Experiences of a
Pilot programme on

Decentralised Water Supply Systems

Malappuram District, Kerala

Technical Support Unit (TSU)
Socio Economic Unit Foundation (SEUF)
Kondotty, Malappuram, Kerala

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Foreword

This workshop for sharing of our experiences and findings of the pilot project on Decentralised Water Supply is an important milestone in the history and growth of Socio Economic Unit Foundation (SEU Foundation)

Socio Economic Units were established in 1987 to facilitate community participation, health and hygiene promotion in Comprehensive Rural Water Supply and Environmental Sanitation Programs supported by the Governments of The Netherlands and Denmark Socio Economic Units also got involved in the sanitation with education programs construction of household and institutional latrines in collaboration with the Panchayats and other institutions This program with several unique features, attracted wide attention

The formation of Ward Water Committees, selection and training of Stand Post Attendants, site selection for stand posts by Ward Water Committees etc were some of the water related activities undertaken Experiments such as Cost Recovery from water users, Training local women for minor repairs Fault Reporting System through Panchayats were innovative in nature

In 1996 Socio Economic Unit Foundation' was formed to consolidate and build upon the experiences gained in water and sanitation sector

It was realised that small community managed water supply schemes, protection of traditional sources, rainwater harvesting etc are the only viable and sustainable solutions, for the ever increasing drinking water scarcity Meanwhile the sector policy of the Government was also undergoing changes in the same direction and the Grama Panchayats were made primarily responsible for drinking water supply In this context this workshop is timely and highly relevant as donors including World Bank has come forward to support Decentralised and Community managed Water Supply Schemes in Kerala

The Royal Netherlands Government through its Embassy in New Delhi has been the main funding agency all along for the various activities of the SEU Foundation The Royal Netherlands Embassy came forward to support the establishment of a Technical Support Unit within SEUF and to undertake a pilot project on Decentralised Water Supply, in 1997, in two Panchayats of Malappuram District where drinking water shortage problem is acute

This document narrates the experiences gained through the pilot project The sustainability and cost effectiveness of small water supply schemes, importance of people's participation etc are amply proved The role and relevance of technical and social inputs from an organization like SEUF and its fruitful collaboration with Panchayats need to be emphasised It is also clear that additional financial resources is also required to cater this basic need to all the people, especially the poor

We do hope that this paper and today's seminar will contribute to healthy discussions leading to policy decisions and implementation strategies in the water sector

Our thanks are due to large number of organizations and individuals for the successful implementation of the programme especially The Royal Netherlands Embassy – Mr Carel D L Brands and Mr Avinash Zutshi, Mrs Christine Van Wijk of IRC, Mr Shef Gussenhoven, ETC Mission, Department of Local Administration – government of Kerala, Cheekode and Kondotty Grama Panchayats 'SEU Foundation owes a lot to the people of the two Panchayats, Panchayat members and staff, convenors and members of the user committee and resource persons associated with the People's Planning Campaign Let me express our thanks to Mr K M Namboodiri for the technical advice rendered right from the inception of TSU The Help of Mr Raj Kumar Daw, NAP Office Hydrabad is also greatly acknowledged The dedication and hard work of all colleagues in TSU under the leadership of Mr Isaac John and Mr Georgekutty Joseph is the prime factor for the success of the project

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Part I

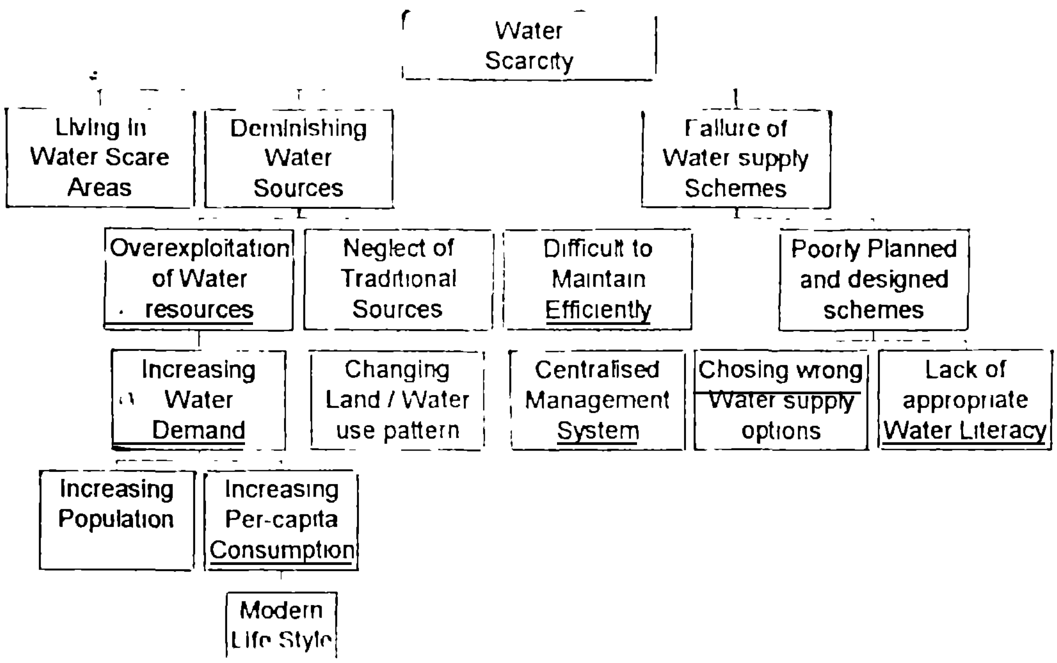
Present Status of Water Supply Situation in Kerala

- An Overview

1. Problems related to Water Supply in Kerala

The State of Kerala is well known for its lush forests, abundant rainfall, perennial springs, rivers, lakes and other water bodies But ironically, Kerala is fast moving towards a severe water crisis The main reasons for this are inadequacies in planning, indiscriminate exploitation leading to rapidly depleting water sources, and an ever increasing water demand caused due to the spiraling population growth and aspiration for an increasingly urban lifestyle Figure 1 attempts to illustrate this problem schematically

Fig. 1. Problems of Water Supply in Kerala



1.1 Diminishing & deteriorating traditional sources

Traditionally Kerala had very sound systems of conservation and management of natural resources of which water conservation was integral part These systems not only ensured adequate water available for both irrigation and domestic needs, but also conserved rainwater to offset any deficiency in the monsoons While shallow open dug wells met the drinking water needs, rivers, streams (Thodus) and ponds met the irrigation and other needs (washing, bathing etc) The agricultural practice was also extremely conducive to water conservation, e g , the paddy cultivation not only helped in crop production but also retaining the excess surface water over the ground for a long duration, thus recharging the ponds and wells

This situation has totally changed today Paddy fields, ponds and even the 'thodus' are being reclaimed either for constructing houses or for cash crop plantations Heavy pumping from deep bore wells have caused significant lowering of groundwater tables resulting in drying up of the shallower open dug wells This drastic reversal of water development strategies (over-exploitation on one hand and neglect of conservation measures on the other) has resulted in large-scale water shortages

1.2 Living & habitation patterns of people

A typical feature of Kerala is the habitation pattern of its people, who prefer to live in a dispersed pattern, independently and on their own property, rather than together in clusters as in the conventional concept of a "village" Hence, majority of households owned independent source of water In water scarce areas, poor people shared either neighbour's well or a public well for drinking water Ponds or streams were widely used for bathing and washing purposes Increasing material prosperity and breaking up of the traditional joint family structures, led to households splitting physically, a consequent division of property along with need for more water sources Due to increased pressures on the land, people not only started reclaiming old ponds and paddy fields for building construction but also started replacing open dug wells with bore wells All these phenomena resulted in a gradual over-exploitation of ground water on the one hand and a collapse of the traditions of conservation of water on the other, contributing to the current water crisis

The peculiar dwelling pattern of people (right in the middle of their agricultural property) and the type of land allotted to poor people also compelled them to live in water scarce areas where no traditional sources are available

1.3 Failure of Public Wells & Hand Pumps

Under various government sponsored development programmes, particularly prior to centralisation of water supply sector, public wells, called "Panchayat wells", were dug in almost all the problem locations of Kerala In fact, until a couple of decades ago, these wells constituted the major source of drinking water for the poorer people who could not afford their own wells

Two reasons changed this situation significantly due to The influence of Gulf economy on the prosperity and lifestyle of a very large section of the population of Kerala, resulted in many more people owning independent property, building houses on such property along with independent water sources Simultaneously, the introduction of piped water supply schemes in the rural areas led to the total neglect of the old Panchayat wells This resulted in collapse, deterioration and drying up of these wells

By early eighties, the concept of deep bore wells and installation of hand pumps was introduced in Kerala, especially in remote areas Many hand pumps were installed under various government programmes by various agencies However, hand pumps were not popular in Kerala probably because these were seen as "public" sources, as compared to the social norm of the "owned" well As the hand pumps remain unused during the monsoon months, the stagnation causes deterioration of water quality (bad taste) resulting in rejection of the same during summer Yet another reason for failure of hand pump schemes is the generally poor quality of construction of bore wells and installation of hand pumps, and the near-absence of a reliable maintenance infrastructure

1.4 Regional piped water supply schemes and their limitations

Over the past two decades, Kerala has been adopting a centralised strategy of planning, implementing and maintaining rural water supply systems Kerala Water Authority (KWA) has been the sole authority of planning, executing and maintaining all water supply schemes in the state of Kerala Ever since its formation as an autonomous body in the year 1982, KWA has taken over all existing (small, medium and large) public water supply projects, throughout Kerala. KWA had constructed many new comprehensive water supply schemes most of which are large regional piped water supply schemes that pump water from rivers or streams, treat the raw water, store it in huge Overhead Service Reservoirs (OHSR) located on high ground and distributed the water by gravity to 5 to 10 Panchayats through a network of pipe lines and public stand posts Due to inadequate O&M system, these schemes are performing below satisfactory level and people in rural area are losing confidence in such big schemes

The most common argument put forward in favour of centralised piped water supply schemes in the context of Kerala is that, unlike other states, there are no villages in Kerala and people live in continuos stretches of houses and as such, decentralised water supply schemes are not feasible This argument sounds convincing at the outset, until one looks at the following facts

- Although the density of houses is very high, in most of the cases, the localities facing water problems occur as isolated clusters of houses numbering less than 50, for which a large piped water supply scheme is not necessary
- Substantial portion of the rural population (households) owns wells While water quality and yield of most of these wells may not be satisfactory, the massive investments already made for these wells cannot be ignored and easily replaced by a regional piped water supply scheme. Ways and means to revive these wells should find consideration
- With privately owned wells as the **primary** source for drinking water, the piped water supply scheme is looked upon as only a **standby** system, used in summer when water level in the private wells are low At such times the ability of the regional scheme to provide water reliably to all its target users is also often questionable

One school of thought subscribes to the view that centralised water supply schemes can still be made more effective through community participation The concept of community participation in this model is understood as the acceptance of piped water supply schemes, avoiding wastage of water, keeping the stand posts clean and prompt payment of water tariffs by the community/Panchayats Naturally, this approach has failed simply because community can not be expected to maintain a system which they do not consider as their primary source and over which they have no or little control and especially in times of need

2. Decentralisation of Water Supply Sector

By early nineties, the national policy on water supply sector changed radically and the following important policy guidelines emerged

- Participation of the Panchayati-Raj institutions and the community
- Emphasis on integration of water supply and environmental sanitation
- Emphasis on the managerial, financial and environmental sustainability of the facilities and systems
- Emphasis on supporting software features of institutional strengthening, community development and hygiene promotion
- Promotion and development of appropriate water supply production and distribution including the use of traditional systems and methods

In Kerala, the implementation of the national policy to devolve government tasks to the level of Panchayat in the Water Supply and Environmental Sanitation (WS&ES) sector is gradually taking shape Legislative measures in this regard are under way However, implementation of these directives is very time consuming since the issues involved in the decentralisation of water supply sector are fairly complicated in the institution context

It has been widely accepted that decentralised community managed water supply schemes are ideally suited for rural areas Although there is unanimity on the need for decentralisation, the methodology of achieving this has been elusive and is only evolving slowly A number of concepts for decentralisation water supply sector are being put forth for consideration

KWA has also been attempting to move towards sector decentralisation As a first step, the existing single Panchayat-level schemes in the custody of KWA are proposed to be handed over to the respective Panchayats Feasibility studies of such a proposition is going on in Malappuram district

Frustrated with the institutional inability to deliver water, people, at many places, have initiated schemes on their own without any help from Panchayat or Government The demand for very small water supply schemes covering only parts of a Panchayat is observed to be an increasing trend under the Panchayat Plans The decentralisation attempts of water supply in Kerala can be broadly classified into three groups

1 **Panchayat Model** dealing with small schemes (outside the purview of KWA)
2 **Private Model** dealing with small schemes fully owned and managed by community
3 **NGO Model** dealing with community managed water supply schemes with financial and institutional support from non-Government organisations

However, not much is known about the number of schemes in each category, their relative performance, replicability, etc All the above models might have their own situation-specific advantages and disadvantages The first phase of an indicative study of a variety of schemes in different parts of Kerala were carried out, during June 1999

The detailed analysis of this study will only be taken up after the study is complete in all respects However, a summary of the initial findings is furnished below

Positive features of Water Supply Decentralisation Models

- **Applicable to all Models**
    - Peoples participation is high compared to the centralized piped water supply schemes
    - Proved the feasibility of decentralisation of water supply sector
- **Panchayat Model**
    - The feasibility of planning and implementing water supply schemes at Panchayat level proven
    - Potential and scope of peoples participation in government programmes established
- **Private Model**
    - Capital and O&M costs are fully borne by the user community
    - Ability of the community in planning, implementing and managing water supply schemes without external "institutional/technical"assistance is
- **NGO Model**
    - Community participation is high
    - Facilitated introduction and promotion of innovative/alternative technologies

Limitations of the present efforts on Water Supply Decentralisation

- **Applicable to all Models**
    - Source yield is seldom tested and is always over-estimated
    - Supply rate is decided independent of water availability
    - Attempts to improve cost effectiveness need to be taken up
- **Panchayat Model**
    - Generally, cost sharing by community is marginal
    - No clear arrangement for O&M
- **Private Models**
    - Per capita capital cost is high
    - Source depletion is common due to over-extraction of water
    - The concept of full cost bearing is not replicable under Panchayatiraj system especially where the community is poor
- **NGO Model**
    - Replicability under Panchayatiraj System not known

Part II

Pilot Programme on
Decentralised
Water Supply Systems
in Malappuram District

1. Inception of Pilot Programme

Socio-Economic Unit Foundation (SEUF) has been involved in supporting community-based Water Supply &Environmental Sanitation (WS&ES) programmes in Kerala for more than a decade initially under Dutch and Danish bilateral assistance programmes for water supply SEUF, being a partner in the Netherlands Assisted Programmes in Kerala in the field of WS&ES, proposed a pilot demonstration programme in community based decentralised water supply and sanitation programme in 1997, to develop replicable institutional models at the Panchayat level The Review and Support Mission for the Netherlands-assisted WSES projects, which visited Kerala during April 1997, recommended the creation of the Technical Support Unit (TSU) under SEUF to implement this pilot programme Based on the encouraging results from the TSU during the first six months of preparatory phase, the Pilot Programme was initiated in April 1998

1.1 Objectives of the Pilot Programme

The general objective of the Pilot Programme was **to find optimal and sustainable solutions to the problems pertaining to water supply and environmental sanitation at the Panchayat level**

The specific objectives of the Pilot Programme were

- To study, field test and disseminate information on the effectiveness and implications of various institutional options in planning, implementing and maintaining community-based systems in WS&ES Sector, in accordance with the provisions of decentralised Panchayatiraj delivery system
- Selecting, adapting and promoting appropriate technologies in water supply and environmental sanitation
- To study, field test and disseminate information on promising, sustainable and replicable technical options in the field of water management and environmental sanitation
- To support building of the institutional capacity at the Panchayat level in planning, implementing and maintaining community-based environmental sanitation and water management projects in Kerala

1.2 Pilot Area

Since Malappuram was considered to be the most backward district in Kerala, it was decided to select the pilot areas from this district as per the following criteria

1 At least one Panchayat each, representing coastal region, mid lands and high lands respectively, facing acute drinking water problems
2 Existence of a strong felt-need by the people to solve the problems of water supply and their willingness to review their existing Panchayat plans (if need arise) and adopt alternative and sustainable techniques
3 Ample scope for introducing as many alternative, community-based water supply and management programmes such as rain water harvesting and water conservation
4 The rapport with community developed by SEUF through its earlier interventions

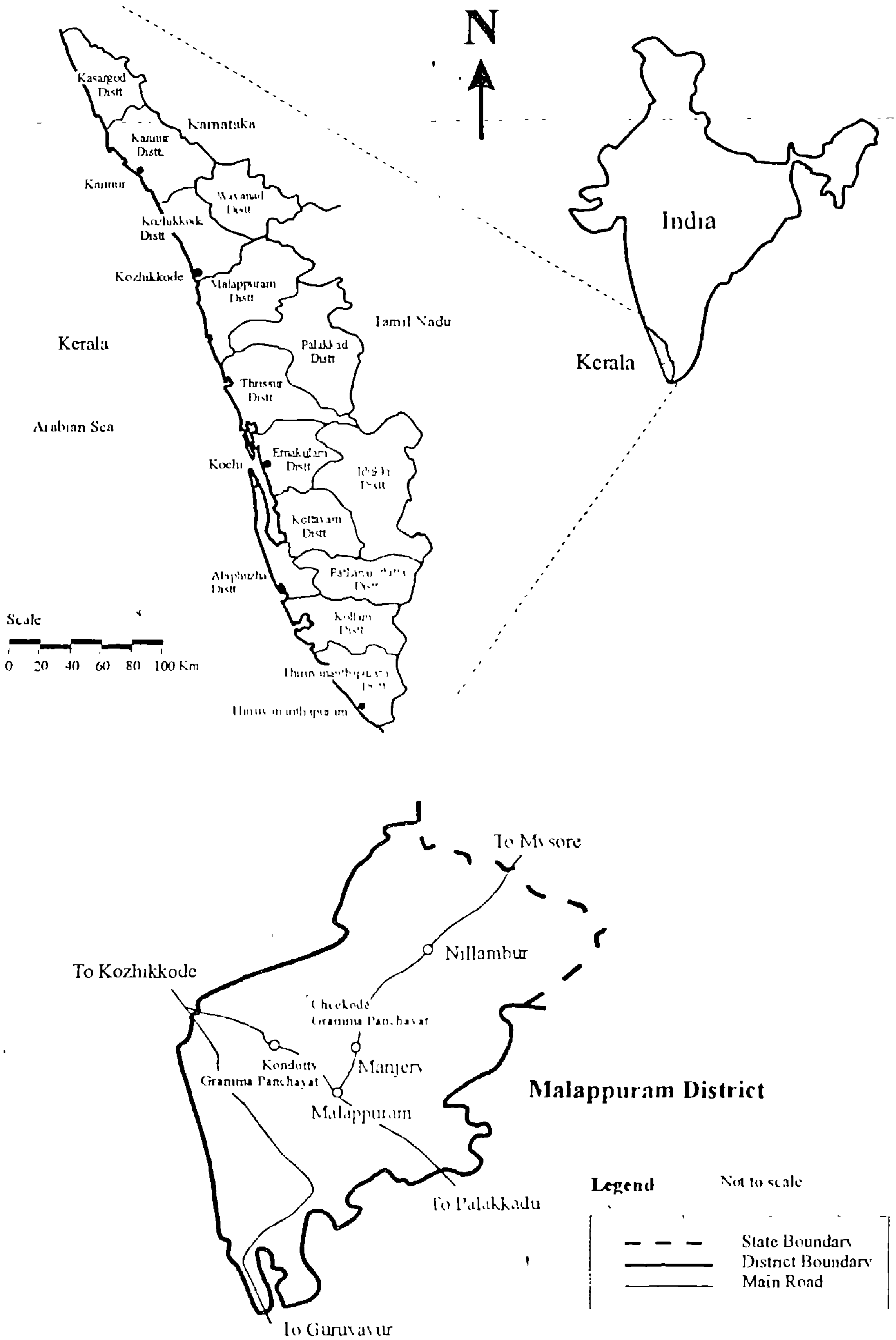


Fig 1 Index Map of Malappuram District

In consultation with the District authorities of Malappuram, three Panchayats representing uplands and midland areas respectively were selected They were

1. Cheekode - Representing Upland features
2. Kondotti - Representing Midland features
3 Perumbadappu - Representing Coastal area

Due to several practical problems, the work at Perumbadappu (coastal region) could not continue Fig 2 illustrates the location of the Pilot Panchayats Table 1 furnishes a summary of salient features of these Panchayats

Table 1 Salient Features of the Pilot Panchayats in Malappuram District

Panchayat details	Chekode	Kondotti
Taluk	Eranad	Eranad
Village	Muthuvallor	Kondotty
Area	46 72 Sq Kms	10 72 Sq Kms
Number of Wards	15	10
Total Households	8272	3429
Scheduled Caste Households	1050	391
Male Population	20836	10793
Female Population	21281	11120
Total Population	42117	21913
Scheduled Caste Population	4754	3698
Number of Water Scarce Locations	83	55
Number of Problem Households	2456	1343
Percentage of Problem Households	30 %	40

2. Strategies

As in the case of any pilot programme, the strategies and procedures were very flexible and were refined as the programme progressed. However, some broad principles followed by TSU were

- The planning and implementation of all the Panchayat level components of the programme (excepting the technical experimentation structures) would be done by the respective forums of the Panchayats through the Neighbourhood Groups -NHGs, after pooling the capital share from SEUF and State funds
- Until the local institutions attain the necessary capacity, as an initial strategy, TSU would assume the role of an implementing agency at the Panchayat/Block level This would also facilitate on-the-job training and capacity building
- The extent of financial support would be restricted to partially covering the problem villages through construction of demonstration structures only The emphasis would be on institutional aspects of planning, implementing and managing the systems and the mobilisation of local resources
- Regarding selection of the beneficiaries, TSU would fully depend up on the existing Panchayat institutions However, priority would be given to those who were willing to organise into groups, and top priority would be given to women groups.
- Substantial sharing of capital cost and full sharing of O&M cost was one of the important components for planning For this reason, TSU would aim at/encourage cost effectiveness in all its activities

3. Planning Principles

The success of community based development programmes greatly depends on the process in which it is developed/planned and TSU has attached great importance to this

However, the experience of the Pilot Project has revealed that there are many constraints in adapting even certain basic principles of planning for sustainable programmes, which will be discussed later Following planning principles/assumptions were followed

- Generally, the problem areas occur mostly in small and isolated clusters of 20 to 40 houses
- The planning should start at participatory workshops with members of the problem clusters. At first, the existing problem was understood clearly, using the Ward Resource Advantages and disadvantages of various possible alternative solutions were discussed keeping the environmental, financial and institutional sustainability in mind This was followed by selection of the most appropriate solution (Table 3 1) These discussions were moderated/guided by experienced resource persons
- Establishing the adequacy (quantity and quality) and sustainability of the sources through a minimum series of scientific tests prior to preparation of plans and estimates was mandatory.
- All the piped water supply schemes would be with house connections and the per capita supply would vary from 20 to 50 lpcd, meaning that a scheme would be considered infeasible if the per capita water availability was less than 20 lpcd and even at places where the water availability was more, the supply would be restricted to 50 lpcd to control overdrafts

3.1 Technical Models of Decentralised Water Supply Systems

The problems related to water supply and their respective solutions are given in Table 3 1 These have been developed in the light of the following

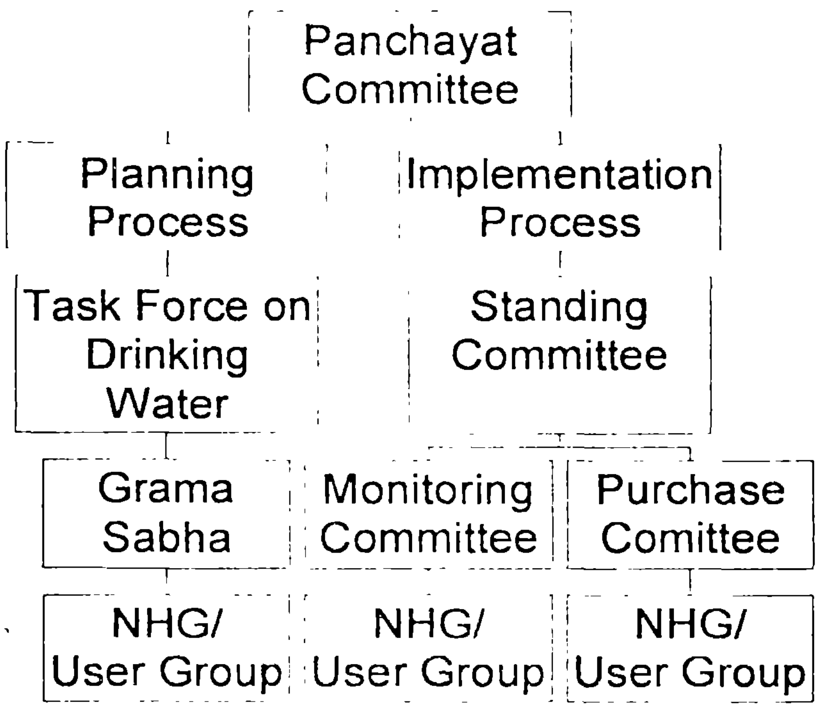
- Tentative findings of TSU on the technical feasibility, financial viability and sustainability
- Study of similar systems in other areas and adaptation to local situations

These technology options were not only environmentally sound and user-friendly but also capable of creating plenty of employment and income generating opportunities Although few options may not be applicable to some places, this table provides search logic for options (if the first option is not applicable then one needs to go to the next and so on) More technical details of these options are given in Annexures 1 to 3

4. Institutional Arrangement

As per the provisions of the Panchaytiraj act of Kerala, the fund allocation and the tentative planning are done at the Panchayat level, followed by the detailed planning at the Grama Sabha The Panchayat would do the implementation either through the User Committee (UC) as a Convenor or through the respective line department The TSU found that this arrangement could be made conducive for planning of sustainable community-based WS&ES programmes

The institutional arrangements at the Panchayat Level as per the People's Planning Campaign are as follows



TSU has introduced the following modifications in the institutional arrangement, which did not violate the provisions of Panchaytiraj Act, and were found to be acceptable to the Panchayats, Gram Sabhas, and the NHGs

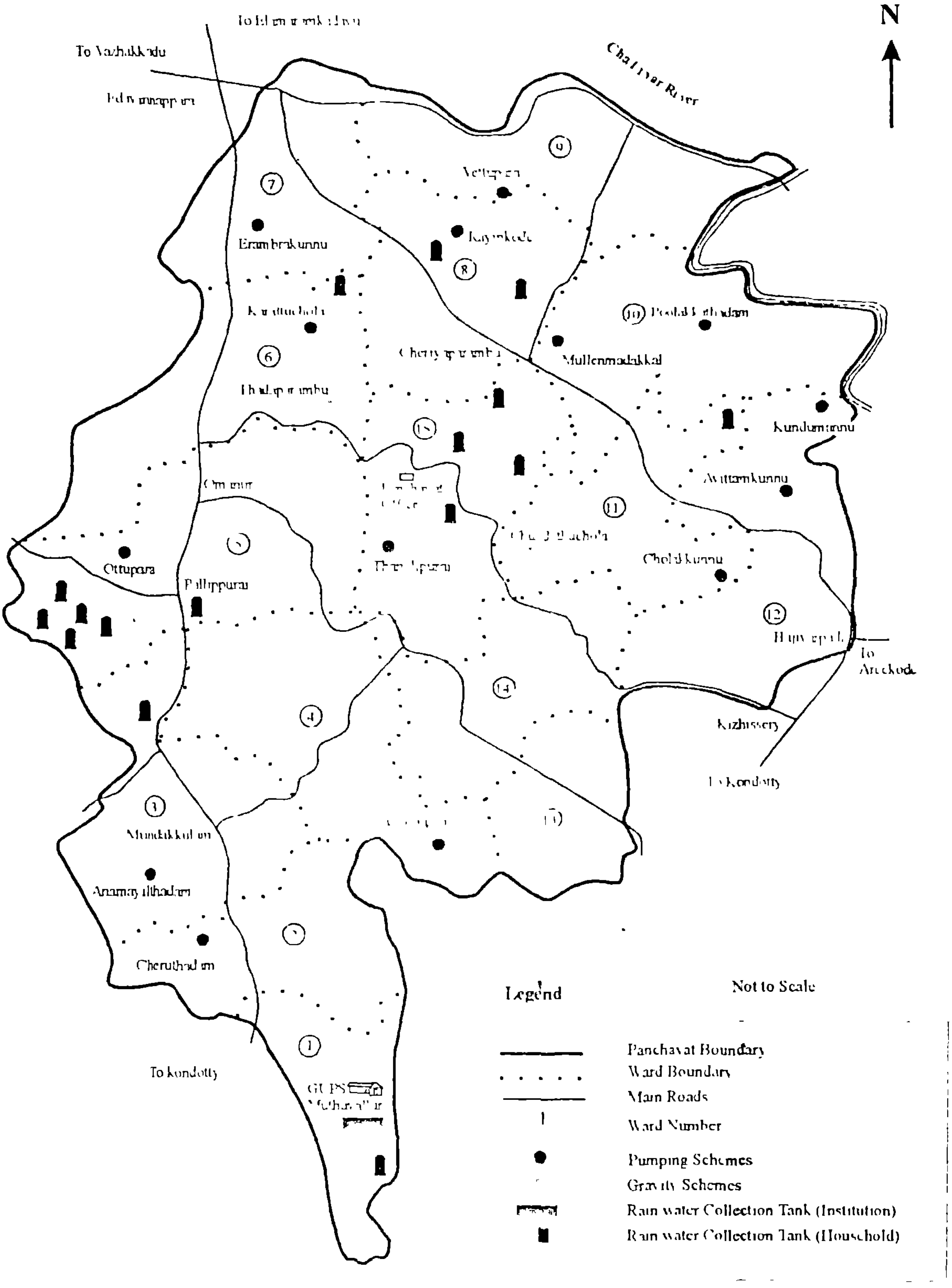
- The NHGs/UCs must be made mandatory
- While the fund allocation and prioritising sector/areas could be done at the Grama Sabha and Panchayat level, detailed planning should be done at the NHGs/UC level
- Normally, TSU would ensure an efficient planning and implementation of water supply systems by requesting Panchayats to comply with the basic guidelines (2, 3, and 3 1) However, wherever the capacity of Panchayat and Ward level functionaries, Task Force, and the NHGs were found to be extremely limited as far as planning and implementing sustainable water supply systems were concerned, and if the Panchayat wished so, the responsibility of detailed planning and implementation of the entire Water Supply Plan could be vested with TSU on a turnkey basis, who would do the same in consultation with and participation of the NHGs and Panchayat
- O&M of the systems created in the rural areas would be vested with the UCs/NHGs

Table 3.1. Solutions for Water Supply Problems

Scope (in the order of preference)	Solutions for various problem categories							
	For households facing water problem for less than 3 months				For households facing water problem for more than 3 months			
	Scattered	Dense <15	Dense (15-50)	Dense >50	Scattered	Dense <15	Dense (15-50)	Dense >50
1.Manual Drawing Systems (Source<100 m)								
Scope of improving existing draw wells	IWR	PWR			IWR	PWR		
New Open Draw Well						Yes		
Developing Springs						Yes		
Rehabilitation of Existing Hand Pumps		Yes				Yes		
New Hand Pumps						Yes		
2.Gravity Pipe Supply (Source>100 m), and community would be able to share capital cost								
Spring yielding > 160 lpd/ family and a gravity main length <25 m/family		GS	GS	GS	GS	GS	GS	GS
Stream water needing treatment yielding > 160 lpd/ family and a gr main length <25m/family		GST	GST	GST	GST	GST	GST	GST
Ponds/Quarries needing water treatment with mean annual storage of 30000 l/ family and a gravity main length <20 m/family		GST	GST	GST	GST	GST	GST	GST
3.Pumping Schemes (Source>100 m), and community would be able to share capital cost								
Spring yielding > 160 lpd/ family and a pumping main length <25 m/family			PS	PS			PS	PS
Existing bore wells yielding > 40 lph/family and pumping main length <25 m/ family			PS	PS			PS	PS
Existing Open wells yielding 15000 – 20000 lpd and a pumping main length <15m/family			PS				PS	
Existing Ponds needing water treatment with mean annual storage of 30000 l/ family and a pumping main length <15 m/family			PST				PST	PST
Stream water needing treatment yielding > 160 lpd/ family and a pmp main length <25m/family			PST	PST			PST	PST
New bore wells yielding >50 lph/family and pumping main length <10m/family			PS	PS			PS	PS
New Open wells yielding 15000 – 20000 lpd and a pumping main length <15m/family			PS				PS	
4.None of the above	RWH	RWH	RWH	RWH	RWH	RWH	SPS	SPS

IWR — Individual Well Rehabilitation to improve the quality and yield of the well
PWR — Public Well Rehabilitation to improve the quality and yield of the well
GS — Gravity Schemes based on springs with individual house connections
GST — Gravity Schemes with Slow Sand Filtration & Chlorination with house connection
PS — Pumping Schemes with house connections
PST — Pumping Schemes with Slow Sand Filtration & Chlorination with house connection

SPS — Special pumping schemes from far sources, sometimes requiring treatment
RWH — Roof Water Harvesting



SEU Supported Community Based Water Supply Schemes in Cheekode Gramma Panchayat

5. Project Cycle/Process

As mentioned earlier, the entire process of planning and implementing water supply schemes in the pilot area was done as per the recommended procedures of the Peoples Planning Campaign However some innovative elements were introduced to further reinforce, accelerate and ensure transparency of the entire process The Table 5 1 illustrates the step-by-step procedures in the entire project cycle It may be noted here that the actual sequence of activities presented here are slightly different from what actually happened in the field, because of practical reasons such as unexpected rains, and the requirements of Panchayats to show physical and financial progress before 31st March But with little more systematic planning, these problems can be overcome in future and this project cycle can be followed

5.1 Planning Process

5.1.1 Preliminary Panchayat Meeting

Every Panchayat may have developed one 5-year plan in which plans were also incorporated for WS&ES sector The problem locations and the tentative solutions for each Ward were also discussed in these plans From this, the most deserving and priority areas (Wards) to be tackled in the succeeding plan year were selected during this meeting

In a meeting of the Panchayat members, TSU representatives would explained the outline of the Programme, planning principles (3 1) and the general strategies proposed (Chapter 2) in planning, implementing and maintaining the schemes Fig 3 illustrates Proposed water supply schemes for Chekode Panchayat

5.1.2 Orientation in planning and implementing community managed water supply schemes

In a joint workshop with TSU, the Panchayat and Block level functionaries involved in planning, the new concepts, strategies, and principles of planning water supply schemes are discussed, and internalised by all

5.1.3 Grama Sabha (Ward Level) Meeting

Public meetings were held in all the selected problem wards where the programme in general and the purpose of studying the problem in detail and preparation of database was explained Few resource persons and volunteers were identified to assist in such resource survey

5.1.4 Participatory Resource Inventory & Bench Mark Survey

Ward Level Resource Maps

TSU provided training to the selected volunteers in the resource mapping and household (Bench Mark) data collection After the training, under the supervision of TSU, resource maps were prepared for the selected wards using the revenue cadastral maps as base maps Following information were are mapped

1 Survey boundaries, roads & footpaths
3 All houses (with House Nos), shops, temples, mosques, schools, etc
4 Water supply status of each house (severity of problem)
5 Water sources (wells with status, tanks/ponds, springs, and streams)

A typical ward resource map is illustrated in Fig 4

Table 5.1. Various Processes of Pilot Programme

S No	Activity (output)	Actors/Participants	Role	Input from TSU
1	Approval of Five year Plan of Panchayat	Task Force, Dev Seminar.PanchayatCommittee Planning Board	Preparation, Approving	Nil
2	Approval of Annual Plan of Panchayat, Sector Prioritisation, Financial Allocation	Task Force, Grama Sabah, Panchayat Committee .DLEC	Preparation Approving	Reference Centre for RWS
3	Orientation in planning and implementing community managed water supply schemes	GP Member, Task Force, Local Resource Person Key Resource Person	ParticipatoryLearning	Awareness Raising/Orientation
4	Ward wise Resource Mapping, Data base	Local Resource Person Ward Member	On the job learning Support	On the job training of LRPs
5	Organising community in problem area (NHG)	User Group, Ward Member LRP	Participates, Leads, Motivates Guides, Facilitates	Trains LRPs in organising, awareness building
6	Source Identification & Assessment	User Group (NHG) LRP	Assists Technical Studies	Trains LRP
7	Survey, Plan, Design & Estimates	Technical Staff/LRPs User Group	Design&Estimates Assists	Trains Technical Staff & LRPs in topo survey, designs, introduction of cost efficient options
8	Preparation of Draft Micro-Plan for CMWSS	Task Force Ward Member	Prepares Plan Assists	Guides Task Force
9	Approval of Micro-Plan	Grama Sabah Panch.Committee	Reviews Approves	Facilitates & Technical Counselling
10	Orientation to BLEC	BLEC Members, Panchayat Presidents Task Force Members	Participatory Learning	Orients and facilitates in preparing guidelines for according Technical Sanction
11	Technical Sanction of Schemes	BLEC	Technical Sanction	Advisory

12	Formalising User Groups	LRP User Group	Facilitates. Election of Committee members, Registering, Opening of Bank Account. Collection of user share	Training the LRPs, Training User Committees in Book/Account Keeping, Explaining the role during implementation, Purchase of local material, Surrender of lands for source, tank
13	Formation of Purchase Committee	Convenors of User committees. Panchayat President, Panchayat Secretary, Task Force Chairman, TSU	Preparation of Procurement Criteria	Advisory
14	Procurement of Materials	Purchase Committee User Committee	Pipes, Pumps etc Cement, Sand etc	Advises on Quality
15	Construction	User Committee Technical Staff LRP	Logistic Support Tech Supervision	Training in low cost/new technologies. Tech guidance
16	Progress Review	Convenors Forum Panch Mont Committee	Problem Sharing Progress Review	Facilitation Socio-Technical Counselling
17	Trial Run	Convenors of Usr Comm LRP/Tech Staff. Local Plumber/Electrician	Inspection Rectification Training in O&M	Training in O&M Technical Counselling
18	Establishing O&M Management System	Panchayat User Committee	Tariff fixation. Procedures for handing over the system to user committee, Identification of support service system for O&M	Facilitates
19	Commissioning of Scheme & Handing Over	Ward Member User committee. Technical Staff	Completion certificates. igning of agreements formal handing over	Nil

Bench Mark Survey

This database would be required to assist in planning as well as comparing the impact of the schemes The database would generate through a simple household level questionnaire The household survey covered the following information

1 Population details (Adults, children, cattle)
2. Present water availability (quantity, quality, and duration)
3. Present water use (Seasonal, for various purposes)
4 Sanitation, health status

The resource maps were used to delineate the cluster of houses facing the most acute water problems (both quality and quantity), which would then be formed into NHGs

Establishing the adequacy and sustainability of Water sources

This would be done by measuring the yield and quality of the source water during the peak summer While it was relatively easy to study the yield and quality of existing sources, for the new open wells, one had to actually dig a trial well at the most feasible location and measure the yield and quality during the peak summer (Refer Annexure 7)

5.1.5 Short listing Priority Problem Locations

Ward level Grama Sabha meetings were organised in the selected Wards where the respective resource maps, particularly the problematic locations, along with the population to be served were explained Depending upon the severity of problem and other considerations, the habitations and the population to be covered in the succeeding year was finalised Referring to the table 3 1, the types of schemes were tentatively selected

5.1.6 Allocation of Funds

In a Panchayat meeting, tentative Water Supply Plans developed at the selected Grama Sabhas were discussed Tentative fund allocation were then made on the following basis

Manual Drawing Systems

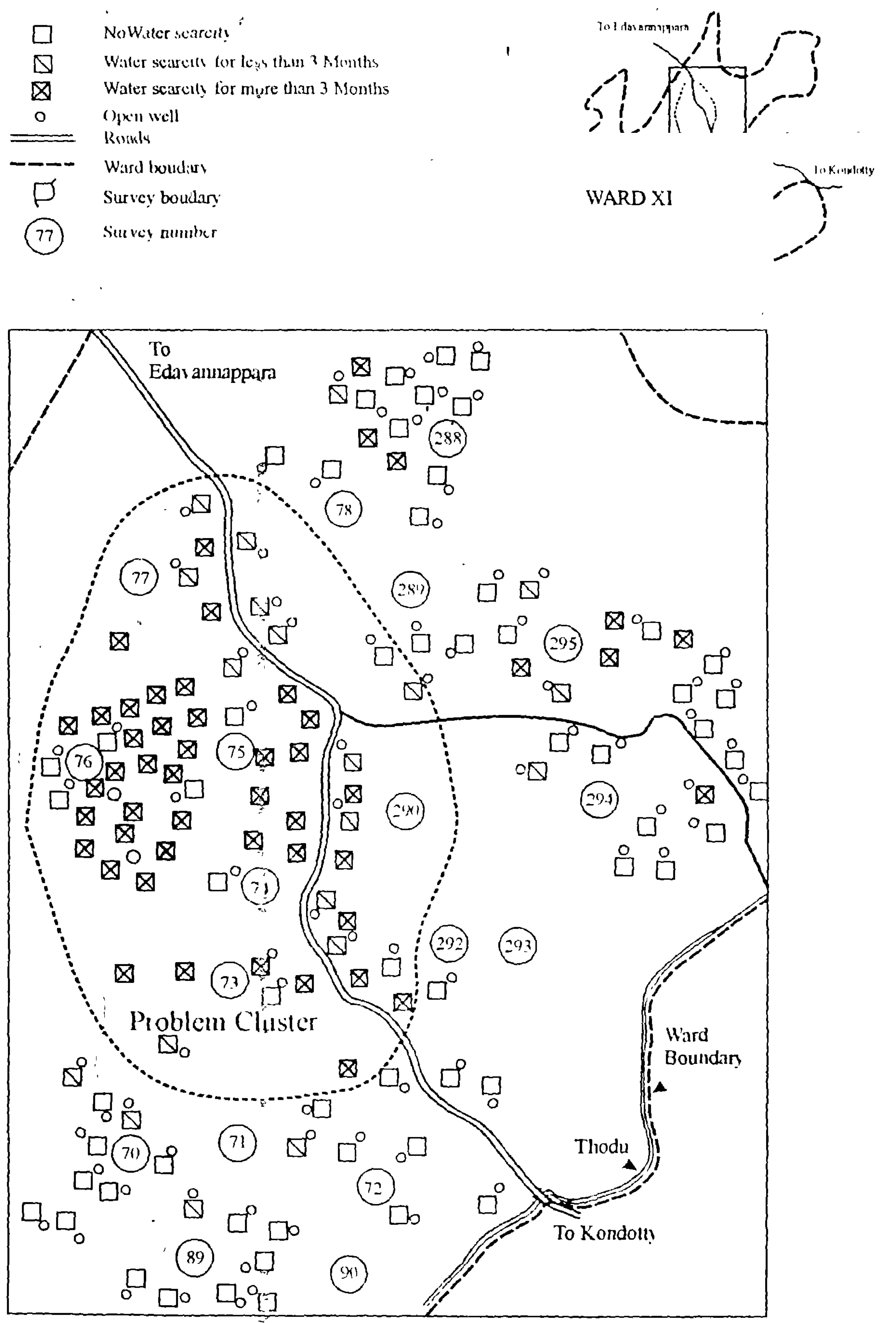
S No	Item	Per Household Allocation (Rupees)			
		Panchayat	User	External	Total
1	Springs	800	200	500	1500
2	Open Wells	1800	200	1000	3000
3	Hand Pumps	900	100	500	1500

Piped water supply schemes

Sl. No	Item	Per Household Allocation (Rupees)			
		Panchayat	User	External	Total
1	Pumping	3000	1000	3000	7000
2	Gravity	2200	600	2200	5000

Roof Water Harvesting Systems

S No	Item	Per Household/Institution Allocation (Rupees)			
		Panchayat	User	External	Total
1	Individual (10 cu m)	5000	3000	7000	15000
2	Institutions (100 cu M)	20000	20000	60000	100000



Not to Scale

A typical Ward Resource Map of Cheekode Panchayat

5.1.7 Approval of Plans by Panchayats

The draft annual plans for all the activities including water supply sector for the entire Panchayat were discussed in the respective Task forces. This was followed by discussion and approval by the Gram Sabha in a "Development Seminar" This plan was then finalised and approved by the Panchayat Committee The TSU assisted in all the processes by providing critical inputs

who took part?

5.2 Motivating & Organising Community

Having approved the tentative plans for water supply schemes, the User community was motivated and organised as follows

5.2.1 User committee at NHG level for Community Water Supply Schemes

A series of meetings were held with the User community to discuss and negotiate various conditions/ strategies for planning, implementing and maintaining the schemes The points under Sections 2 0 and 4 1 were fully endorsed Secondly, the extent, type and method of User contribution were agreed upon in principle A committee consisting of 40% women and 60% men was constituted with an agreement to register under Societies Act later The responsibilities of the committee were tentatively agreed up on as follows

1 Assisting in detailed survey and planning
2 Mobilising User contributions
3 Taking the lead in implementation of the programme under the supervision of TSU
4 Generating a corpus/depreciation fund
5 Managing the O&M of the scheme including collection of water tariffs

5.2.2 User Group for Individual RWH Schemes

The beneficiaries of Roof Water Harvesting schemes were formed into informal groups with the following limited purposes

1 To explain the principles, advantages and limitations of Roof Water Harvesting System
2 To conduct exposure trips to successful demonstration models in the same Panchayats
3 To explain the type, kind and method of User contribution
4 To explain the O&M of the schemes

These groups would cease to exist after the physical implementation of the schemes

5.3 Detailed Planning

This involved detailed technical survey, preparation of scheme maps showing the locations of the source supply reservoir, pipe lines, house connections etc by the TSU assisted by the UC and the trained volunteers As mentioned earlier, TSU gave great importance to cost effectiveness and many cost-effective measures were introduced while designing the scheme These technologies are discussed in Annexures 4 to 6

TSU has developed simple data formats that can be used to collect basic scheme data by a trained villager A computer programme has been developed by TSU for preparation of designs and estimates of all types of schemes Using these tools, it becomes feasible to prepare designs and estimates for a number of schemes in short time Since the chances of these designs & estimates going wrong are very remote, the approval by the Panchayat and BLEC can be very scientific

who were these?

5.4 Resource Mobilisation (Water Supply Schemes)

5.4.1 Mobilising User contribution

In the water supply sector, TSU's experience in cost recovery in Kondotti was pioneering Peoples' contribution went up from nothing (in KWA Schemes) to as high as 40 % in the schemes being implemented with TSU's assistance in Cheekode and Kondotti In fact, now the User share is being stated as a pre-condition in all the schemes Further, fully sharing the O&M costs by the User community was a unique feature of the schemes taken up under TSU. In new schemes, the scope of increasing the peoples share would be explored with the formation of micro credit groups of beneficiaries linked up to financing of water supply User contribution for individual roof water systems is proposed to be raised, as a high demand is expected

The collection of the User contribution was the most time consuming and difficult process. The arguments put forth against such contributions were

- While everywhere, the water supply is free why should this group be required to pay
- The user group was poor and could not afford to pay

The arguments in favour of contribution for piped water supply schemes were

- While the government programmes provided only public taps or hand pumps, the present programme would provide house connections
- The scheme would be planned and implemented by the user group
- The scheme would also be owned and run by them

For the individual Rain Water Harvesting schemes the negative points put forward were

- The cost was very high and the water availability was very limited
- Would the quality of water remain good throughout the year?

The favourable points were

- Users were convinced about the water quality (test results and actual taste) and utility after visiting a demonstration RWH system
- RWH systems were particularly useful where conventional water supply systems were not possible
- The RWH systems would be individually owned
- Water would be available through taps next to the household kitchen
- The RWH systems required little or no maintenance

The User contribution would be collected by the committees and deposited in a temporary joint Bank Account in about 5-6 monthly installments As soon as the entire contribution is received, the amount would be transferred to the PD account of Panchayat against a receipt

5.4.2 Transfer of Panchayat (Plan) and SEUF (Dutch) Funds

SEUF has been recognised as a competent Implementing Agency by the concerned Panchayats through a resolution This means that SEUF can receive the funds from Panchayats and implement the scheme provided the financial and project implementation procedures of SEUF are in compliance with corresponding rules of the Panchayatiraj Act Once the provisional approval of BLEC was obtained, the first installment of Panchayat share was transferred to a TP account of SEUF (opened in the Treasury or a recognised Nationalised Bank) SEUF then transferred a matching share of funds (from the Dutch assistance for the project) into the same account. After the Technical Sanction (TS) was obtained and sufficient progress was made with the first installment, and after the User contribution was received in full, the Panchayat transferred its second installment, along with the User Contribution, to the TP account

5.4.3 Procurement of Materials

A purchase Committee consisting of Panchayat members, Chairman of the Task Force, representatives of the User Committees and officials of TSU decided upon the specifications, supplier/s and supply procedure of various materials For supply of pipes, motors and bulk items, quotations were invited from reputed companies The Purchase Committee studied the quotations and selected a few suppliers, companies and respective products and approved the rates Quality of the products, quick and prompt supply of materials and availability of after sales service were considered to be important factors in addition to a competitive price The actual procurement and payment was done by TSU

5.5 Implementation of Water Supply schemes

5.5.1 Piped Water Supply Schemes

As soon as the committee collected the first few installments of User contributions, the work started simultaneously at all places This is necessary to boost the morale of the beneficiaries After all, seeing is believing Although SEUF was the implementing agency, most of the work (arranging skilled and unskilled labours) was organised by the committee

The digging of trenches for pipelines was done in one or two days by the beneficiaries themselves through free labour in a big festive mood with community lunch, etc The digging of the well was fully done by the committee who called for quotations locally and awarded the work to the most economical and efficient person on contract basis The supervision and payment was also be made by the committee members The payment was reimbursed by TSU after check measurement later Installation of pumps, construction of Ferro cement service reservoir, laying of pipelines etc was done under the direct supervision of TSU

5.5.2 Roof Water Harvesting Systems (Individual and Institutional)

These works were done by TSU with the full participation of beneficiaries Arrangement and transportation of all materials was done prior to the monsoon and the construction started in as many places as possible as soon as the monsoon started and completed by end of September, so that curing could be done properly (all the locations were remote and depended upon rain water for construction and curing) and the tanks could be filled with the NE monsoon

5.6 Progress Review & Monitoring of Water Supply Schemes

The User committees, jointly with TSU reviewed and monitored the progress Only if there were any problem, the matter was being referred to the Panchayat level monitoring committee The convenors of all the UCs met every fortnight at TSU office and discussed the problems However, since the present pilot programme was the first of its kind by TSU its success in quality of construction, community satisfaction and speed of progress was very important to TSU. Due to this reason, weekly review and very close monitoring of progress was done at the TSU level

5.7 Commissioning of Water Supply Schemes

It was decided that the Panchayats would initially hold all the community assets for at least six months and as such the electricity connections for the pump houses would be taken in the name of Panchayat This would be handed over to the User committees after they were registered and had generated a corpus fund The scheme would formally handed over to the BC after the source yield has been tested during peak summer, trial-run of the scheme completed for at least one week and the water quality had been tested and certified

6. Physical & Financial Progress

All the 18 community managed small water supply schemes in Cheekode and four community managed small water supply schemes in Kondotty Grama Panchayat is being implemented as per the schedule and specifications Since open well is the source of majority of the scheme the digging could start only in the last week of April after waiting for the water table to recede While the digging work of 10 wells could be completed as per schedule, due to unexpected early monsoon rain in the second week of May the work in the remaining five wells could not be started One pumping scheme and two spring based water supply schemes are fully commissioned and other schemes are either in progress or completed but waiting for the newer connection The table 6 1 given below shows the progress

Table 6.1.TSU supported community based water supply schemes in Cheekode Panchayat

Sl No	Ward	Scheme area	Population Benefited	Source identified	Estimated Cost (Rs)	Progress (%)	Total Expenditure
1	II	Cheruthadam	550	Well	435937	75	170729
2	III	Anamayilthadam	185	well	162887	75	70861
3	IV	Kuttikkadu	280	Well	202310	70	98800
4	V	Ottupara	110	Well	181411	100	113106
5	VI	Karattuchola	215	Spring	165422	100	111024
6	VI	Thadaparambu	216	spring	111436	100	134581
7	VII	Erambrakunnu	155	Well	156443	100	135608
8	VIII	Rayinkode	215	Well	151118	85	94318
9	IX	Vettupara	120	Well	141607	100	108252
11	X	Poolakkathadam	136	Well	132241	70	45695
11	X	Mullenmadakkal	171	Well	154791	100	107652
12	XI,XII	Cholakkunnu	155	Well	120354	100	102456
13	XI	Chundathuchola	127	spring	111416	100	118805
14	X,XII	Kundumanuu	270	Well	212860	80	75406
15	XII	Avittamkunnu	135	well	135364	75	61406
16	XV	Thanolipurayi	139	Well	142381	70	67355
17	V	Maniparambu	55	Well	44546	100	40615
18	III	Mundakkulam*	210	Bore well	15000*	100	14750
19	I	Kottaparambu*	700	well	30000*	100	28960
20	I	Muthvallur School	700	Rain water	120000	100	121407
21	All	F C Tanks nos 16	95	Rain water	240000	100	223853

Table 6.2.TSU supported community based water supply schemes in Kondotty Panchayat

why fewer?

Sl No	Ward	Scheme area	Population Benefited	Source identified	Estimated Cost (Rs)	Progress (%)	Total Expenditure
1	V & VIII	Kottaparambu*	900	Well	450000	100	44300
2	IX	Thaithottam	325	well	100000	75	
3	I,III,IV	Cheppilikunnu*	280	Well	30000	100	29465
4		F C Tanks nos 9	55	Rain water	135000	100	112898

*SEU supported only in FC Tank construction

7. Capacity Building

The present project area is one of the most backward (Socially & Economically) districts in Kerala State Ample stress was given in the project implementation strategy for gender development and poverty alleviation through the capacity building training programme Stress was also laid on developing the Panchayat level capacity in planning, implementing and maintaining community managed water supply schemes The following training programmes were undertaken

User committee members

i Planning and Team building
ii Operation and Maintenance
iii Water literacy & projection of source
iv Simple book-keeping and accounting
v Society registration/Day to day running of societies

Users

i. Health and hygiene awareness
ii Maintenance of water points

Local Volunteers (Block)

i Resource Mapping
ii Topographic survey

Local Technicians

i Plumbers
ii Electricians

Panchayath Members, Task force Members (Water and Sanitation) & BLEC members

i Planning and Implementation of Small water supply programme
ii Low cost Technology
iii Technical assistance to the BLEC for technical sanction of panchayath projects

Mason Training for Women and Men

i Basic construction for women
ii Ferro-Cement Tank construction for Women and Men
iii Stand Post, Sock Pit & Drainage construction for Women

Table 7.1. Number of Trainees

Training Programme	Women	Men	Total
Resource Mapping	8	20	28
Community Organisation	7	16	23
Book Keeping for Society Convenors	8	24	32
Ferro-cement Construction	4	12	16
Electricians & Plumbers	-	8	8
Women Mason	6	-	6

8. Findings & Conclusions

8.1 Institutional

- The institutional arrangements of Panchayatiraj system of Kerala, particularly the Neighbourhood Group recommended as the smallest unit of planning is ideally suited for planning, implementing and managing small community managed water supply schemes, provided effective steps are taken to increase the awareness, capacity and capability of Panchayat and Block level functionaries
- Through series of consultations and meetings conducted by the trained community organisers, the families (particularly women) of the NHGs were organised and registered as user associations under Societies Act and were prepared to take up the tasks of implementation and management of the schemes. They received the funds from Panchayat including its own share and implemented the scheme under the provisions of Peoples Planning Campaign assisted by the trained cadre Subsequently the Panchayat transferred the entire assets to these associations for maintenance under a written agreement with clauses of taking over by Panchayat on request from majority of users
- The society collects necessary water tariff from the user families and carries out the O&M of the scheme by hiring the services of the trained plumbers and electricians

8.2 Project Tenure

- The prevailing concept of planning and implementing the scheme in the same financial year (April-March) is not conducive to planning water supply systems, especially when the source has to be newly created.
- As the scheme can be designed only after the yield is tested in the peak summer, the project spills into the next year. In order to avoid such spills and to "show" progress, the normal observed practice is to risk completion of the water tanks, the pipelines, pump houses and even installation of pumps The well is done in the last during March. In many cases, it was reported that well failed to yield adequately in which case the entire investment is wasted
- Hence normally, the water supply schemes require two years to complete planning and implementation.
- One good suggestion that is worth considering is to adopt the following steps

   1. To take up only source development/creation in all the priority problem locations of the Panchayat in the first year and complete this job by March Organising the community and collection of community share can also be taken up during this period.
   2. All the sources are tested for yield and quality in April, and depending up on the water availability, apply for electricity, design the schemes and prepare the plans & estimates for water supply, to be completed by December. By that time, the power supply would have been availed and the scheme can be commissioned by January

natural environ/nature-based rather than administration based cycle.

8.3 Technical

- Small community managed water supply systems were ideally suited for rural Kerala because:
  - Water scarcity occurred in small isolated clusters of 40 to 50 houses
  - There were always local sources that could supply enough water on a sustainable basis to small number of families
  - Such systems avoided over-exploitation and its environmental impacts (depleting aquifers, salt-water intrusion) as the systems were managed by the community.
- Participatory Studies such as Resource Mapping, data base generation and establishing the sustainability (quality and quantity) of the water source through minimum scientific tests are to be made compulsory prior to designing and implementation of the scheme.
- The community should chose the basic design criteria such as per capita daily supply and type of supply based on the above studies and ability to pay for different service levels.
- Various technical options such as small pumping schemes, gravity schemes (tapping perennial springs), Roof Water Harvesting Systems, revival of Traditional Sources such as ponds and wells etc , are to be considered by the community along with their long term merits and demerits before finally choosing one particular option (a "cafeteria" approach)
- There is a great need and scope for introducing cost effective0 technologies.

8.4 Social

- Although majority of the user community were poor, they shared 30% to 40% of the capital cost depending upon the type of supply (street taps, house connection, Roof Water Systems)
- Community managed and fully paid for the Operation and Maintenance of the Schemes.
- The collection of the User contribution was the most time consuming and difficult process. The points put against such contributions were:
  - While everywhere, including urban areas, the water supply was free why should these users pay?
  - They were poor and could not afford to pay
- The attractive points in favour of contribution for piped water supply schemes were:
  - While the government programmes provide only public taps, or hand pumps, the present programme provides house connection, which was very important for a Keralite
  - The scheme would be planned and implemented by them.
  - The scheme would be owned and run by them
  - The payment could be made in instalments.
  - The users were convinced about the satisfactory construction, fast completion and good performance.

Influence transparency ?

- For the individual RWH schemes the negative points put forward were as follows:
  - The cost was very high and the water availability was very limited
  - Whether the quality of water would remain good throughout the year or not
- The favourable points for RWH systems were:
  - Users were convinced about the water quality (the test result and the taste) and utility after visiting the demonstration model
  - The beneficiaries were situated in places with no scope of alternative water supply system.
  - The systems would be individually owned.
  - Water would be available through taps next to kitchen.
  - Little or no maintenance was required
  -

8.5 Economics

8.5.1 Capital Cost

Some of the typical financial parameters for capital cost of water supply systems, which are tentatively emerging, for the midlands and hilly areas of Kerala are as follows:

Table 8.5.1 Average per capita investment for Water Supply Schemes

Item	User		Plan/Panchayat		External		Total	
	%	Amount	%	Amount	%	Amount	%	Amount
Pumping Schemes	27	288	43	458	30	319	100	1065
Gravity Schemes	48	336	21	147	31	217	100	700
RWH (10 lpcd)	21	534	29	738	50	1273	100	2545

8.5.2 O&M Costs

The O&M costs of open draw wells and roof water systems are considered to be negligible. The community did not consider hand pumps feasible, as there was a large percentage of rejection by users. The O&M cost of piped water supply schemes based on the pilot project where experience was available, was as follows

Table 8.5.2 Average Annual O&M cost per family for
Small Piped Water Supply Schemes (50 lpcd)

Type	Fixed Cost	Energy Cost	Repairs & Spares	Total	No Of Families	Cost Per Family
Pumping	2400 00	2400 00	2400 00	7200 00	40 00	180 00
Gravity	2400 00	Nil	1200 00	3600 00	40 00	90 00

8.6 Benefits Accrued

- The benefits of water supply projects in rural areas (with house connection) were all intangible and amounted to increased convenience as follows

  - Saving of about 3 to 4 hours of time that was used for fetching water.
  - Avoid walking about 2 Km daily (3 trips of 300 m to the old water source) with water pots
  - Availability of more water for consumption
  - Increased scope of wage earning by women amongst working class.
  - More attention to children particularly the school going ones
  - Reduced physical strain and increased leisure time for women

Financing, financial management, accountability?
(Water rates)

⇒ Potential for replication? Institutional Arrangements?

Annexures

List of Annexures

Annexure I

Community-Managed Piped Water Supply Systems

There are many pockets in Kerala with good ground water potential For this reason, piped water supply systems, based on pumping from open/bore wells designed, implemented, owned and maintained by small communities existing in the rural areas since decades This means, that this technology is well known in rural Kerala and there is still tremendous scope for introducing similar systems in a large scale

1. Advantages of Community-Managed Piped Water Supply Systems

Small community based piped water supply systems based on ground water have the following advantages over other types of bigger piped water supply schemes

1 Danger of over-exploitation of ground water is less
2 Investment cost per capita is less because the source is located nearer to the supply region and all the residents of the supply region suffer from water shortage
3 Community is willing to own and maintain these systems by sharing the capital and maintenance cost because the size is small, technology is simple well known and affordable, and above all, scope of ensuring reliable performance

2. Need for Establishing the Sustainability of the Source

The present strategies of designing ground water-based pumping schemes has resulted in either over-exploitation of ground water in certain regions or under-utilisation in other regions The main reason for this is absence of any scientific planning Detailed hydrogeological investigations, aquifer system studies to establish the aquifer parameters, annual recharge, ground water system boundaries, detailed water balance studies and ground water budgeting are essential pre requisites before launching ground water exploitation programmes

3. Suitability

1 Regions with extensive aquifer systems and good recharge potential, established through scientific studies
2 Regions where the threat of salt water intrusion is not impending
3 Ground water quality is acceptable established through scientific tests and user preference

4 The beneficiary house holds should not exceed 100 and should be living in a continious compact area

5 The horizontal distance from the source to the highest point in the supply region should be less than 1000 metres

3 Advantages of Ground Water Based Systems

1 Capital cost per unit of water produced is minimum

2 No treatment required in normal conditions

4 Disadvantages

1. Can be supplied only through pumping or manual lifting

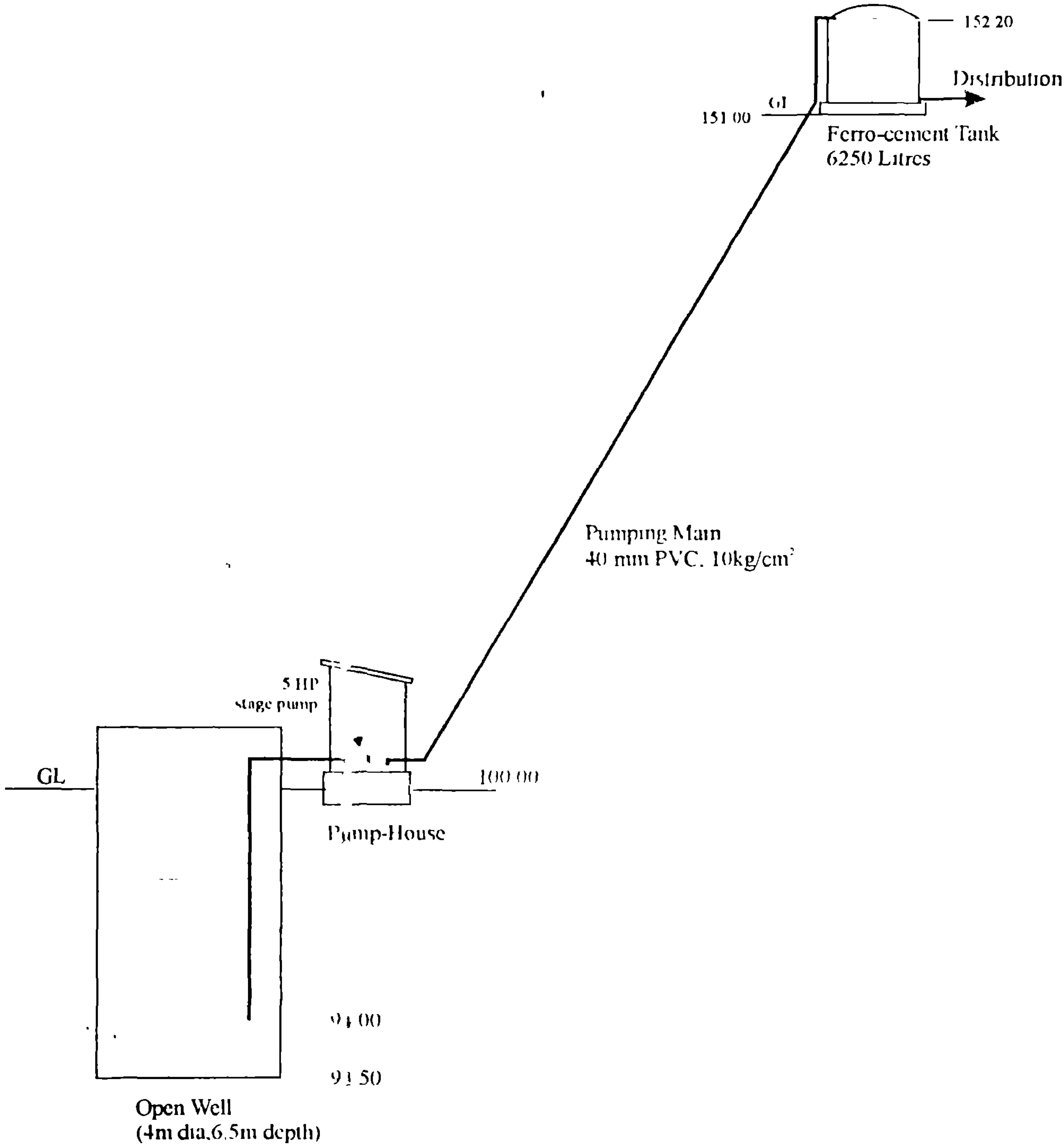
2 If not properly monitored and carefully exploited can lead to the overdraft of ground water and source failure

3 If not scientifically planned, bore well schemes might adversely affect the neighbouring open wells

5 Technical specifications of a typical Water Supply Scheme (Source - Open Well)

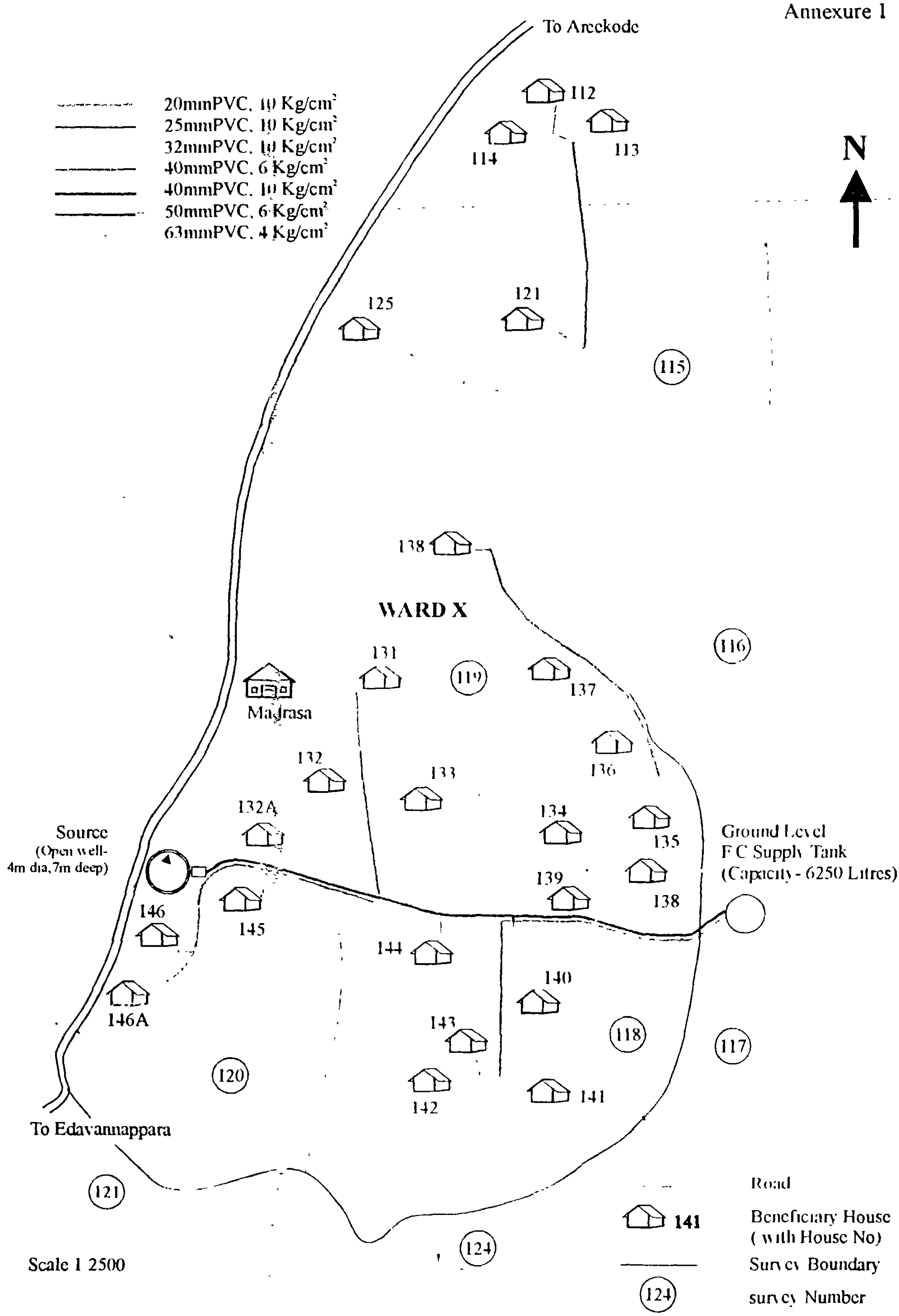
1	Diameter of well	=	4m
2.	Depth of well (below Ground)	=	6 5m
3.	Benefitted population (27 House holds)	=	185
4	Daily demand	=	50 Lpcd
5	Total Pumping Head	=	70 m
6	No of Pumping Hours	=	4
7	Disharge of Pumping Main	=	3000 LPH
8.	Pumping Main (40mm PVC, 10kg/cm^2)	=	270 m,
9	Distribution Lines (20mm to 63mm PVC)	=	1475 m,
10.	Pump House	=	1 2mx1 7m
11	GL reservoir (ferro-cement) 6 25 Cu m capacity	=	2 7 m dia 1 2 m high
12	Lining in RR masonry (below ground)	-	6 5m, 23cm thick
13	Parapet wall in RR masonry (above ground)	=	0 9 m
14.	Pump	=	5 HP (Stage Pump)
15	Distribution	=	One Tap per Household

Annexure 1



Schematic Diagram of a Typical mini Pumping Scheme

Annexure 1



Scheme Map of a typical Water Supply Scheme

Annexure 2

Spring Protection & Development

Springs are ground water out-crops in hilly areas Interestingly, a majority of people living in the hilly tracts all over kerala are still dependant on natural springs, although many of them are at the verge of drying up, thanks to the indiscriminate deforestation Hence today the first step in spring development is to regenerate the springs Protecting them from sources of contamination is another important consideration If protected well, springs can provide safe, potable and palatable drinking water to a small community on a sustainable basis

1 Suitability

Developing springs as a source for rural water supply is ideally suited for the following situations

1. The springs are perennial (at least discharge at the rate of 20 lpcd during peak summer) and of good water quality (to be tested for chemical & bacteriological contamination)
2. Chance of polluting the catchment is minimum
3. The beneficiary population lives within close proximity of the springs preferably in the down stream areas of the springs

The spring water collected in the chamber can be supplied to the consumers through gravity pipe where the community is living in the downstream areas

2 Advantages

1. The cost of source development is significantly low
2. Easy to construct and maintain by the local communities
3. The maintenance cost is negligible
4. As long as proper catchment protection measures are ensured, the source is sustainable because only the naturally flowing water is extracted
5. Traditionally used system and local community has good knowledge about protecting, developing and using the spring sources

3 Disadvantages

1. Usage is limited to hilly tracts with perennial springs
2. If the spring catchment is not properly protected, the springs may either dry up or become unsafe for drinking

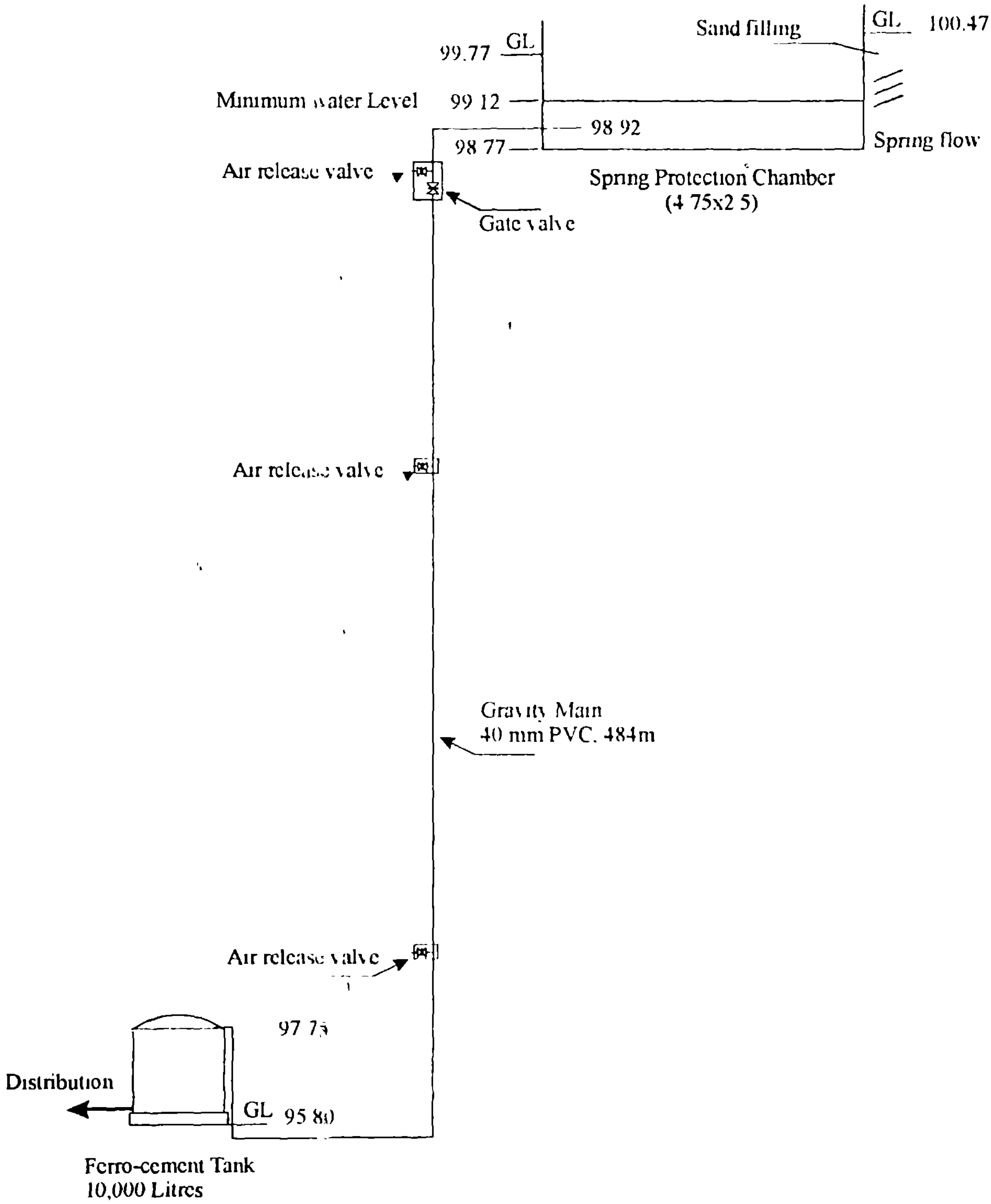
In view of the above, the hilly tracts of both the mid lands and western ghats of Kerala are suitable for spring development

4 Design Assumptions

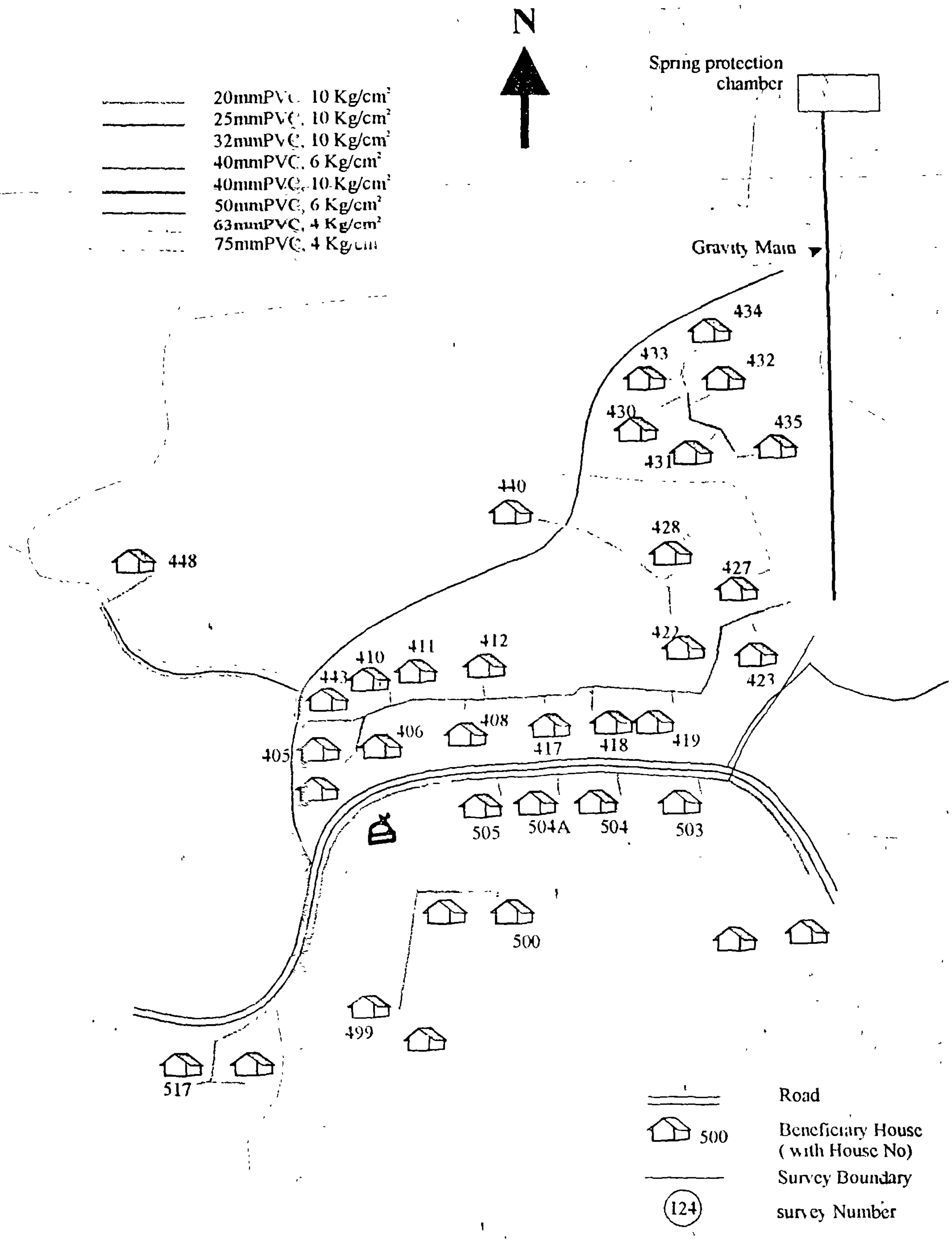
1. The spring is perennial with minimum discharge rate of 20 lpcd
2. The benefitted population lives within 1Km from the source
3. Water quality is acceptable as per test results and peoples taste preference
   Turbidity level is below 5 NTU even during the monsoon period
4. Demand is about 20 to 50 lpcd
5. Benefitted population is about 250 (50 house holds)
6. Catchment area is about 100 Ha
7. Community lives more than 10 m below the spring level

5 Technical Specifications of a typical Scheme

1	Discharge of the spring	=	500 lph
2	Benefitted population	=	200 (35 households)
3	Supply rate	=	50 lpcd
4	Spring Protection Chamber	=	4 25mX2 5mX1m
5	Gravity Main (40 mm PVC, 6Kg/cm²)	=	484 m
6.	Supply Tank (18 hours storage) (Standard Ferrocement Tank)	=	10,000 Lt (10 Cum)
7	Distribution Lines (20mm to 75 mm PVC)	=	1047 m
8	outlets	=	house Connection



Schematic Diagram of a Typical Gravity Scheme



Scheme Map of a Typical Gravity Water Supply Scheme

Annexure 3

Roof Water Harvesting Systems in Kerala

The uplands and mid lands of Kerala are characterised with several isolated and scattered habitations facing acute water scarcity where no conventional water supply systems are feasible. Rain Water Harvesting (RWH) is found to be the most, if not the only, appropriate solution in such areas Attempts are being made to develop, adapt and propagate various designs of RWH suitable to varying site conditions However, it should be borne in mind that all types of RWH systems are designed to store and collect rain water to meet the drinking and cooking needs (10 lpcd) of households for about 100 to 180 days of non rainy periods Another requirement is hard roof that gets cleaned with the first two or three showers.

1. Suitability

Roof Water Harvesting systems are ideally suited to the following situations

1 At localities where the rainy days in a year are spread in such a way that the storage requirements are reduced to the minimum In most parts of Kerala, the tank starts filling in May and gets constantly replenished until end of October. This means the maximum storage required is for about 200 days in a year However, there are many localities where the water scarcity is felt only for two to three months in a year At such locations, the storage is required only for three months (say 100 days)

2 The roof is of a hard surface and thatched roofs should be avoided

3 At localities where all the other cheaper and sustainable alternative water supply systems such as decentralised piped water supply schemes (Springs, wells, bore wells, rivers, ponds) either by gravity or small head pumping are infeasible.

The remote and hilly tracts with scattered population and coastal areas with saline water problems are ideally suited for RWS in Kerala

2. Advantages

1. Simple design and easy to construct and maintain
2. Assured water supply
3. Cost-effective compared to piped water supply systems with long dead pipe lines
4. Negligible maintenance cost
5. Owned and managed by the beneficiary and as such maximum care will be taken to maintain and avoid wastage of water

3. Limitations

1. Initial cost (Rs/Litre) is high
2. Can supply only the minimum requirement (for drinking and cooking)

Design assumptions for a standard unit

1	Minimum Roof area	:	15 Sq m
2	Type of Roof	=	RCC/Tiled
3	Average Rainfall	=	2500 mm
4	Run off coefficient	=	80%
5	No of family members	=	5
6	Per capita supply (drinking)	=	10 litres
7	Storage requirements for	=	200 days (Ignoring refilling due to summer showers)
8.	Water collection method	=	The drainage pipe from the roof feeding a tank through a sand filter

4. Technical Specifications

4 1 Individual Houses (200 days storage)

1	Storage required (200X5X10)	=	10000 Litres
2	Type of storage tank	=	Ferro-cement Tanks (20 mm thick walls) kept outside the house close to the external wall
3.	Number of tanks	=	1
4	Size of tank	=	2 7 m dia and 1 80 m high
5	Foundation	=	Laterite masonry, 30 cm AGL and 25 cm BGL with 5 cm thick concrete floor
6	Cost per litre	=	Rs 1 2 – 1 8

4 2 Converting Abandoned Open Wells into Rain Water Storage Tanks

Like any other regions of rural Kerala, people have invested massively on open wells in lateritic areas. Many of the wells dry immediately after the rainy season and as such are abandoned by the owners

The high rainfall notwithstanding, the highest water table in the high lateritic regions is about 5 m below ground during the monsoon, whereas the water table drops as deep as 10 to 15 m below ground during summer For this reason, the wells in the lateritic regions are quite deep Many wells end in massive rock On the hilly areas, the bed rock slopes steeply causing rapid drainage of ground water These are the wells that remain dry for three to four months in a year
There are two basic features of wells in lateritic regions ending in rock that remains dry during summer

1 The wells are neatly cut in laterites offering smooth but stable inner surfaces
2 Good impermeable and stable foundation

Both the above features bring in good scope for converting these wells into subsurface tanks to store rain water The rain water falling over the roof can be diverted to fill the wells By pouring concrete over the bottom and cement plastering the inner surface, seepage loss can be prevented Providing a concrete slab on top of the wells will prevent contamination and evaporation loss

Some calculations indicating the feasibility of this proposition is given below

1	Average volume of a lateritic well (3 m dia, 8 m deep)	23 cu m
2	Average roof area of rural houses	30 sq m
3	Average run off (80% of 2500 mm annual rainfall)	2000 mm
4	Average annual run off volume (30 x 2)	60 cu m

Since the run off is more than the volume of the well, the proposition to fill the wells with the runoff water is feasible If the volume of the well is more, more houses can be tapped

Although the above proposition seems to be promising, there are many unknown areas involved in the technology because this has never been done before Following factors need to be studied

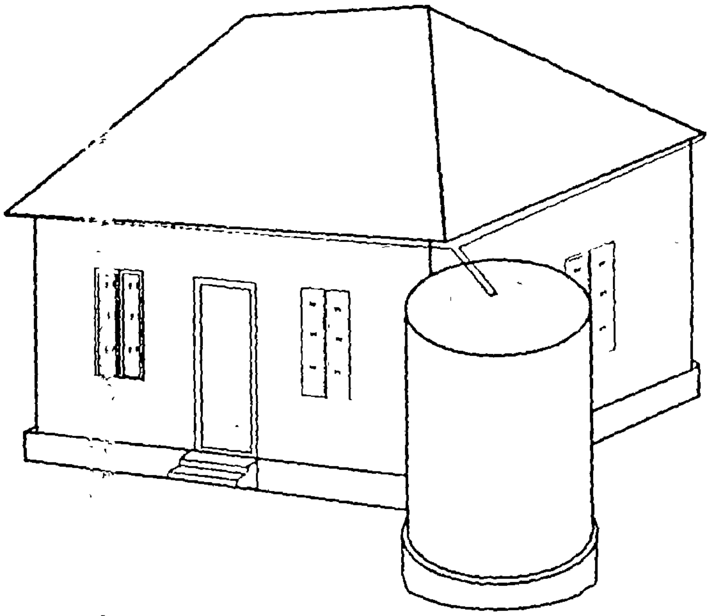
1 Effectiveness of various plastering and water proofing materials
2 Structural stability of side plastering and bottom concrete
3 Water quality changes if any, during one year

4 3 Underground Sumps (Water Supply for Schools)

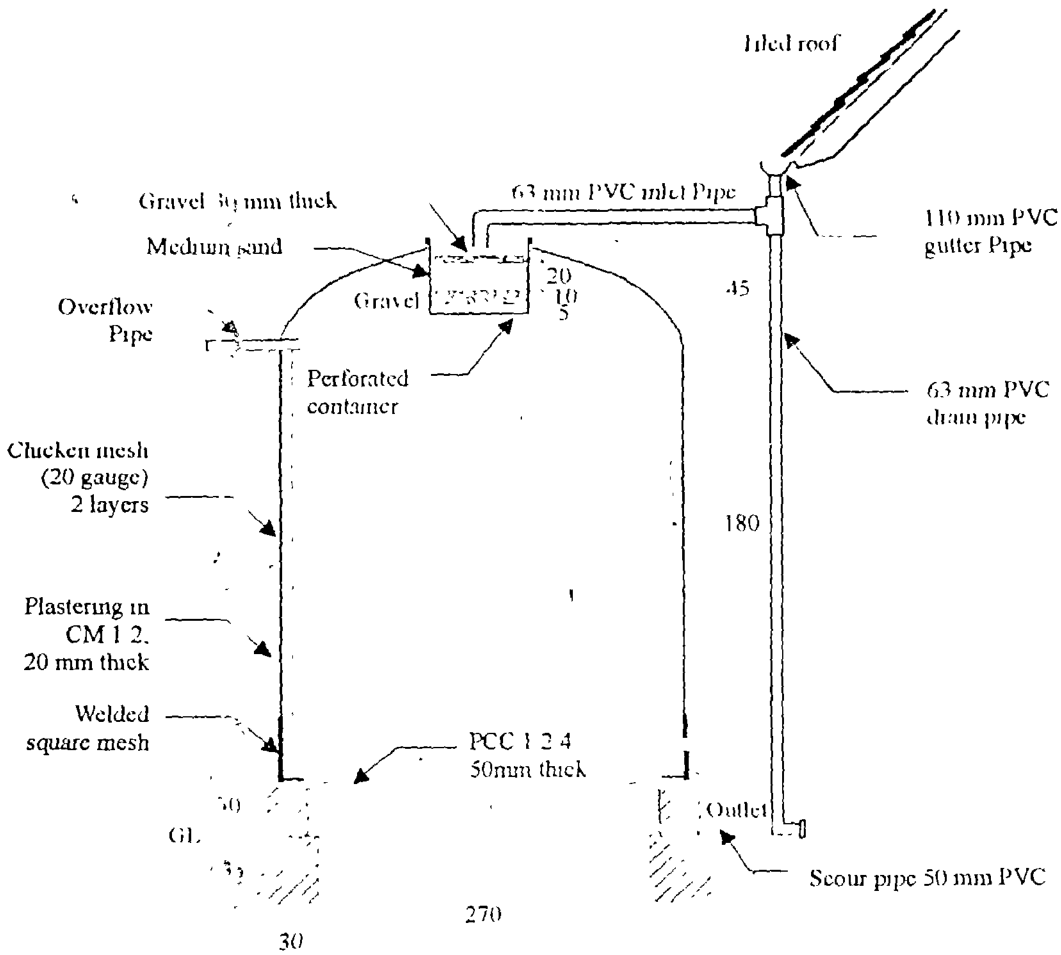
Many schools are located on lateritic hills The school wells tend to dry during summer and the children have to fetch water from far off places The hard laterite exposed on the surface in such areas offers the possibility of underground tanks, by digging a rectangular sumps, concreting the floor, plastering the sides, and covering the same with RCC slab Collecting the rain water from the school roof and storing the same in these underground sumps is feasible The water can be pumped into a small supply tank using solar/kerosene/electric pumps and supplied through a set of taps The pump is to be installed in such a way that pumping from underground sump or school well is possible as and when required

The following calculation, may be interesting

Average strength of a school	-	700 students
Daily requirement (@ 2 5 lpcd		1750 litres (1 75 Cum)
Number of working days to be supplied (summer)	=	60 days
Total storage required	=	105 Cu m
Average roof area		100 Sq m
Run off (@ 2 cum/sq m)		200 Cu m
Size of underground sump	=	10mx3mx3 5m
		(3m BGL and 0 5m AGL)
Cost per litre		Rs 1 25 (Including sump, pump&pumphouse, supply tank and pipelines)



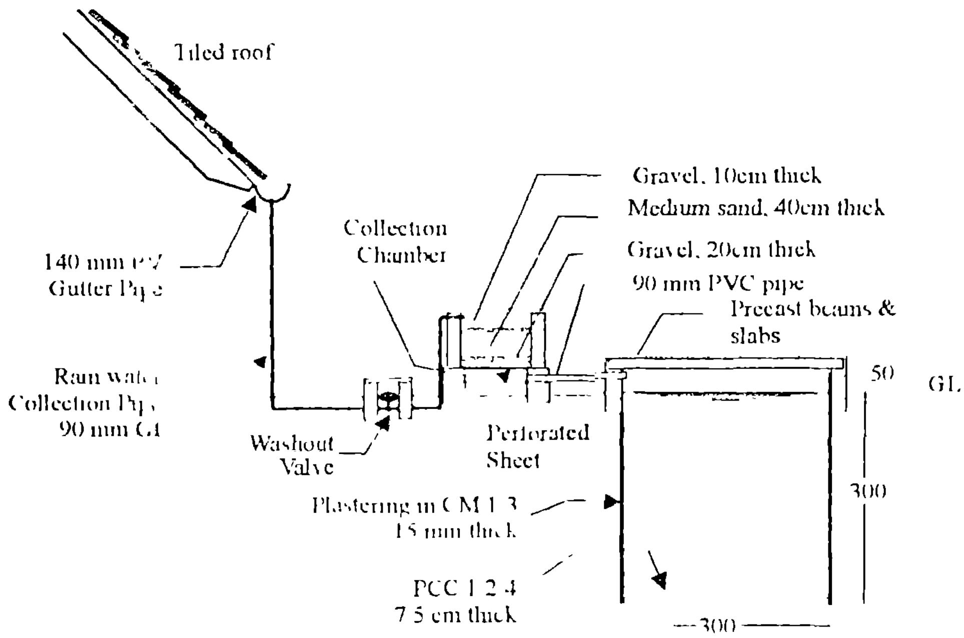
General View



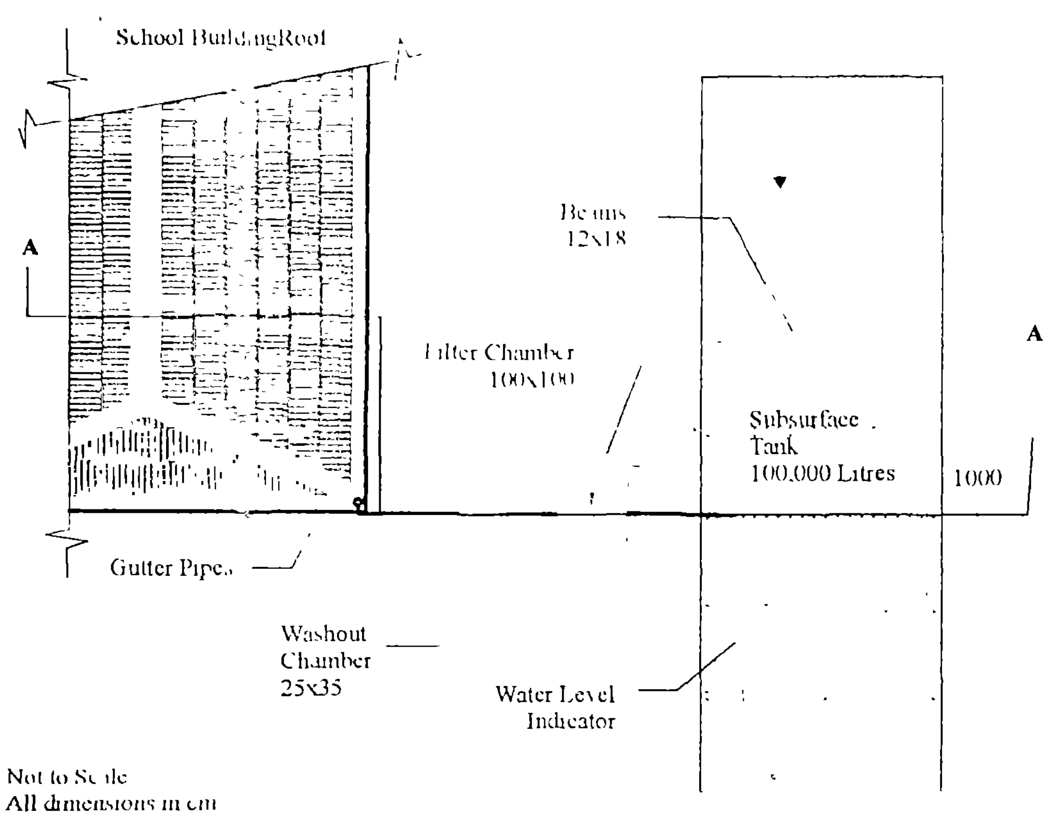
Sectional Elevation

Not to Scale
All dimensions in cm

Ferro-cement Rainwater Collection Tank (capacity 10000 Litres)



Section AA



Rainwater Collection System with Subsurface Storage for Schools

Annexure 4

Use of Ferro-cement water tanks in small pumping schemes

One of the main considerations under the decentralised planning for rural water supply is ensuring cost effectiveness particularly in light of the fact that the community is expected to share the capital cost substantially For this, not only should the capital and the O&M costs of the structures be minimum but also the structures should be strong enough and easy to construct

One important structure in water supply is the ground level storage tank The conventional economical designs are Reinforced Cement Concrete tanks and HDPE modular tanks These tanks cost as high as Rs 3/ to Rs 6/ per litre for capacities higher than 1000 litres

Ferro-cement (reinforced cement mortar) tanks are made of cement mortar reinforced with two layers of 20 gauge 12 mm hexagonal GI wire mesh *Additional reinforcement of welded mesh is provided* at the bottom in order to with stand the bending stresses The critical design factor for FC water tank is the maximum stress developed in the cement mortar which should be less than the tensile strength of the mortar in order to avoid cracks and leakage As per the experiments conducted by the Structural Engineering Research Institute, Gaziabad the maximum stress at the outer layer (at the bottom section where bending stresses are developed) in a 2 M high, 25 mm thick FC tank with two layers of mesh is less than the tensile strength of the cement mortar Many FC tanks in different parts of India with thickness less than 25 mm have not developed any leak even after 12 years of construction

The strength of FC Tank depends on the way it is constructed (high density of cement mortar), the mortar mix (1, 2 to 1.3), the quality of the ingredients and the extent of curing Since these aspects are very critical in FC construction these items need to be done under the direct supervision of the site engineer But since FC is a new concept, IS codes are yet to be developed For these reasons, the rates for FC construction cannot be compared with the PWD rates

On an average the cost of FC Water Tanks vary between Rs.1.5 to 1.8 per litre which is less than half of the cost of conventional tanks.

Technical Support Unit (TSU) of Socio Economic Unit Foundation is constructing Cylindrical FC Tanks with dome typed roof using collapsible mould With simple training, the FC tanks can be easily constructed by local masons TSU has already trained few masons who are constructing good quality FC Tanks in the Pilot Villages of Kondotti & Chekode

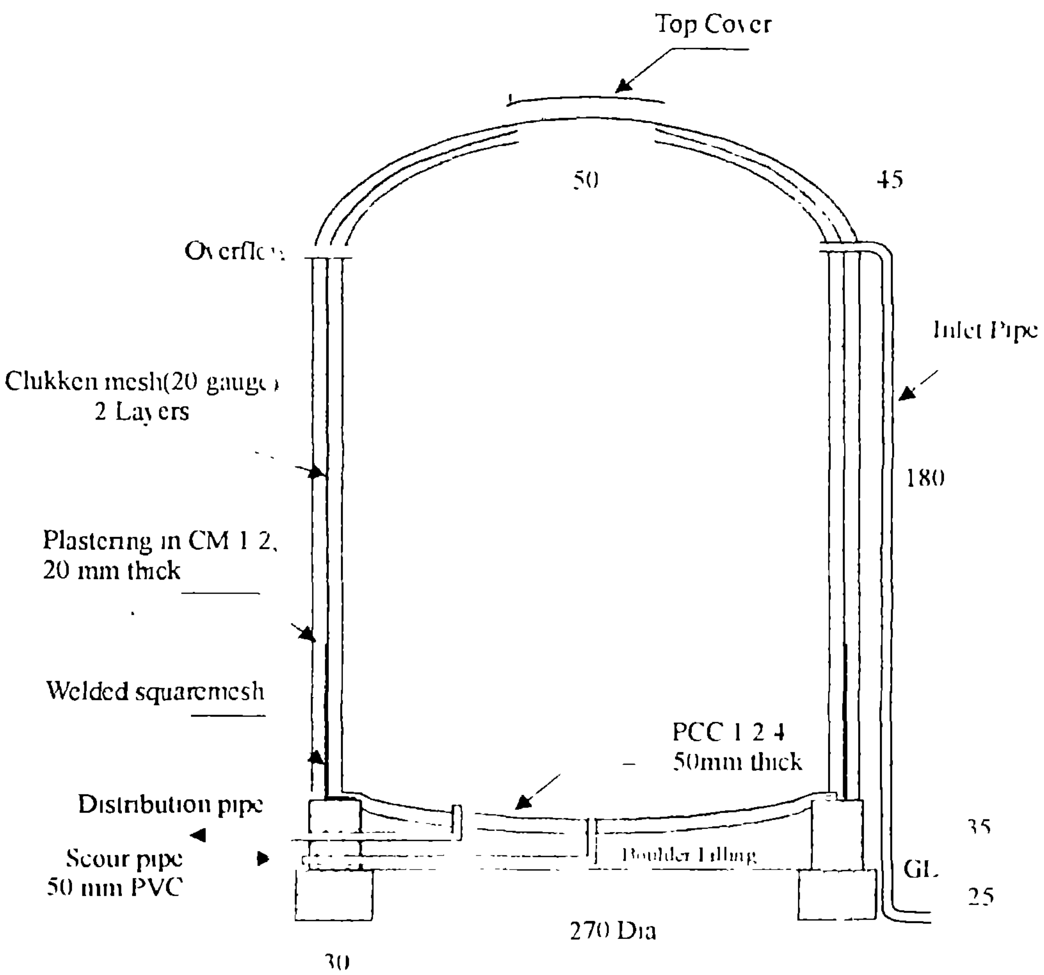
The technical details of FC Water tanks (Refer attached Figure) are as follows

1	Thickness of Walls	=	20 mm
2	Cement Mortar	=	1 2
3	Reinforcement	=	Two layers of 20 gauge 12 mm hexagonal wire mesh with additional reinforcement of 18 gauge welded mesh for 60 Cm height from bottom
4	Size of tank	=	(1) 1 85 m dia and 1 m to 1 86 m high For size 2500 to 5000 Litres (2) 2 70 m dia and 1 m to 1 86 m high For size 5000 to 10000 Litres
5	Foundation	=	Laterite masonry, in cm 1 6, 20 cm above ground and 40 cm below ground with 5 cm thick conical concrete floor

Annexure 4

Typical estimate for an FC Tank (based on actual current local rates) of 10,000 Litres is given below

Cement 14bags @ 195/bag	2730 00
Sand 2.5Cu m @ 400/Cum (Including road transport)	1000 00
Laterite 75 Nos @ 9/No (Including road transport)	675 00
6 mm metal 0 43 Cu m @ 550/Cum (Including road transport)	237 00
1/2" Chicken Mesh(20 gauge) 48 Sq m @ 26 5/Sqm	1272 00
1/2" Expanded mesh 5 4 Sq m @ 100/Sqm	540 00
GI Wire (6&20 gauges), MS wire	400.00
Water proofing Compound 5 Kg @ 20/Kg	100 00
Boulder, brick bats etc, for filling foundation	500.00
Skilled Labour 13 man days @ 185/day	2405 00
Unskilled Labour 22 man days @ 150/day	3300 00
Transportation by headload	1000 00
Transportation by road	750 00
Total	**14909.00**



Sectional Elevation

Not to Scale

All Dimensions in CM

Ferro-cement Water Tank (capacity 10000 Litres)

Annexure 5

Use of Multi Stage pumps in small pumping schemes in hilly areas

One of the main considerations under the decentralised planning for rural water supply is ensuring cost effectiveness particularly in light of the fact that the community is expected to share the capital cost substantially

One important component in water supply is the pump and motor The conventional centrifugal pumps are widely used in small water supply schemes for pumping water from shallow open wells These pumps are ideal for high discharge (more than 15000 litres per hour) at relatively low head But many of the small water supply schemes with 25 to 60 households in the hilly areas require a discharge of about 2500 lph to 5000 lph at head varying from 60m to 125m Such pumps if used in this situation require high motor HP resulting increased capital cost and high energy costs

Stage pumps are designed to deliver low discharge at high head, which is ideal for such situations Majority of the water supply schemes in the hilly areas require 3 to 10 HP motors and 1¼" to 1½" dia pumping line if stage pumps are used in place of centrifugal pumps of 7 to 20 HP. Thus the capital cost of the pumping system can be substantially reduced and the energy cost also will be minimised

Submersible pumps can also be used with advantage over both centrifugal and stage pumps when the suction head is more than 7 5m Initially submersible pumps were very expensive and used only in bore wells and as such were rarely used in Kerala For this reason, the after sales service was very poor But nowadays not only the prices have come down (comparable with stage pumps) but also there are many reputed suppliers in the market offering satisfactory after sales service

Annexure 6

Equalisation of discharge through taps in small water supply schemes

Non equitable distribution of water among the beneficiary households is a common problem in the water supply scheme in hilly areas Since the difference in altitude between houses is normally high, the households living on the hill top may not get sufficient water when the lower level taps are opened This may advgrsely affect the user relationship and smooth running of the scheme

In order to avoid such situation and to assure adequate water supply to all users, the flow through the lower level taps is to be regulated This can be done by either providing a control valve on each tap or using low diameter pipe for tap connection The former is very expensive where as PVC pipes less than 20mm (½") is not available in the market A simple and low cost arrangement by which flow regulation is possible is described below

Plastic coins of 20mm dia are used for this purpose Holes of 4mm to 15mm dia are punched at the centre of these coins either by drilling or with heated iron rod A coin with a suitable hole is placed inside the 20mm PVC coupling and inserted in to the PVC pipeline near to the tap The size of the hole is determined by trial and error by measuring the tap discharge with a calibrated bucket The tap at the lowest level requires small diameter hole to get the desired discharge The cost of this system per tap is about 5 rupees only Cost can further be reduced to Re 1 if the plastic coin is placed directly in the joint socket near the tap

In fact, the above simple techniques were developed through trial and error using locally available materials with the active participation of local plumbers Due to this approach, this technology is not only cost effective but also adaptable by the local plumbers

Annexure 7

Yield Estimation of an Open Well

Source failure is becoming increasingly common in small pumping schemes This is because no or little steps are taken to actually measure the "safe yield" of the source

How much water can your well give? You must have a clear answer to this question in order to decide how much water each household can get or how many households can the well be used for especially in peak summer

You can do this by some simple measurements, **but it must be done in the peak summer** You also need to pump your well nearly dry and make some observations of time and water levels, as described later

The basic idea is to estimate the time required for the well to refill after it has been fully or partially emptied If a well refills to almost its original level, within 12 to 16 hours, then this refilled volume of water is safely available, every day, for your scheme This is the Daily Safe Yield of your well can provide It is the amount of water that the well can supply daily when pumping is done twice 3 to 4 hours each time, leaving 12 to 16 hours for the well to refill

Steps for Safe Yield Estimation

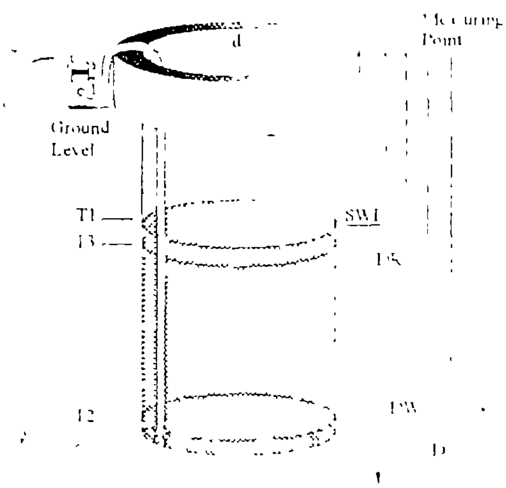
1 Using a measuring tape, note down the diameter of the well in meters
2. Using a thin rope or string with a stone tied on one end, measure the depth of the water level from the ground or the parapet wall of the well Convert this into meters using the measuring tape
3 Use the rope again, and from the same place on the well wall (or ground), this time to measure the total depth of the well
4 Install a pump to dewater the well making sure that the foot valve is close to the bottom of the well
5 Start the pump and note the time
6 Stop the dewatering when the water level has dropped very close to the foot valve Note the time and the depth to the water level, using the string and the measuring tape
7 Wait until the water level in the well rises to nearly (within 10 cm, use the tape to verify this) its original level before you started pumping Initially the water level will rise quickly Later this rise will be much slower and may take 8 hours or more Therefore, visit the well initially every half hour and later every one hour and judge the rate of recovery to decide when recovery is nearly completed
8 Note down the time and depth to water level when recovery is nearly complete
9 As mentioned earlier, the safe yield per day can be estimated as the quantity of water that flows back into the well within 12 to 16 hours time It is assumed that the difference between the initial water level and the water level at the time of recovery is negligible

Precautions:

1 Measurements in Steps 1, 2, 3, 6 and 7 must be from an identifiable and fixed point at the ground level or the well wall You may need to make measurements again from this point later

2 If your well has recovered to its original level within 4 to 6 hours then, its yield is very good However, if the water level has not come to half its original column height, within 6 to 8 hours, then your well is not very high yielding In such a situation let your well rest without pumping for two days Then repeat dewatering, this time pumping till only

3 It is also possible that when pumping from your well, it affects the neighbouring wells Check if this happens by at least two measurements of water levels in your closest neighbouring well while your well is dewatering If a drop in the water level in an adjoining well is observed, then **your well is not suited for sustainable use**



Complete the calculations as illustrated below

If

Diameter of Well	= d (m)
Depth of Well	= D (m)
Depth to Initial Water level	= SWL (m)
Time of starting dewatering	= T1 (Hr /min)
Depth to Water level at end of dewatering	= DW (m)
Time at the end of dewatering	= T2 (Hr /min)
Depth to Water level at end of recovery	DR (m)
Time at the end of recovery	= T3 (Hr /min)

Then

Safe yield = Volume of recovered water

$= \frac{22}{7} \times \frac{(d \times d)}{4} \times (DR-DW)$ cu m

= 0 786 (dxd) (DR-DW) x1000 litres

= Quantity of water available every day from your well

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