹20,000/- to fill a 0.2 acre area with 1.5ft of sand.

Summary of protocols for setting up drinking water facilities.

- Select schools and individual beneficiaries based on maps of selected villages and consequent discussion with community representatives.
- Ensure that community assets are placed so that:
  - They are built on community/government land.
  - They are accessible to a maximum number of households.
- Construct elevated stands for hand-pumps that are in low lying areas to prevent contamination.
- Create drainage for all water sources to prevent contamination.
- Use simple, locally available equipment which and train in its assembly, maintenance and repair.
- Ensure that women are able to maintain and repair the equipment.
- Use construction materials so they are reusable and can be dismantled and reassembled if necessary.
- Ensure maintenance of structures and protection from stagnation of water are a part of training activities.
- Ensure awareness activities in the community and with individuals raise consciousness about water quality and personal hygiene.
- Prevent the contamination of shallow aquifers and water storage units by draining out excessive water from the vicinity of hand-pumps and by discarding the rainwater harvested from the first rain.

Chapter 4 Sanitation facilities

Protocol Outline

4.1. Introduction

The project villages faced a large number of issues pertaining to sanitation and management of solid wastes. This project specifically targeted the provision of toilets for vulnerable individuals and for school children, particularly girls. Solid waste management and open defecation were some of the issues raised during the awareness programmes, mapping exercises and micro-planning exercises. Clear signboards were put up in areas close to water collection points to discourage dumping of potential contaminants.

4.2. Site selection

Sites for construction of toilets were decided based on surveys and mapping exercises described in the earlier section. These maps and discussion held with the community helped identify individual beneficiaries and prioritise schools in the village. Individual beneficiaries were limited to households with members with disabilities and women-headed households. In addition, areas where water logging was a problem were identified. Water logging was a problem in many villages as it prevented people from using existing water supply and sanitation systems.

Sites for drainage systems (both permanent and semi-permanent), were decided on the basis of participatory mapping exercises in the villages which were followed by micro-plans. Additionally, sand filling activities were carried out in many areas including schools, community halls, water collection points and defecation areas to aid in better access to these locations.

Characteristics of the site dictated the type of toilets to be constructed. Eco-san was adopted in high water table areas, like in the Coastal villages of Cuddalore District. They replaced normal pit latrines which are not a good option because:

- they get filled during rains and floods making them inaccessible and
- they contaminate the ground water (sub-surface), which is the main source of fresh water.

In cases where there was high resistance to eco-san latrines, raised twin-pit latrines were constructed. It was decided to not build public latrines as past efforts made by the government and independent agencies have not been well received and the community expressed their reservations against public latrines during discussions.

4.3. Type of toilet

The decision on the type of toilets most appropriate for the condition was based on the site specific features such as drainage, water availability and depth of water table. The report by the Total Sanitation Campaign[1] was used as a guide to the selection of toilets. The costs of both the eco-san as well as a twin pit toilet were similar at about ₹18,000/-.

Individual toilets

Eco-san toilets were the preferred design of toilet because they would minimise contamination of high freshwater aquifers through their raised compost/disposal pit design. Further, the toilets, improvised for people

[1] Technology Options for Household Sanitation - A report by Ministry of Rural Development and UNICEF (2010)

with disability, would be accessible even during floods when the target group of differently abled persons and women face difficulty in travelling to defecation areas in the villages. Given that there was resistance to eco-san toilets by some selected beneficiaries, a cost-effective alternative, the 'raised' twin pit pour flush latrines, was also provided.

It needs to be noted that wherever eco-san toilets were installed, a great deal of effort was spent on training the beneficiaries about their advantages over the flush type of toilet. Further training ensured they were familiar with the use, maintenance and recycling of the wastes.

School toilets

Twin pit four flush toilets and separate urinals for girls were used for school toilets. These were decided upon as eco-san toilets require a higher level of personalised training as opposed to the flush toilet which is more prevalent and familiar to the students. As the focus of this project was on girls, new urinals were constructed for them alone. These cost about ₹60,000/- per unit. Additionally, urinals for boy students were repaired and upgraded in schools requiring the same. The decision to construct urinals in addition to toilets was taken on the basis of discussions with teachers and the community.

Summary of protocols for setting up sanitation facilities.

- Select schools and individual beneficiaries based on maps of selected villages and consequent discussion with community representatives.
- Couple the installation of toilets with demonstrations of good sanitation practices both to beneficiaries (individuals and school children) as well as the entire village.
- Target vulnerable groups first, in this case persons with disabilities and women-headed households.
- Building capacity of the community on the need for good sanitation – social marketing in partnership with the District's Total Sanitation Campaign (TSC).
- Select appropriate types of toilets based on local conditions.
- Ensure maintenance and recycling of solid wastes is part of the training modules.
- Ensure awareness activities in the community and with individuals raise consciousness about water quality and personal hygiene.
- Utilise local labour and materials where possible to bring down costs and increase the level of contribution and participation by beneficiaries.

Chapter 5 Logistics and accounts

Protocol Outline

5.1. Introduction

Projects involving the purchase, fabrication, construction and installation of equipment and assets require an implementation framework which ensures accountability and transparency. This enables the project to deliver high quality facilities at reasonable costs. This chapter briefly describes the basic protocols put in place to ensure that the project outputs were delivered on time and as per the highest standards of quality and cost.

5.2. Procurement of materials

All procurement was done through a system of quotations from nearby towns as well as urban areas. Quotations were compared based on both costs and quality of the materials as well as transportation costs. Payments for all materials were made through cheques or online bank transfers by the accounts section where possible. Materials like hand pumps, motors, basins and doors were paid for by cheque or bank transfers. Lowest bids for locally available materials such as sand and bricks were occasionally paid for by cash as the suppliers did not hold bank accounts. All

Figure 5.1.: *A manually operated drilling apparatus in use.*

payments were cross validated by an independent accounts team which also ran cross checks of costings through phone-calls and independent visits to the suppliers.

Quality of materials was assured by comparing the products from different manufacturers and ensuring compliance with technical specifications.

5.3. Labour arrangements

The project maximised the use of local labour for this project so that employment generated by the project would benefit the community itself. Organisation of labour was usually done by the WASH committees or the Panchayat representatives. In cases where skilled masons were not available, training was provided for constructing toilets for which a specialised mason was hired. Teams of specialised labourers for drilling shallow wells were also available locally and were hired. These teams were equipped with manually operated drilling apparatus.

5.4. Site logistics

In order to cut down travel time between site visits, a house was hired in a central location in the project site. This house also served as a storage place for materials and equipment which was to be installed. Most travel to and from the site and the office was done using public transportation and motorcycles. Locally available transportation, largely bullock carts, motorised tricycles and mini-vans were hired for moving equipment and materials from suppliers to the site.

5.5. Role of participant/beneficiary

Project beneficiaries and other stakeholder contributed significantly to the project through logistic, material and labour inputs. While some of this was paid for by the project, other activities such as sand filling and clearing of weeds from schools compounds and ponds was undertaken under the National Rural Employment Guarantee Act. This was facilitated by the WASH committee members through the village Panchayats.

Individual beneficiaries took up the maintenance and management of their assets immediately after they were handed over. Likewise the WASH committees through the Panchayats were handed over community assets like hand pumps, shallow tube wells with electric motors and rain water harvesting structures. School administrators and teachers took over the operation and maintenance of assets created for the schools.

Summary of protocols for logistics and accounting procedures.

- Ensure procurement rules are followed. These should typically include:
  - Comparison of quotations on basis of cost, quality of product and transportation to site.
  - Payment by cheque or bank transfer and not by cash.
  - Field checks by accounting staff to project sites to set up a standardised voucher and billing system.
- Adherence to technical specifications and quality norms.
- Utilise local labour and materials wherever possible.
- Community contributions need to be recorded and billed as and when possible.
- Minimise travel and transportation costs by setting up a field office which serves as housing for both staff and materials.

Chapter 6 Sustainability and Monitoring

Protocol Outline

6.1. Introduction

The long term sustainability of any project hinges on the ability of the implementing agency to hand over project running to the local stakeholders. It can be further strengthened through linkages with government run programmes and schemes so that assets can be enhanced by tapping into available resources. Management of such programmes over long periods also requires that they conform to existing government regulations and policy. This section deals with the process by which this can be achieved.

6.2. Institutional framework

Any long-term initiative must consider operational and maintenance aspects; the design and processes must be such that they can be locally maintained and more importantly women to have a central role in it. The village Panchayat has a pivotal role in the maintenance of water and sanitation facilities in each village. To this effect each village is expected to

Figure 6.1.: *Structure of village level WASH committees.*

form a Village Water and Sanitation (WASH) Committee. In line with these guidelines, WASH committees were formed in each village to oversee all the infrastructure activities, the structure and roles of which are given in figure 6.1.

A two-pronged approach was selected to implement the operation and management plan, which comprised of (a) active participation and (b) passive participation.

Active participation

The active and more pro-active approach that was promoted was through the existing institutions - the Panchayat and the Self-Help Groups. For common water and sanitation infrastructure such as community management water supply and sanitation systems, a formal agreement was signed with the Panchayat for the operation and management of the infrastructure set up. The agreement specified the role of the Panchayat in the operation and maintenance during and post project period. The Panchayat was also responsible for providing space and electricity requirements where necessary and formal agreements on these were signed as well. The village animators, who are part of the women SHGs were asked to act as ‘watch dogs’ to report on status of the infrastructure while the Panchayat took on the responsibility of repairs and maintenance.

For individual beneficiaries, especially women-headed households and disabled persons, an individual agreement was signed for operation and maintenance/management of the infrastructure set up. The SHG was actively involved in the selecting of these beneficiaries and the village animators are trained to monitor and encourage the users to maintain the infrastructure.

Passive participation

The passive approach was through creating awareness among the users on the maintenance of the infrastructure set up. Clear messaging in local language through mass media (loud speakers), distribution of information, education and communication (IEC) materials and placards with 'Dos and Donts' in each of the infrastructure set up was adopted.

6.3. Infrastructure operation and management

The operational and management aspects of each of the infrastructure provided in the community and the responsible groups are provided in the tables that follow.

Operation and maintenance aspect	Responsibility	Frequency
Use	Community	Regular
Repairs	WASH Committee and locally-trained technicians	As and when the need arises
Maintenance (oil and valve check)	WASH Committee and locally-trained technicians	Once in 3 months
Permission for relocation of hand pumps	WASH Committee after discussions with representatives from the community	As and when the need arises
Platform repairs	WASH Committee and locally-trained technicians	As and when the need arises
Soak pit desilting	Animators to encourage Women SHG members	Once every 2 months

Table 6.1.: *Operation and management of handpumps.*

Operation and maintenance aspect	Responsibility	Frequency
Use	Community	Regular
Repairs of taps and piping	WASH Committee and locally-trained technicians	As and when the need arises
Maintenance (oil and valve check of the pump)	WASH Committee and external technicians	As and when the need arises
Permission for relocation of storage	WASH Committee after discussions with representatives from the community	If the need arises
Platform repairs	WASH Committee and locally-trained technicians	As and when the need arises

Table 6.2.: *Operation and management of community water supply system.*

Operation and maintenance aspect	Responsibility	Frequency
Use	Women-headed household and disabled	Regular
Repairs	Individual beneficiary	As and when the need arises
Maintenance (cleaning the latrines and regular supply of ash)	Individual beneficiary	Regular
Removal of compost	Individual beneficiary	Once in 6 months
Use of compost	Individual beneficiary	Depends on the user (can either use it in their garden or sell it)
Changing vegetation for urine treatment	Individual beneficiary	Once in a year

Table 6.3.: *Operation and management of eco-san latrines.*

Operation and maintenance aspect	Responsibility	Frequency
Use	Community	Regular
Repairs	WASH Committee with help from Women SHG groups	As and when the need arises
Maintenance (cleaning the roof, roof wash and piping)	WASH Committee with help from Women SHG groups	Before and after the rainy season
Prevention of contamination to the recharge ponds and maintain hygiene around these infrastructure	WASH Committee (particularly the Village Animator)	Regular

Table 6.4.: *Operation and management of rainwater harvesting, recharge and drainage.*

Operation and maintenance aspect	Responsibility	Frequency
Use	School children and teachers	Regular
Repairs	School management with help from the Panchayat members/WASH committee	As and when the need arises
Maintenance (cleaning the toilets, rainwater harvesting system and drainage)	School management	Regular
Awareness on need for good personal hygiene and sanitation for the children	School management	One awareness program every 3 months

Table 6.5.: *Operation and management of school WASH.*

6.4. Monitoring and adaptive management

A two pronged strategy was followed for monitoring of project activities and maintenance and management of assets created. WASH committees which were set up in all the villages were responsible for the monitoring of the assets and their use by the various beneficiaries. Their observations were recorded in their minutes books which were updated every three months - to coincide with the WASH committee meetings. Any issues

(a) Coordinator, Total Sanitation Campaign for Cuddalore District inaugurating a toilet built as part of the project.

(b) Engineers of the Tamil Nadu Drinking Water and Drainage Board participating in a workshop on environmental health during emergencies organised during the project and conducted by RedR.

pertaining to the assets and infrastructure were brought up during these meetings and conveyed both to the Panchayat and the project staff.

The second level of monitoring was done by the project staff through regular visits to all project villages and individual as well as school beneficiaries. Field records and an inventory of the various components installed was maintained and reported to the project coordinator on a weekly basis.

This system ensured that both Panchayat officials as well as the project team were abreast of developments and were able to intervene where necessary. Interventions were of different types, from replacement of broken or faulty components to meetings and discussions with communities to resolve conflicts and ensure regular use and maintenance of the infrastructure created.

6.5. Linkage with government agencies

The project had a conscious strategy of linking with the government machinery engaged in water and sanitation at the district level. This included the District Rural Development Agency, under which the Total Sanitation Campaign is run. The project officer actively participated and facilitated project activities. Officers from government agencies engaged in the area of water and sanitation also participated in training programmes and awareness campaigns organised by FERAL which ensured the project activities were in sync with corresponding projects of the government.

6.6. Lessons Learnt

There was a clear difference in the effort required to implement activities between different target groups and the level at which the installed infrastructure was utilised by them. Schools and school children were uniformly superior targets for this programme. Awareness and training programmes conducted with them were better received and well integrated with other teaching activities. Infrastructure set up was utilised

Summary of protocols for sustainability and monitoring.

- Ensure that the project creates or integrates with community based organisations within the framework provided by the government for management and maintenance of WASH projects. This necessarily would require:
  - Engagement with the local department involved in the total sanitation campaign and drinking water supplies.
  - Involvement of Panchayats and elected ward members and
  - Integration of existing SHGs in the programme activities.
- Create a WASH committee as above and ensure it has formal meeting schedules and responsibilities towards operation and maintenance of the facilities.
- Have clear strategies for awareness and involvement of the community so that both active as well as passive participants are targetted.
- Create explicit and clear rules, regulations and duties for beneficiaries, members and representatives of CBOs for each kind of infrastructure and facility created.
- Create a community centric monitoring system on whose basis quality and condition of water and infrastructure are tracked and decisions taken on operation and maintenance of the facilities.

A.1. Purpose

The main purpose of hydro-geological assessments (or ground water exploration) is to locate sub-surface water in large quantities, and capable of producing sustained yields at reasonable rates and for the fresh water to be of good quality. To be effective and reliable, this exploration must combine scientific knowledge with common sense and experience as regards local terrain, water sourcing systems, and other relevant local knowledge. The job of a hydro-geologist is to find the correct location and determine the kind of sourcing system that will provide consistent water yields. Hydro-geologists are employed in geological survey departments or geological engineering consulting companies.

A.2. Techniques

The simpler and first tools of a hydro-geologist include the use of the surface evidences of groundwater and the interpretation of geological data as well as the use of well inventories. All these provide indications as to the general situation in the local area. The geological information can be listed under the heads of geological maps and cross-sections, aerial photographs and satellite imagery, and today even Google maps which provide good surface indications of groundwater. Additionally, surface evidences which include topographic features including land forms, stream patterns etc provide valuable clues.

The use of remote sensing techniques like aerial photographs, satellite imagery and Google images has now become an indispensable tool in studying water conditions underground.

Then, there are the geophysical techniques, which work on the principles of physics as applied to geology. The most popular and cost –effective of these is the electrical resistivity method. Seismic refraction, magnetic and gravity methods are also used, albeit to a much lesser extent and in specialized conditions.

Geological Maps

Geological maps provide information on rock formations, based on their outcropping, and also the strike and dip of the formations themselves. Structural information like location of fractures and faults, joint patterns etc provide valuable information to the study. The strike and dip of rock formations studied in combination provide clues to maximum aquifer thickness. Bedrock contour also indicate maximum depth for drilling.

Geological Cross-sections

Cross sections indicate the character, thickness and formation successions especially in sedimentary terrain and thereby the depth and thickness of underlying aquifers. Much of this information can be gleaned from road rock cuttings, well sections, and valley side exposures.

Remote Sensing

Aerial Photographs: Aerial photographs with 60 percent overlays to provide a stereo pair are studied using a stereoscope which allows features like landform and land use, drainage pattern, alluvial plains, gravel pits, terraces, etc to be discerned and clearly demarcated. Such interpretation will help in locating the most promising areas for groundwater development. Air photos are made by aircraft flying and talking pictures with a defined overlap.

Satellite imageries help in the identification of lineaments or large structural disturbances on a large scale. Google maps also provide significant clues to the drainage patterns land use and provide clues to groundwater.

Well Inventories

Information from drilling reports and dug well construction as well as historical information about well performance provide relevant data for creating well logs which contain information on well depth, formation thickness, rock description, yield and drawdown. These records are pertinent from the viewpoint of not only siting new wells but also from the need to avoid well interference. The construction of water table contour maps showing the water table incline in hilly areas, etc are also useful in determining the most suitable locations for sourcing ground water.

Surface Evidences

These are gathered largely during the field studies where the geologist would examine in greater detail the important surface and superficial features noted from the air photos, Google maps, topographic sheets, etc. These features include land form and land use, drainage patterns, lakes, springs, vegetation type and canopy cover.

As far as land forms go, valleys are more likely to have larger quantities of water than hills. Valley fills deposited by rock debris from upland erosion can hold significant quantities of water. Surface flow evidences like streams, springs, marshy areas - all provide indications of ground water.

Vegetation, especially of hydrophilic (water loving) varieties like arjun (Terminalia arjuna), jamun (Syzygium cumini / Eugenia jambolana), bamboo sps, reed varieties like cattails - are clues to the presence of groundwater The table given below provides information on the different types of groundwater investigations including geophysical methods used in general.

Overall the broad techniques fall under two categories:

- surface investigations for ground water
- sub-surface investigations for ground water

Surface Investigations For Ground Water

No	Tool	Method	Usefulness / Remarks
1	Geological maps and cross sections	Rock formations and structural features	Location of fracture zones and aquifers
2	Well inventory	Construction of water table contour map	Siting of wells
3	Remote sensing	Aerial photos, Satellite imagery, Google map images	Understand general trends
4	Surface Evidences	Study of land form and land use, drainage patterns, lakes, springs, vegetation type and canopy cover	Clues to the presence of groundwater
5	Geophysical techniques		
5.1	Electrical resistivity	Electrical resistivity of a rock determines the amount of current passing through it. Commonly used Schlumberger and Wenner configurations	
5.2	Seismic refraction	Small shock wave created and time travel and propagation of the seismic wave measured, reflection and refraction as in the travel of light. Relation between travel time and media through which it is passing, e.g. velocity highest in solid igneous rocks and least in unconsolidated sediment, porosity reduces wave velocity, water content increases it	Most popular for ground water exploration. Equipment highly portable and easy to use. Can study both vertical and horizontal profiles by varying electrode spacing or moving all electrodes evenly. Sounding can indicate aquifers, water tables, salinities, bedrock depths and impermeable formations Horizontal profiling can indicate aquifer limits and groundwater quality changes
5.3	Magnetic	Mapping of magnetic fields	Not much relevant since magnetic contrast shows little association with groundwater, possible exceptions include dolerite dykes and sometimes volcanic (basalt) rock boundaries.
5.4	Gravity	Density differences may indicate geological structure	Method expensive and water content rarely shows measurable difference not much used. Useful in large buried valley conditions to outline the aquifer boundaries

Table A.1.: *Types of surface investigations for ground water*

Sub-Surface Investigations for Ground Water

No	Tool	Method	Usefulness / Remarks
1	Test Drilling	Small diameter test drilling to verify groundwater conditions before drilling large dia borewells. Also used later as observation wells and testing aquifer parameters. Use of geological and drill time logs	Lower costs of investigation Confirmatory for other studies
2	Yield Tests	Yield and drawdown testing	To determine pump type, capacity and placement depths
3	Geophysical Logging	Use of sensing devices including resistivity, sonic, gamma logs, temperature, etc	Correlation of sub surface data from well to well and supplement geological logs.
4	Resistivity Logging	Multi electrode used to measure spontaneous potential and resistivity	Indications of lithology, demarcation of fresh and saline zones

Table A.2.: *Types of sub-surface investigations for ground water*

A.3. Advantages

The costs of an electrical resistivity investigations remains considerable low compared to any sub surface investigations like drilling or open excavation.

The advantages of following a systematic and well designed ground water exploration plan is that one can use confirmatory geophysical analysis to match with the geological data developed during the field work and air photo and satellite imagery / Google map interpretation. The scale of the investigation will also determine the array of techniques used.

A.4. Limitations

It is possible that the hydrological picture is still incomplete even with results of a scientific investigation, yet the point remains that costs are much less compared to sub surface investigations.

In the electrical resistivity method, changes in resistivity at great depths have a very limited influence on the apparent resistivity compared to those at shallow depths the method is not effective for depths below a

Figure A.1.: *Electrical resistivity test underway.*

few hundred metres. Also, electrical leakages from transformers, electrical earthing and high voltage lines, horizontal buried metal pipes and highly conductive minerals can cause equipment reading errors.

It must be said that water dowsing or divining by using coat hangers and coconuts cannot achieve the quality of results that a well conducted geological and geophysical survey can in significant percentages.

Besides electrical resistivity, the methods like seismic, magnetic and gravity are much less used either due to cost and manpower considerations or due to the limited information provided in most situations by techniques like gravity and magnetic. Seismic techniques are also not suitable for small areas.

Test drilling is not often used except in very large project due to the high expenditure for such investigations.

A.5. Conclusions

Detailed investigation including geological and geophysical studies can provide information for not only selecting suitable sites for locating wells, but also the type of well that would be most appropriate.

Additionally, these studies can help determine locations and types of ground water recharging structures.

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5. Aerial photography - archive.ilmb.gov.bc.ca/crgb/airphoto/airphoto_faq.htm

Appendix B Resources on the Internet

1. Ministry of Drinking Water & Sanitation, Rajiv Gandhi Drinking Water Mission. Documentation repository: http://www.ddws.gov.in/documentreports/term/62
2. The India Sanitation Portal, an open, inclusive, web-based platform for sharing sanitation knowledge amongst practitioners and the general public. http://indiasanitationportal.org/
3. Rural Water Supply Network. http://www.rwsn.ch/
4. A selection of technical, policy and advocacy documents produced by UNICEF on water, sanitation, hygiene and the environment. http://www.unicef.org/wash/index_documents.html
5. Links to various online resources on water and sanitation published by the IRC International Water and Sanitation Centre. http://washresources.wordpress.com/