TASK FORCE REPORT ON WATER SUPPLY & SANITATION FOR THE NINTH PLAN

December 1996

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This Report is the outcome of the deliberations of a committee led by K. Pushpangadan and comprising of Ajay Kumar Varma, Babu Ambat, Balachandra Kurup, B Ekbal, C Harichandran, G Satheesh, G Murugan, M Dasan, M Vijayakumar, P Basak, P Sundaresan, R Ramachandran Nair, S Krishnaveni, S M Vijayanand, Teeka Ram Meena, T N N Bhattathiripad and T R Gopalakrishnan.

The task force would like to express its sincerest gratitude to Padmashree L W Baker for designing the cover page of this report. We thank the CDS team consisting of M Rajesh, Sam Jose, Sojan V V, Sunil P., M Krishnankutty and Phil Roy for assistance in the preparation of this report.

K. Pushpangadan.

December 1996.

Foreword

This report is prepared at a time when the water supply and sanitation sector faces two challenges. The first one is how to improve the quality and quantity of water when the sector is facing increasing financial crunch; and the second, how to sustain the use of water resources without environmental degradation. These issues were the main focus of the international conference on 'Water and the Environment' held in Dublin and the 'Earth Summit' in Rio de Janeiro in 1992 attended by about 100 countries including India. The conference endorsed unanimously that water is no longer a free good and should be treated as an economic good. Country experiences suggest that the above challenges can be met with user financing and with user participation in the management of resources [Serageldin, 1994]. These institutional changes can then mobilize the resources needed for improving the relatively neglected area of environmental sanitation. From reliable sources we understand that the Sen Committee on decentralization also favours local resource mobilization and complete involvement of local self-governing institutions in the management of existing systems and the taking up of new water supply schemes. The message is very clear for the IXth Plan. In the first place, the participatory role of the users has to be ensured through institutional innovations. Secondly, people's contribution, however small, should be collected through the new institution with the idea of *many a penny make a pound*. Moreover, this new institution should ensure financial viability, change the role of the state from provider to facilitator, make Water Authority an innovator in cost effective technology and provide the masses with quality water in adequate quantity at a cheaper rate. These recommendations are only the first steps towards the *promised land of health for all* where quality water and clean environment are assured even for the poorest.

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16 December 1996.

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II

Terms of Reference

A. WATER SUPPLY

(a) Coverage

i. Examine and reconcile the coverage estimates at various points of time given by various agencies such as Census, KWA, NSSO and National Family Health Survey.

ii. Identify ward-wise non covered and partially covered areas in Panchayats, Municipalities and Towns.

iii. Estimate the actual user rates of public taps (piped systems and handpumps). Analyze the actual production of water season-wise and the number of public and private connections provided in rural and urban areas. Estimate the actual coverage on the basis of availability of water in both rural and urban systems. Suggest appropriate norms for the coverage of piped water supply and handpumps separately.

iv. Recommend ways of converting conventional sources for increasing the coverage and explore possible technological innovations to meet potable standards acceptable to the users.

v. Examine the coverage of SCP/TSP schemes. Assess the effective coverage and expenditure of SCP/TSP for the last ten years, from a random sample of completed schemes.

vi. Evolve appropriate strategies for coverage in the ninth plan.

(b) Summer Scarcity

i. Identify the factors contributing to the increased summer scarcity of drinking water.

ii. Estimate district-wise annual expenditure on providing water during summer seasons since 1985/86.

iii. Estimate the rate of increase in private well population.

iv. Estimate the rate of depletion of traditional water harvesting structures and survey traditional methods of conservation and preservation of water. Explore the extent of utilisation of conventional sources and assess how far it can be used as a means of providing sustainable water supply. Examine the effect of conversion of wet land on water table.

v. Examine the effectiveness of the strategies adopted to provide drinking water during scarcity periods and device cost effective and sustainable measures for reducing summer scarcity.

vi. Formulate a long term strategy for solving the problem of seasonal scarcity.

(c) Evaluation of Existing Piped System

i. Prepare a complete list of commissioned and uncommissioned piped water supply schemes in rural and urban areas with year of commencement of construction and year of commissioning including partial commissioning.

ii. Examine the main reasons for the existence of large number of incomplete schemes.

iii. Estimate the rate of breakdown for the last ten years and identify the main reasons.

iv. Estimate permanent failure of systems and identify the reasons; examine the quality of construction and the systems for supervision.

v. Estimate the resource requirement for the annual replacement of piped systems as well as for the satisfactory completion of ongoing piped water schemes.

(d) Evaluation of Existing Handpump Systems

i. Prepare age specific distribution of handpumps in rural and urban areas. Estimate the number of working handpumps in each district.

ii. Estimate the number of handpumps not working and examine the reasons.

iii. Estimate the annual replacement cost of handpumps.

(e) Cost of Water Supply

i. Estimate unit-wise water supplied with seasonal effects.

ii. Analyze unit-wise cost of power, chemicals, wages and salaries, repairs, maintenance, and administrative overheads for the last five years.

iii. Estimate the unit-wise capital stock using the Asset Evaluation method suggested by Price Waterhouse.

iv. Examine the scale effect in urban and rural piped systems.

v Examine the sources of cost escalation if any, and recommend measures for containing them. Estimate the average period for the completion of projects.

vi. Suggest methods of reducing delays, if any, in the execution of projects.

(f) Operation and Maintenance

i. Examine the present administrative set up for operation and maintenance (O & M) of rural and urban systems.

ii. Estimate the district-wise requirement of manpower, transport and equipments exclusively for O&M. Suggest measures for improvement of O&M.

iii. Examine the policy for utilisation of technical talents to ensure efficient planning, implementation, monitoring and evaluation of the projects.

iv. Examine the procedure for the redressal of public grievances, such as non-availability of adequate quantity, delay in repair, inappropriate timings of supply, erroneous billing etc..

(g) Financial Issues

i. Forecast the financial outlay for the complete coverage of rural and urban systems.

ii. Estimate the replacement requirements arising out of expired systems for the next five years.

iii. Examine the financial performance of KWA by analyzing the revenue and expenditure of the last five years. Examine unit-wise revenue and identify the problems in its collection.

iv. Study the feasibility of unbundling and institutional innovation in revenue collection.

v. Suggest ways and means of making the system sustainable and financially viable with a change in the present role of government from provider to facilitator.

(h) Quality of Water

i. Conduct district-wise analysis of quality of water from all sources. Examine the laboratory results for the last five years for rural and urban systems separately. If there are quality problems, identify remedial measures.

ii. Examine the pattern of water borne diseases and its relation to quality of water. Recommend a suitable water quality monitoring system.

(i) Externally Assisted Projects

i. Examine the performance of externally aided projects since the inception of Water Authority.

ii. Examine the field mission reports of various externally aided projects since 1985/86.

iii. Assess the financial requirement for externally aided projects for the ninth five year plan. Suggest methods of mobilising the required funds.

iv. Provide appropriate guidelines for financial allocation and utilisation.

B. SANITATION

i. Assess the growth in investment and coverage of piped sewerage systems - commissioned, partially commissioned and uncommissioned.

ii. Identify the causes for the delay in commissioning sewerage projects and recommend appropriate measures for their speedy completion.

iii. Compare the cost of piped systems with other sanitation systems like septic tank, twin-pit pour-flush latrines etc..

iv. Assess the demand for and technology options in sanitation for both rural and urban areas.

v. Reconcile the coverage estimates from different agencies and sources.

vi. Examine the coverage of sanitation among the SC/ST/Fishermen and other weaker sections.

vii. Suggest innovations in increasing the coverage of sanitation among weaker sections, especially in coastal and water-logged areas.

viii. Identify institutional innovations in the provision of sanitation to the rural community.

ix. Evaluate the role of community participation and NGOs in providing the service.

x. Forecast the financial requirement for achieving full coverage and suggest ways of resource mobilisation.

xi. Examine the hidden demand for latrine systems and device measures for creating employment opportunities.

xii. Examine the present form of providing sanitation by multiple agencies and recommend ways of improving its efficiency.

xiii. Examine the implementation of the seven components of sanitation as a package.

xiv. Examine the relationship between recurring water borne diseases and sanitation. Suggest remedial measures.

C. HEALTH/ REPORT/ EDUCATION ETC.

i. Analyze the trend and pattern of district-wise incidence of water borne diseases for the last 15 years and assess its impact on governmental expenditure.

ii. Prepare a report on the research findings of Centre for Water Resource Development and Management (CWRDM), Calicut in the field of drinking water.

iii. Identify major studies undertaken on water supply and sanitation since the formation of KWA (1984). Analyze the recommendations of the various committees and Expert groups and suggest ways of implementation.

iv. Assess the present status of health education especially among the rural and urban poor.

v. Recommend measures for achieving universal health education. Evaluate school health education programme since its inception. Identify lapses if any and suggest ways of improvement.

D. GENERAL

i. Examine the role of *Panchayati Raj* and *Nagara Palika* institutions in water supply and sanitation.

ii. Examine the role of community participation by case studies and device institutional options for sustainable water supply and sanitation.

iii. Prepare a State Water Policy for drinking water similar to the National Water Policy. Prepare a water balance sheet across different hydro-geological regions in the state.

III

Discussion on Terms of Reference

I. WATER SUPPLY

1. Coverage

1.1 The national definition of coverage needs modification for Kerala in the light of its diversified settlement pattern. This is clear from the difference in the coverage as reported in the 1991-93 Water Census and the 1991 Census of Population. More specifically the national norm based coverage is 34 percent whereas coverage based on the actual number of users is only 12.2 percent.[1] The above coverage of 12.2 per cent is very close to the estimates from National sample survey and the National Family Health Survey. Based on this, we redefine the coverage norm as 90 instead of the national norm of 250 persons per tap.

BOX 1.

Coverage (norm) from Water census in 1993/94 . 34 %
Coverage (actual) from Population census in 1991 12 2 %
Ratio of coverage of norm to actual· 34/12 8 = 2 8
Regional norm (Kerala) 250 / 2 8 = 90 persons per tap

Source. Pushpangadan, et al [1995]

1.2 The rural coverage can be increased substantially if the population covered by open wells, 45 percent of rural population, is made to meet the potable standard. A study of 150 open wells in three districts by the Kerala State Pollution Control Board indicates that they have a high degree of bacteriological pollution. Therefore appropriate technical solutions should be evolved to make the wells meet potable standard. Rajiv Gandhi National Drinking Water Mission (RGNDWM) should be requested to take necessary R & D effort to achieve this goal. Socio Economic Unit Foundation has already initiated some work in this regard which should also be considered in the conversion of open wells to meet potable standards.

1.3 The all India validation survey on the 1991-93 Water Census have come up with the following conclusions. There were about 1821 non-covered (NC) habitations (without a single public source for potable water) in the state in 1994. The survey team noticed that the number of NC habitations in three districts - Kasaragod, Kannur & Wayanad - was unusually very low as reported in the Water Census. Considering the small size of the sample and the relative scarcity for drinking water in the three districts, a postal survey was conducted for identifying the reasons. This survey found that habitations were wrongly classified as covered in the Water Census. Hence a re-census was recommended in the three districts. Without a resurvey of the three districts, it is not possible to achieve full coverage in the IXth Plan as recommended by the chief ministers' conference on Basic Needs Programme.

1.4 A sample study should be undertaken for evaluating the real benefit to the targeted group as envisaged in SCP/TSP schemes.

2. Summer Scarcity

The state faces acute scarcity of water during summer. For evolving a long term strategy for minimizing water scarcity Trivandrum District Panchayat has come up with a novel project for funding from the RGNDWM. A survey conducted for this purpose has shown that, on the average, 58.3 percent of the households in the district faces severe scarcity of water in summer. This summer scarcity is attributed to the drying up of private/public open

BOX 2.
Scarcity of water and seasonality of public sources in Trivandrum district, 1996.

	Percentage of Total
1. Households with summer scarcity	58.3
2. Seasonal public wells	69.6
3. Seasonal public ponds	26.6
4 Seasonal tube wells	40 6

Source : Satyan [1996]

Note :
1. Estimates are based on 51 Panchayats from a total of 84 in the district
2. Seasonality means drying up of the source in summer.

[1] See Pushpangadan, et al [1995], Table 3

wells and the conversion of wet land into dry land. In order to contain this problem, a rejuvenation programme is suggested the cost of which is only 26 percent of constructing new public wells and ponds.

In addition to the rejuvenation/ reclamation of traditional harvesting structures, the following recommendations are also made to harvest rain water:

a) New buildings should be encouraged to have rain harvesting structure in order to compensate for conversion of public wells and ponds arising out of land scarcity. Here one could use the cost effective *Baker* structure or that of *Nalukettu* design for harvesting the rain water. A subsidy can be given to popularise the idea. This is not a new idea. In many countries such as Australia, the state insists on rain harvesting structures in the construction of houses and includes it in their bylaws. For *Baker ideas* along these lines, see Appendix C6. Contour trenching should also be encouraged.

b) Checkdams can also be used for reducing summer scarcity However, a scientific evaluation is needed for its effectiveness before popularizing it. In this case, the research findings of the ongoing study at CWRDM should be used.

It is also recommended that other districts should follow the example of the Trivandrum District Panchayat and prepare similar projects for reducing the intensity of summer scarcity.

3. Evaluation of Existing Piped System

No reliable data is available from secondary source. A survey is being undertaken by CDS for the evaluation of the piped water systems in the state.

4. Evaluation of Existing Handpump System

The evaluation of the existing handpump system is very difficult in the absence of reliable data from secondary sources. A study based on primary survey is the only way out.

During Validation Survey, India Mark II pumps were found to be unacceptable to the users due to the presence of iron arising from the corrosion of casing pipes or connecting rods of the pumps. Therefore, India Mark III pumps and PVC pipes alone should be used for new installations.

5. Cost of Water Supply

BOX 3. Direct Costs of Water (Rs per KL)

	87-88	90-91
Salary	0.21 (18 26 %)	0 30 (21 28 %)
Power	0.13 (11 30 %)	0 25 (17 73 %)
Chemical	0.04 (3 47 %)	0 22 (15 60 %)
Repairs & Maintenance	0 13 (11 30 %)	0 04 (2 84 %)
Depreciation	0 64 (55 65 %)	0.60 (42 55 %)
Total Unit Cost	1 15	1 41

Source Ferguson & Co [1992]

The only information on unit cost of production is the study on cost and revenue by Ferguson & Co for Kerala Water Authority (KWA). It shows a 22.6 percent increase in the direct unit costs of water during the period 1987-88 to 1990-91. But the changes in the components, especially operation and maintenance, power and chemicals are not in the same direction and magnitude. (See Box 3.) The implications of this finding for cost effectiveness are discussed in the following sections.

5.1 Power

The TERI study on HT/EHT schemes and the ongoing CDS study on rural schemes indicate that energy efficiency is very low. It is below 50 percent for rural schemes and slightly above 50 percent for urban (see Box 4). This could be a reason for the escalation in cost of energy observed by the Ferguson study. (see Box 3.) A case study of urban water supply in Trivandrum also confirms the increased energy use in the system.[2]

The source of energy inefficiency in water supply need careful study and measures should be recommended for cost effectiveness.

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2 See Pushpangadan & Murugan [1995]

BOX 4.
System efficiency of rural and urban schemes in Kerala

Rural: 46.13%
Urban: 56.98%

Note: Efficiency is the ratio of hydraulic output in kilowatts to power drawn in kilowatts (percentage) The result is based on the study of 15 rural schemes in Trivandrum and 27 urban schemes in Kerala.

Source: *1. CDS study*
2. TERI [1995]

5.2 Chemicals

The Ferguson study on cost and revenue shows an increase in the cost of chemicals as a proportion of total direct costs from 3.5% in 1987-88 to 15.6% in 1990-91. (See Box 3.) This can be attributed to the increase either in the price or the quantity of chemicals used. A case study on cost efficiency of urban water supply in Kerala has indicated that the quantity of chemicals per unit of water produced during the period 1974 - 1991, has more than doubled[3]. This increase in the chemical use has serious health implications especially for the poor since they mainly depend on public sources. Therefore there is a need to effectively monitor the right dosage of chemicals. For this purpose, the following measures are suggested.

i. Chemical use should be based on the analysis of quality of water at source on a regular basis.

ii. A computerized programme may be developed for estimating the exact amount of chemicals to be used in order to minimize the cost.

5.3 Operation and Maintenance (O&M)

Box 3 shows that the proportion of O&M in total direct costs have come down from 11.30 percent in 1987-88 to 2.84 percent in 1990-91. This reveals that O&M has come to be increasingly neglected over the years. This may be the reason for the occurrence of a large number of defunct systems in the state. (See Box 5.)

BOX 5.
Failure rate of rural water supply systems

1. Piped Water Supply
Commissioned before 1984 : 30 to 60 percent
Commissioned after 1984 : 25 percent

2. Handpumps
Number of handpumps in 1994: 4460
Number of working handpumps in 1994: 3420
Failure rate: 23.32%

Source: *1. Price Waterhouse [1994],*
2. Government of India [1996].

In order to ensure that O&M is given its due importance, it is recommended that it may be handed over to the users. The institutional mechanism and the transitional issues should be carefully examined by an expert committee before making such transfer.

In the present system of accounting O&M expenditure, the amount spent on maintenance is not kept separately. Therefore it is difficult to assess whether annual maintenance is taking place on a regular basis. To overcome this problem it is suggested that the present accounting of O&M should contain maintenance expenses separately.

6. Financial Issues

The total estimated financial outlay of KWA for the IXth plan is Rs 6518 crores of which Rs 4000 crores is for urban sewerage and the remaining Rs 2518 crores for water supply.[4] Out of Rs 2518 crores, Rs 1095 crores is to implement the Japanese aided external projects. During the initial discussions with the State Planning Board, it was suggested that the maximum allocation for the sector during the ninth plan period will be to the tune of Rs 800 crores. The total plan allocation is not even one-third of the money needed for water supply.

Under these circumstances, the KWA has to establish a priority in the allocation of funds and every effort must be made to mobilize resources from within and outside the sector. The following priority is suggested for the allocation of plan funds.

3 Ibid.

4 See the budget proposal given in the Appendix B1.

i. The first priority should go to the completion of ongoing projects.

ii. The selection of the new projects prepared on the basis of CPHEEO design norms should be ranked for implementation using the formula suggested by the working group on Second Netherlands assisted programme on water supply in Kerala.[5] This will ensure maximum social benefits.

iii. In order to spread the limited funds over more new projects, cost sharing among the users is strongly recommended.

The mobilization efforts should have two major components:

i. An efficient tariff formula.

ii. An efficient collection mechanism.

BOX 6.
Monthly tariff per household for rural water supply in Kerala .

	Full cost	O&M
Handpump	4.2	1.6
Piped system	19.6	13.2

Source: Pushpangadan [1996]

Tariff rate must be based on welfare principles of both consumers and producers. To achieve this, a rate structure based on two-part tariff is suggested[6]. This formula is applicable only to *metered* systems with data on cost of production. For the rural sector which is mostly *unmetered*, a tariff rate is estimated from aggregate expenditure data. The estimate shows that for full cost recovery the households using handpumps have to pay Rs 4.2 per month and for piped systems Rs 19.6. (See Box 6.) In order to avoid delay in the revision of rates, it is recommended that a tariff board be constituted.

Efficiency in the collection of tariff assumes that all meters are in working condition. If the meters are not functioning, then the customers are charged historical rates. In other words, they are charged only a flat rate instead of a varying rate according to their metered consumption. It is well known in the theory of public utility pricing, that such consumers have a tendency to misuse the resource since they are not charged for the marginal consumption. As a result, the sector is incurring considerable loss of revenue, the magnitude of which is unknown. However, a study of Trivandrum urban water supply indicates that it is around Rs 2 crores per annum[7]. Therefore for ensuring maximum revenue, we recommend the following:

i. Replace all nonfunctional meters and maintain them properly. The activities of maintenance and meter reading may be auctioned out, say, to technical institutions such as ITI/ITC/Polytechnic/etc., if there is shortage of manpower with the KWA. The cost of the meters should be recovered from the users over a period, the period being determined on the basis of consumers' ability to pay.

ii. Computerized billing should be introduced at least in all the corporations and municipalities. This may also be privatised.

iii. Prompt payment from local self governing bodies should be ensured.

7. Cost-effective measures

Studies show that not many cost effective technical innovations have taken place in the water supply and sanitation sector. Therefore we endorse the low cost treatment plant developed by Messrs. M N Rajeevan and N P Govindankutty of KWA for field test and technical evaluation.[8] Since it can save crores of rupees if found successful, we suggest that the technology be tried in ongoing projects where substitution is required or in new projects.

The electricity charge for water supply should be reduced to its break even rate, instead of the industrial rate presently charged.

Inter-unit competition should be encouraged by giving them more autonomy in decision making and constituting annual award for the "best-run" system.

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5 See Appendix B2 for details

6 Two-part tariff = Entry fee + marginal cost of production, where entry fee is equal to fixed cost of production divided by number of connections See Murugan & Pushpangadan 1994

7 Pushpangadan et al. [1995]

8 See the Appendix C3 for the details

New water supply schemes should be linked, if possible, to all existing and proposed reservoirs of irrigation and hydel projects.

8. Quality of Water

No data on quality of water supplied by KWA is available from published sources. The Panchayati Raj institutions / WATSAN cooperatives (See section III) should be entrusted with the monitoring of water quality in both Rural and Urban systems using the UNICEF kit.

9. Externally Assisted Projects

A committee should be set up to study the field mission reports and recommend measures for getting external funds.

II SANITATION

In terms of public investment, the sanitation sector with the exception of latrines, is one of the least developed sectors in Kerala. In fact, there is a lack of well defined sectoral policy for the government. Therefore it is recommended that a committee should study the comprehensive environment sanitation needs of the state with due emphasis on linkages between all the components of sanitation. More specifically, the strategy should be different for different components of sanitation - provision of latrines, urban piped sewerage, solid waste disposal, hygiene practice and sullage disposal. Hardly any reliable data exist on the generation of solid waste or sullage. Census 1991 shows that the households with latrines is 44.1 percent in the rural and 72.7 percent in the urban areas. But piped sewerage facility exists only in two corporations, viz., Thiruvananthapuram and Cochin and that too covers only a small section of the population, about 30 percent in Thiruvananthapuram and just above 10 percent in Cochin. The extensive urban coverage in latrine programme is predominantly through the twin-pit pour-flush latrine. Meager piped sewerage facility in urban areas is mainly due to the high capital cost and very small rate of cost recovery which is not sufficient even for O&M. Therefore new urban piped sewerage systems and the completion of the ongoing ones should be based on a demand driven approach with cost sharing. In this context there exists a hidden demand for sewerage connections. For instance in Trivandrum, latrine coverage is 81percent whereas piped sewerage is only 30 percent. Majority of the 51 percent households without sewerage facility would be willing to take house connections because of two main reasons.

i. The difficulty in cleaning up the filled up tanks and the associated management problems.
ii. Relative scarcity of land availability and its high opportunity cost in the urban areas.

In order to assess the demand and the willingness to pay of the users a survey may be conducted before any new initiative is taken. In other words, the future development in this sector should be purely demand based.

Looking at the historical development of sanitation in Kerala there cannot be much progress in piped sewerage during the ninth plan too. But considerable progress could be achieved in other components of sanitation without much financial assistance from the government. We elaborate on the method by which this can be achieved, specifically in three

areas: 1. coverage of latrine in urban and rural areas; 2. coastal coverage; and 3. urban solid waste disposal and rural sullage disposal.

For accelerating the rural coverage, "Midnapur" experiment in West Bengal should be initiated under WATSAN cooperatives discussed in section III.

BOX 7
Midnapur Experiment: Features

I	Demand driven approach instead of a supply driven approach
II	Social marketing with opening of block level sanitary marts
III	Potential for rural employment generation.
IV	Managed by village level organisation
V	Three grama panchayats in the district fully covered with latrines and declared as Sanitation Grama Panchayats
VI	Revolving funds for working capital and subsidy for the poor
VII	Cost sharing
IX.	User participation in management.

Source: 1 UNICEF; 2. Chakraborthy [1996]

Midnapur, one of the totally literate districts of West Bengal, had a rural population of 7 5 million during 1991 with a Sanitation Coverage of 4.7 percent. The Integrated Sanitation Project (ISP), sponsored by UNICEF and implemented by Ramakrishna Mission Lokshiksha Parishad (RMLP), became operational in the district in 1990 with the active support and involvement of the central and state governments This alternative provision has increased the coverage of 4.7 percent since independence to an average of 70 percent in the district in six years (100 percent in 130 villages)

Information, education and communication (IEC) have become the prime movers of the project, in the place of the usual subsidy, in the generation of demand for sanitation. In IEC, the users reveal their preferences for different technical and cost options. This was backed up by a revolving fund for financing, and institutional arrangements for delivering materials through sanitary marts opened throughout the district. Subsidy was limited to Rs 200 per family below poverty line and distributed in kind. An important indirect benefit for poverty alleviation is the creation of about 4 lakh employment days. Following the success of the experiment, the government of West Bengal is advocating this model for full coverage of sanitation in other districts of the State. This fruitful collaboration of NGO, international agency, state and the users should form a cost effective alternative to the existing form of provision in Kerala.

Latrines for the urban poor should be provided as a public good. Subsidized credit should be given to households below poverty line, if they demand private provision.

Coastal sanitation should be taken up on urgent basis with increased subsidy for full coverage.

So far, emphasis has been given only to latrine coverage neglecting solid waste disposal. The disposal of solid wastes is the responsibility of the local bodies. As a result, there has been no linkage between the two components. In order to accelerate coverage, linkage between the two components should be established by giving the responsibility of both to the local bodies or the WATSAN cooperatives.

Presently it is the responsibility of the urban local bodies to take care of the garbage disposal There exists no linkage between this activity and sewerage. Private initiative/ people's co-operatives can be tried at least on a pilot basis in the three municipal corporations for linking garbage disposal with sewerage.

Importance should be given to imparting extensive hygiene education both among the urban and the rural community. Public media should be used for popularising the hygiene education programme. At present hygiene education is being implemented by the Health Services Department. In order to get maximum benefit, this has to be implemented through the *grama panchayats* and/or the WATSAN co-operatives. This has tremendous potential for employment generation also.

In the provision of sanitation, cost effectiveness is usually ignored. In order to introduce the concept of low cost sanitation, we provide ideas from Baker, a pioneer in the field of low cost housing.[9]

9 See Appendix C5 for details

III INSTITUTIONAL INNOVATION

Government of Kerala has constituted a Committee under the chairmanship of Dr. S. B. Sen for recommending measures for the effective decentralization of power to the local self-governing institutions (LSGIs). Initial discussions with various sources and press reports suggest that the committee is of the opinion that the provision of drinking water should be entrusted with the LSGIs with resource mobilization from the users.

As a first step in this direction, we recommend that O&M of all newly commissioned water supply schemes be handed over to the LSGIs. In the case of existing schemes, the transfer should be based on the willingness of the LSGIs to manage the system. LSGIs should take up the development, management and maintenance of new water supply schemes based on non-conventional water sources like springs, surangams, tanks and ponds. The reports prepared by the Centre for Water Resource Development and Management (CWRDM) may be considered for initiating such projects.

The difficulty in mobilising resources from the users is the lack of a suitable institutional set up. In order to overcome this problem, WATSAN Cooperatives, which belong to the family of collective action models, is suggested for initial experimentation.

WATSAN Cooperatives

Box 8.
Watsan Cooperatives

I. Membership is limited to Users
II. Legal framework already exits.
III. Manage the operation and maintenance of the system.
IV Borrow from the financial institutions
V Need only Government's role as a facilitator
VI Collect tariff rates for cost recovery
VII. Repay debt component of the capital cost.
VIII. Extend subsidised credit facility for users
IX. More accountability to the users
X Accelerate for full coverage.

Collective action models can succeed if it satisfies certain conditions[10]. Cooperation has a higher chance of success if the resource and its beneficiaries are clearly identifiable and of small size. Public taps and their users obviously satisfy this condition since Government of India norm stipulates that a public tap should be provided for every 250 persons. Moreover, the success rate of such institutions is higher if there is overlapping of the resources and the users. This condition is also valid for drinking water since the public tap should be within a distance of 1500 meters from the households. In addition to these factors, the WATSAN cooperatives can also solve some of the problems facing the sector.

Box 9.
Integrated Rural Water Supply and Environmental Sanitation: The Karnataka Experiment

I. Total villages covered 1203
II. Population benefitted. 4 8 million
III Total Cost. Rs 447.2 crores
IV Financing pattern:
78 percent by World Bank
15 percent by state
7 percent by the community
V Major components
Rural Water Supply
(1203 piped water system, 2400 new pumps, rejuvenation of 500 wells, replacement of 1000 handpumps)
Environmental Sanitation
(small side surface sullage, bathing cubicles, cattle troughs, washing platforms, individual latrines, street dust bins), bio-gas pilot plants
Institution building and Project Support
(creation of village water supply and sanitation committees, comprehensive training programmes for strengthening project management in public health engineering divisions and zilla parishads)
Health communication
(software support for the creation of community awareness and demand for hygiene and environmental sanitation)
VI. Management· Village water supply and sanitation committees

Source. Government of Karnataka [1996].

The financial burden of the sector is eased as a result of cost sharing by the users and the management of O&M by cooperatives.

10 See Wade (1987), chapter 10

Under the new institution, the role of the state changes from provider to that of facilitator in the following sense. If the cost of the project is more than the amount from users' share and the grant from the state, cooperatives can borrow from financial institutions under state guarantee. The debt component can be repaid from tariff collected from the users. This option makes the sector financially viable. It is also a cost effective institution as opposed to state provision. The novelty of this model is that there is enough finance for commissioning the project. This reduces a major component of cost escalation, time overrun arising from financial crunch.

The nature and composition of the model varies from region to region depending on traditions and social norms. Hence it is suggested that it should be tried on an experimental basis as done in the Karnataka project on Integrated Rural Water Supply and Environmental Sanitation assisted by World Bank. The project, probably for the first time in the rural sector in India, introduces cost sharing by the beneficiaries as an important source of finance and an institutional set up, the village water supply and sanitation committees, to hand over O&M to the users. The entire capital cost of water supply and 70 percent of that in environmental sanitation is financed by the government. The cost of domestic connection of Rs 800 and the complete O&M cost should be recovered from the households managed by the committee.

IIII
Recommendations

I. WATER SUPPLY

1. Coverage

1.1 Based on actual user rates, coverage norm for Kerala should be 90 instead of the national norm of 250 persons per tap.

1.2 Water from open wells should be converted to potable standard based on the advice of the Rajiv Gandhi National Drinking Water Mission (RGNDWM).

1.3 A re-census of the three districts of Kasaragod, Kannur & Wayanad is recommended for estimating the total number of non-covered (NC) habitations in Kerala. Only then can full coverage be achieved in the IXth Plan as recommended by the Chief Ministers' conference on Basic Needs Programme.

1.4 A sample study should be undertaken for evaluating the real benefit to the targeted group as envisaged in SCP/TSP schemes.

2. Summer Scarcity

2.1 A rejuvenation programme is suggested for public wells, ponds and tube wells for reducing summer scarcity.

2.2 Traditional rain harvesting structures like *Baker* structure, *Nalukettu* design, contour trenching etc., should be encouraged. Checkdams can also be introduced after scientific evaluation of their impact.

2.3 All District Panchayats should prepare projects for reducing the intensity of summer scarcity.

3. Evaluation of Existing Piped System

Detailed data on piped systems including cost of production should be collected and published on a regular basis.

4. Evaluation of Existing Handpump System

4.1. Detailed data on handpump systems should be collected and published.

4.2. Only Mark III pumps and PVC pipes should be used for new installation.

5. Cost of Water Supply

5.1 Causes of observed high energy consumption in water supply should be studied and measures recommended for efficient use.

5.2 Chemical use should be based on the analysis of quality of water at source on a regular basis. A computerized programme may be developed for estimating the exact amount of chemicals to be used in order to minimize its cost and health risk.

5.3 O&M should be handed over to the users. The institutional mechanism and the transitional issues should be carefully examined by an expert committee before making such transfer. For ensuring the maintenance of the system, separate account of the maintenance expenditure should be published annually.

6. Financial Issues

6.1. In the allocation of plan funds, the following priorities are suggested.

i. The first priority should go to the completion of ongoing projects.

ii. The second priority should go to the new projects prepared on the basis of CPHEEO design norms. Funds should be allocated among these projects according to the ranking based on the formula suggested by the Working Group on Second Netherlands assisted programme on water supply in Kerala for maximum social benefits.

6.2. In order to spread the limited funds over more new projects, cost sharing among the users is strongly recommended.

6.3. Tariff rate should be based on two-part formula for break-even. In the rural sector, mostly *unmetered*, full cost recovery should include a replacement cost and an O&M cost.

6.4. In order to avoid delay in the revision of rates, it is recommended that a tariff board be constituted.

6.5. Replace all nonfunctional meters and maintain them properly. The activities of maintenance and meter reading may be auctioned out, say, to technical institutions such as ITI/ITC/Polytechnic/etc., if there is shortage of manpower with the KWA. The cost of the meters should be recovered from the users over a period, the period being determined on the basis of consumers' ability to pay.

6.6. Computerized billing should be introduced at least in all the corporations and municipalities. Billing and collection may be privatised.

6.7. Prompt payment from local self governing bodies should be ensured.

7. Cost-effective Measures

7.1. The low cost treatment plant developed by Rajeevan and Govindankutty of KWA is recommended for field test and technical evaluation. This may be tried in ongoing projects where substitution is required or in new projects.

7.2. Electricity charge for water supply should be reduced to its break even rate, instead of the industrial rate presently charged.

7.3. Inter-unit competition should be encouraged by giving the units more autonomy in decision making and constituting an annual award for the "best-run" system.

7.4. New water supply schemes should be linked, if possible, to all existing and proposed reservoirs of irrigation and hydel projects.

8. Quality of Water

The local self-governing institutions / Water Supply and Sanitation (WATSAN) cooperatives should be entrusted with the monitoring of water quality in both Rural and Urban systems using the UNICEF kit.

9. Externally Assisted Projects

A committee should be set up to study the field mission reports and recommend measures for getting external funds.

II SANITATION

The government should set up a committee to study the comprehensive environment sanitation needs of the state with due emphasis on linkages between all the components of sanitation in order to evolve a sectoral policy.

New urban piped sewerage systems and the completion of the ongoing ones should be based on a demand driven approach with cost sharing. In order to assess the demand and the willingness to pay of the users a survey may be conducted before any new initiative is taken.

For accelerating rural coverage, "Midnapur" experiment in West Bengal should be initiated under WATSAN cooperatives.

Latrines for the urban poor should be provided as a public good. Subsidized credit should be given to households below poverty line, if they demand private provision.

Coastal sanitation should be taken up on urgent basis with increased subsidy for full coverage.

Private initiative / people's co-operatives should be experimented in the three municipal corporations for linking garbage disposal with sewerage.

Hygiene education should be implemented through the *grama panchayats* and / or the WATSAN co-operatives with extensive use of public media.

III INSTITUTIONAL INNOVATION

O&M of all newly commissioned water supply schemes should be handed over to the local self-government institutions (LSGIs) or WATSAN cooperatives. In the case of existing schemes, the transfer should be based on the willingness of these institutions to manage the system.

Non-conventional water sources like springs, surangams, tanks and ponds should be developed by the LSGIs.

User financing should be implemented through WATSAN Cooperatives. The Karnataka experiment on Integrated Rural Water Supply and Environmental Sanitation programme should be adapted for this purpose.

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Appendix

Appendix - A1

Task Force Members

Chairperson

Dr. K. Pushpangadan, Associate Fellow, Centre for Development Studies, Thiruvananthapuram.

Members

1. Dr. B. Ekbal, Member, State Planning Board, Thiruvananthapuram.
2. Sri. P. Sundaresan, Secretary to Government, Irrigation & Water Supply, Government of Kerala, Thiruvananthapuram.
3. Sri. Teeka Ram Meena, Joint Secretary, Irrigation and Water Supply, Government of Kerala, Thiruvananthapuram.
4. Sri. S. M. Vijayanand, Deputy Secretary, Rural Development (GOI)
5. Smt. S. Krishnaveni, Managing Director, Kerala Water Authority, Thiruvananthapuram.
6. Sri R. Ramachandran Nair, Additional Development Commissioner, Rural Development Department, Thiruvananthapuram.
7. Sri. G. Satheesh, Chief Engineer (Southern Region), Kerala Water Authority, Thiruvananthapuram.
8. Sri. T. N. Narayana Bhattathiripad, Chief Engineer (Northern Region), Kerala Water Authority, Calicut.
9. Sri. T. R. Gopalakrishnan, Special Secretary (Finance), Government of Kerala, Thiruvananthapuram
10. Dr. Balachandra Kurup, Executive Coordinator, Socio-Economic Units, Kerala Water Authority, Thiruvananthapuram.
11. Dr. P. Basak, Director, Centre for Water Resources Development & Management (CWRDM), Calicut.
12. Mr. John Abott, Technical Liaison Officer, Kerala Water Authority, Kochi.
13. Dr C. Harichandran, Chief, State Planning Board, Thiruvananthapuram.
14. Sri. G. Murugan, Centre for Development Studies, Thiruvananthapuram.
15. Sri. Ajay Kumar Varma, Scientist, *Bharat Gyan Vigyan Samiti*, New Delhi.
16. Sri. M. Dasan, M.L.A., Nadakkavu, Calicut.
17. Dr. M. Vijayakumar, Department of Community Medicine, Medical College, Thiruvananthapuram.
18. Dr. Babu Ambat, Centre for Environment Development, Chirakkulam Road.

Convener

Sri. A. K. Vasudevan, Deputy Director, State Planning Board, Thiruvananthapuram.

The Task Force met thrice: on 5 September 1996 at the State Planning Board, on 11October 1996 at Centre for Development Studies (CDS); and on 22& 23 November, 1996 again at CDS.

Appendix - A2

WORKSHOP ON THE FINALIZATION OF TASK FORCE REPORT ON WATER SUPPLY AND SANITATION (WATSAN) FOR IX PLAN

Centre for Development Studies, Trivandrum.

22 - 23 of November 1996.

PROGRAMME

22 November, 1996

Morning Session

1 A survey of research at Centre for Water Resource Development and Management (CWRDM) with particular reference to WATSAN
(Mr K D Namboothiripad, Dr K N Ramani & Mr R Gopakumar CWRDM, Calicut)

2 State's financial needs of WATSAN in the IX Plan
(Smt. Krishnaveni, Managing Director, Kerala Water Authority)

3 Unbundling activities in WATSAN
(Dr K Pushpangadan, CDS)

4 Issues in Sanitation
(Sri. G Murugan, CDS)

5 Evaluation of field mission reports of Externally Aided Projects and of Committee reports on KWA
(Sri Teeka Ram Meena, District Collector, Trissur)

Afternoon Session

1 Towards an objective criterion for determining priorities in the financial allocation for WATSAN
(Sri S M Vijayanand, Special Secretary, Local Administration, Government of Kerala)

2 Strategies for solving Summer Scarcity
(Sri Ajay Kumar Varma and Sri T N N Bhattathiripad)

3 Panchayat Raj institutions and Community Participation
(Dr C Harichandran, Chief, Social Services, State Planning Board, B Satyan President, District Panchayat, Trivandrum & Dr Balachandra Kurup, Executive Coordinator, Socio-Economic Units, KWA)

4 Quality of Water & Water borne diseases in Kerala
(Dr. Babu Ambat, Centre for Environment Development & Dr M Vijayakumar, Dept of Community Medicine, Medical College, Trivandrum)

23 November 1996

Morning Session
Cost-effectiveness in WATSAN

1 Technology Options
(Sri P K Sivanandan, Secretary, Planning and Economic Affairs)

2. Traditional Structures for Rain Harvesting
(Sri B. Satyan, President, District Panchayat, Trivandrum)

3 Achieving Full-Coverage in Rural Areas
(Dr V. Santhakumar, CDS)

4 Low-cost Treatment Plant
(Sri M N Rajeevan, Executive Engineer, KWA)

5 Alternative Financial Models for WATSAN
(Dr. K. Pushpangadan & Sri G Murugan, CDS)

6 Hand-pump Sector
(Sri. G Satheesh, Chief Engineer, KWA)

Special Invitees

Dr I.S Gulati, Vice-Chairman, State Planning Board, Thiruvananthapuram
Dr. V Santhakumar, Research Associate, Centre for Development Studies, Thiruvananthapuram
Sri B. Satyan, President, District Panchayat, Thiruvananthapuram
Sri M N Rajeevan, Executive Engineer, KWA, Thiruvananthapuram
Sri Mohammed Soofi, Chief Engineer, KWA, Thiruvananthapuram
Sri R Ramanujam, Superintending Engineer, KWA, Kannur

Appendix B1

Kerala Water Authority
Abstract of the 9th Five Year Plan Proposals

Slno	Item	Amount (crores)
1	Survey Investigation Planning and Design	1 25
2	Research and Training	5 00
3	Completion of World Band aided schemes	4 55
4	Completion of Netherlands aided schemes	40 00
5	Completion of Bilateral - Danish aided schemes	1 00
6	WSS proposed to be taken up with bilateral (Japanese) aid	1095.00
7	Improvements to existing RWSS and Extensions for additional coverage in NC/PC (0 to 10)	86 50
8	Augmentation and improvements to existing UWSS	34 00
9	Other RWSS - Continuing and New ones	24 00
10	Completion of partially completed / ongoing ARP schemes	145 00
11	Completion of partially sanctioned ARP schemes	24 00
12	Rural WSS not eligible for ARP assistance	370 00
13	RWSS (LIC aided)	62 00
14	UWSS - continuing schemes (LIC aided)	15 00
15	Counterpart funding to newly sanctioned LIC/HUDCO aided urban schemes and schemes proposed to be taken up during the 9th plan	240 00
16	WSS to Naval Academy at Ezhimala	17 50
17	Water supply arrangements to Medical College	10 00
18	WSS to Newly formed Municipalities	15 00
19	Construction of dam at (a) Kakkadavu	60 00
	(b) Chttar	60 00
20	Accelerated UWSS with 50 % state share (Including schemes sanctioned and prepared by IPD)	28 00
21.	Providing water supply facilities to NC habitations and improving water supply level in PC <= 10 lpcd habitations	80 00
22	SCP/TSP schemes	100.00
	Sub Total	2517 80
23	Sewerage system in 10 coastal cities	
	Phase I	193 00
	Phase II	1394 00
	For complete Urban coverage Phase III	2413.00
		4000 00
	TOTAL	6517 80

Appendix - B2

Criteria for Selection of Concentration Areas
Second Netherlands Assisted
Water Supply & Environmental Sanitation Programme

	Criteria	Reason for Selection	Weight
01	Rural Population Density	With higher rural population densities, need for environmental health improvements are generally greater with economies of scale anticipated for sector investments	15
02	Rural Population SC & ST numbers	The rural SC & ST population is generally poorer and in greater need for sector benefits It is also government policy to give additional assistance toe SC & ST population	10
03	Socio-economic status of the rural population	The primary programme objective is to improve the environmental health status of the poor The indicator is numbers of rural households below the poverty line (annual income Rs 11000/yr at 1991/92 prices)	15
04	The Status of Women	The Programme will give preference to disadvantaged women This is also policy Indicators are sex ratio, female literacy and female child mortality	5
05	Health status of the rural community	Environmental health status is the basic concern of the Programme This is indicated by morbidity levels resulting from water borne diseases.	5
06	Child Mortality	Child mortality (both sexes, 1 - 5 or 6 years is a direct indicator of adverse environmental health conditions and poor hygiene behavior in the communities	5
07	Latrine Coverage	Access to sanitary latrines is a primary Programme objective The need for additional water supply development is indicated by the number of rural households without existing or planned access to safe drinking water	15
08	Rural Water Supply NOT covered	The need for additional water supply development is indicated by the number of rural households without existing or planned access to safe drinking water	15
09	Rural Water Supply not using taps	The need for both improvements to existing water supplies and new development is indicated by the number of rural households who do not use tap water	5
10	Rural Water Supply - Source Quality	Areas where the quality of source water (surface and ground) is a particular problem will need special consideration for the provision of and acceptable water supply	10

Source: Government of Kerala [1995].

Appendix - C1

Financing options and institutional innovation in Water Supply and Sanitation Sector in Kerala.
K. Pushpangadan, Centre for Development Studies, Kerala.

The main focus of the present task force is to suggest social institutions to implement the various recommendations of the past task force reports for achieving full coverage of water supply and sanitation within a short period of time with minimal assistance from the state. This is a very challenging task, but is the need of the hour for the sector since several radical changes are being contemplated at the national level. Here our aim is very modest, hence only a beginning is proposed. These ideas need refinement and detailed formulation for application in the IX plan. These institutional innovations are the by-products of the research undertaken and ongoing in the sector at CDS for the last couple of years. These social experiments are suggested to achieve the following objectives in the sector:

I. Financial viability and sustainability;
II. Consistency with national plan;
III. Role of State as a facilitator.

For the above purpose, two ways are proposed. the first is to unbundle activities with a view to achieve cost effectiveness The second is to design collective action as an alternative to state and privatisation in the provision of drinking water supply Let us examine the details of the unbundling in the sector.

I

Unbundling the activities

Several activities are undertaken by KWA for the provision of the public good. But it is time to review the cost effectiveness of these actions In a recent study at CDS, we have examined the financial requirement for sustainable rural water supply in India. It clearly shows that even the operation and maintenance of the existing systems cannot be met unless resources are mobilised from the users In other words, maintenance of the assets will be impossible unless user financing is introduced urgently. These issues were the focus of a national workshop held in October organised by Government of India in Delhi. The consensus was to give the responsibility of O & M to users under some form of collective management. Hence, we suggest that the same should be done in Kerala at least for the units commissioned hereafter. The collective management proposed is very general but need careful examination to suit Kerala conditions. A version of the cooperative model is given below which may be adopted for O & M management. A second action for unbundling is to encourage efficiency among units of production. In this case, we examine the case of revenue collection with a pilot experiment in the case of Trivandrum Urban Water Supply.

It is estimated that about forty thousand of the total one lakh *meters* installed in Trivandrum Urban Water Supply are not working. As a result, they are charged by the historical tariff rates. In other words, they are charged only a flat rate instead of varying rate according to their metered consumption. This is equivalent to an entry fee only in a pricing formula based on multi-part tariff rates It is well known in the theory of public utility prices that such consumers have a tendency to misuse the resource since they are not charged for the marginal consumption. As a result, the sector is loosing the revenue equivalent to the value of the overused water. In order to evaluate the extent of misuse, the following cost effective action is proposed. For a year or two, unbundle the activity of maintenance and reading of meters to private agency. This may be restricted to industrial training centres or polytechnic in the private sector in and around Trivandrum city. An interesting feature of this proposition is that the institutions can use the money thus obtained for improving its infrastructure facilities. A computerized billing system should be introduced and tariff collected on a monthly or quarterly basis The services of the retired employees from KWA, commission agents etc. can be used on a commission basis for this purpose. The experiment should be repeated for a period of three years with monitoring and evaluation conducted every year. This experiment will also give us a picture of transmission loss, the cost efficiency of the system and the badly needed data for an economic evaluation of whether to undertake the measures for preventing transmission and distribution losses. If the experiment is successful, it can be extended to other units for monitoring the cost effectiveness of water supply in Kerala

The major constraint facing the sector is the inadequate provision of finance for its activities. The sector is not able to utilize fully the Central Government grants due to the State's inability to provide the matching contribution (20 % of the capital cost of the project) in rural areas. To overcome this problem, the following action plan is proposed.

II

Financing options

A public good can be provided under three different institutional setup: (i) By State, (ii) By Private sector, and (iii) By Cooperative sector. In Kerala, it is completely dominated by the state. Government of India has already initiated private property rights in the provision of urban water supply in a big way While this option is there in urban sector in Kerala, we examine only the feasibility of cooperative action in the provision. For this purpose, the following institutional arrangement is suggested in the case of projects which are complete in all respects but not taken for want of finance After identifying the projects, user cooperatives should be set up in the area for sharing the cost of those who need household connections. For conducting the survey and raising finance from the users, the expertise of Socio-Economic Unit or other experienced NGOs can be utilized. After assessing the cost share of the users, the grant component from the Government of India should be assessed and collected The remaining amount should be borrowed from financial institutions like, LIC/UTI/HUDCO etc. If the cost share is very little, it should be in the state's sector. If the cost share is equal to the cost of the project it is completely financed by the users' capital. If cost share and the grant share is enough for the project, then the loan component is not required. If the loan component is needed, government should provide the guarantee. Obviously, under collective action, the government's role has changed from provider to facilitator. The main feature of the model is that there exists a wide range of options for the government for the provision of water supply Once the finance is secured, the work should be executed jointly with the Water Authority and the cooperatives. The advantage of using the three component financing - cost sharing, grant and loan - is that the time overrun can be completely eliminated. After completion of the system, it can be transferred to the cooperatives for its operation and maintenance The cooperatives can raise the resources from a suitable tariff rate on the users.

Conclusions

The O & M of all new water supply systems should be given to user cooperatives. Inter-system efficiency should be encouraged in revenue collection and cost of production. To understand the issue clearly, a pilot experiment is suggested for the Trivandrum Urban Water Supply. Additional coverage of water supply should be in cooperative action wherever possible. In this context, user cooperatives are suggested as an institution for raising resources from users, government and financial institutions.

Appendix - C2

Community Participation in Water Supply and Sanitation

Dr. K Balachandra Kurup, Executive Director, Socio-Economic Unit Foundation, KWA
Thiruvananthapuram, Kerala.

1. Introduction

In many countnes significant numbers of water supply and sanitation facilities are non-functioning or not effectively used by the community. The reasons for these are selection of inappropriate technology, wrong location, community not being consulted or involved while developing the facility, etc. The main problem in the use and maintenance of improved WSS in several areas is reported to be the non-participation of the community during installation and maintenance. The community has a role to play as acceptors of new technology, as users of improved facilities, as managers of WSS and as agents for promoting hygienic practices. Therefore, it implies action by the people to solve their own problems. Since social, economic and cultural conditions differ from one community to another, the degree and form of community participation in developmental activities also vary. The theoretical literature on this concept is fairly strong, but more sincere and practical attention is needed to develop operational strategies to involve communities effectively in the various stages of development and management. For the fulfillment of the objectives of the 73rd and 74th constitutional amendments, community participation and management in the water supply and sanitation sector should play a key role in local level development.

For the management and sustainability of water supply schemes, they have to be technologically sound, economically viable, environmentally compatible and socially acceptable While discussing this issue, it is worthwhile to review the drinking water scenario of the State. The 1995 Annual report of KWA indicates that there are 1462 schemes under operation and approximately 450 schemes under construction. Based on the available information it appears that the small schemes (population coverage less that 20,000), are the ones that suffer most from insufficient operation and maintenance. Approximately 50% of the schemes fall under this category. Broadly, the drinking water system can be divided into three categories.

River based urban and rural water supply schemes;
Ground water based rural water supply schemes;
Family based/managed drinking water systems.

The first two systems are owned and operated by the Government through Kerala Water Authority and State Ground Water Department. The third system involves individual families creating their own drinking water sources by constructing wells and renovating springs in their own house compounds and managing by themselves The government statistics reveal that 37% of the rural and 70% of the urban population has access to piped water supply schemes. The 1991 census demonstrates that only 15.2% of the rural population is using piped water. The National Family Health Survey (1992-93) reveals that 19.3% of the rural households are consuming piped water. This further stresses the need for rejuvenating the family or community based water systems in the state. Institutional and financial constraints prevented the development of the O & M sector in tune with the increase in the number of water supply schemes

The situation in sanitation is also not different. In the sanitation sector, Kerala has an important place in history, starting from the 1950s. However the state lacks a clear-cut strategy and management style in the implementation of community based sanitation programmes. The low implementation rate of many of the sanitation programmes proves this further. The main institutions involved in the sanitation sector in Kerala are : (1) Rural Development Department; (2) Municipalities; (3) Panchayats; (4) Fisheries/Matsyafed; (5) Housing; (6) Tribal Welfare Department; (7) Department of scheduled Caste; (8) Social Welfare department; (9) Education department; (10) Co-operative Banks; (11) Kerala Water Authority; (12) the Socio-Economic Unit Foundation, Kerala; (13) People's Action for Development PAD/CAPART Kerala through NGOs and Women's organisations.

2. Sectoral Policy on Community Participation

The programme development in the water and sanitation sector should be based on sector policy. The GOI policy for the sector is well developed and the Government of Kerala generally follows the national policy in many respects However, Kerala needs an independent sector policy document mainly due to its geography, population density, dwelling pattern, water behavioral practices, etc.. The norms, technology and coverage should be based on the local need and reality. Moreover the recent policy feature on the active role of *Panchayati Raj* and *Nagarapalika* institutions should be given sufficient importance during the planning process Here the community and the elected representatives should play a major role in identifying the areas for new facilities.

It is also a process by which the individual and the community assess the local situations, solutions and resources to solve their problems and take more responsibilities to become self reliant. Since social, economic, educational and other cultural conditions differ from one community to another, the degree and the form of participation in developmental activities also vary. Moreover community should be aware of the cost of the schemes, problems for the delay in implementing the schemes, cost escalation etc. Community participation in WS&S is mandatory in the following areas.

a) Community should participate in the planning process, including the budgeting of the projects;

b) Community should be involved in cost sharing, the resolving of issues like land acquisition for source, treatment plant, etc , and the solution of other problems,

c) Community should be responsible for the implementation, management and the operation & maintenance of the schemes,

d) The whole community should share the benefit of the project;

e) Community should be involved in cost recovery of the schemes;

f) The community should also be involved in the monitoring of the service level and the evaluation and modification of the project if necessary

For institutionalising the community participation component in the sector, 10% of the funds should be earmarked for community organisation, mobilisation, training and other related activities. In this connection it may be worthwhile to mention that the cost of Socio-Economic Units, Kerala was below 2.5% of the cost of water supply schemes.

3. Need for Innovative Guidelines

Detailed, innovative and clear guidelines have to be developed for formulating and operationalising the programmes. The role of government, sectoral departments, Panchayats, municipalities, WATSAN committees etc., has to be clearly stated in the guidelines. The percapita cost of the schemes and the need for cost sharing has to be given thrust in the guidelines. The maximum permitted percapita cost ceiling reimbursable amount should be indicated in the guidelines and exceptions can be given only in deserving and convincing cases Similarly the time frame, cost sharing, technology & cost variations, criteria, cost recovery, operation & maintenance etc. has to be focused as the necessary prerequisite for the success of the water supply schemes

4. Development of Water and Sanitation (WATSAN) Committees

Water and Sanitation Committees have to be formed in all the wards and they should be responsible for all the activities related to water and sanitation in the locality. They can be identified through the ward level meeting. The residents from the locality will be requested to assemble in a common place either in a school/health centre or any other convenient place During this gathering they will nominate their representatives for the committee Similar type of committees are to be constituted at the Panchayat, Block and district levels and their role should be to monitor the performance of the water and sanitation activities.

Composition of the WATSAN committee

- # elected ward member as Chairman
- # 2 women representatives
- # 2 youth representatives
- # 1 local school teacher/active social worker
- # 1 representative of ICDS/Health or any other active department

A Secretary will be nominated from this group It may be useful to have 4 women members in the Committee.

Guidelines to select WATSAN committee members

1. should be a resident of the particular ward;
2. should be respectable, reliable and committed;
3. should be able to read and write;
4. should be 18 years of age;
5. should be willing to offer voluntary service;
6. should be willing to attend training programmes;
7. should be willing to organise hygiene promotional and environmental sanitation programmes,

Responsibilities of WATSAN committees

Assist in assessing the local situation related to water and sanitation, helping the site selection and mapping steam in the process of site selection;

Assist in the process of acquisition of private property when necessary;

Help installation of standposts and solve problems likely to rise in future;

Organise people's participation for the implementation of the various programme components and also for future operation and maintenance;

Take action on standpost attendant's reports of misuse of drinking water and also provide other required support;

To oversee that standpost surroundings are kept clean and create awareness among users on various environmental sanitation aspects;

Organise hygiene promotional activities in various local levels;

Supervision and management of the construction of low cost latrines, drainage, traditional water sources and other environmental protection programmes;

Provide the necessary advocacy and support for the implementation of water supply and environmental sanitation programmes;

Pursue and accelerate the recovery process of cost from the consumers and local panchayat;

5. Criteria fore selection areas

Objective criteria have to be evolved for identifying the most deserving areas for new water and sanitation schemes. The following 10 criteria could be adopted since they have already been used for the identification of areas for the second Netherlands supported water supply and environmental sanitation programmes.

Population density
SC/ST population
Socio-economic status
Status of women
Health status (morbidity due to water borne diseases)
Child mortality
Latrine coverage
Water supply not covered
Proportion of households do not use taps
Quality and Quantity of water

In addition to these, criteria which are locally more specific and relevant could be adopted for identifying the areas for new water and environmental sanitation programmes.

6. Criteria for location of Stand post:

The site selection procedures have to be developed for locating public stand posts and hand pumps They could be based on the following criteria

a. *Service criteria:* Focus on areas that cannot afford private connections. Priority to water deficit areas with poor households,

b *Distance criteria.* One standpost to serve a minimum of 15 to a maximum of 40 households within a walking distance of 250 metres,

c. *Physical criteria:* Ensure good drainage, avoid water logging on platform and surroundings. Avoid putting standposts in areas too close to roads and pathways that will be obstructive to traffic Technical feasibility will be checked by KWA before approving the location of standposts,

d. *Utility and financial criteria* Locations and numbers of standposts must be approved by the users, by the water and sanitation committees of the ward and the panchayat, with the indication of the willingness of the panchayat (and sometimes the users around the stand posts) to pay for the stand posts.

Following these criteria, the number of public stand posts can be curtailed and focus on standposts can be given to the colonies and places where the poor and needy people reside. As indicated above, from the mapping exercise, the economical and social status of the households can be stratified into three: (a) *rich* - for house connection (b) *Middle income* - for house connections and (c) *poor* - for public stand posts. Since the local bodies have to pay Rs 875 in the rural areas and Rs 1314 in the urban areas, for operation and maintenance of the stand posts it may be advisable to control the use and maintenance of such taps by the users themselves. It is worthwhile to add here that 60% of the people are willing to pay for the cost of water through stand posts and other public distribution systems. However, the supply should be regular and they should be informed about the developments occurring in the system including the difficulty in supplying water regularly. The users should be given more importance and their suggestions should be followed if feasible.

7. Cost Sharing

The users should be consulted and informed about the various aspects concerning the scheme including the technology, source costs and other aspects. They should be given opportunity to become partners of the programme In the spring development and well improvement programme, users contribute 50% of the cost of the facility. In areas where they cannot afford to contribute financially, they provide all

the labour including the transportation of the materials to the site. Such initiatives should be given greater importance in the new water supply schemes.

8. Operation and Maintenance

The operation, management and maintenance issues are to be discussed with the users while planning the project and responsibility has to be given to various groups. O & M funds should be introduced from the very beginning of the scheme and should be deposited into a joint bank/post office account.

Skilled persons from the locality could be identified and trained in repairing the tap, small distribution net work, hand pump and other simple and common pipeline leaks. In view of the 73rd and 74th constitutional amendments, a cost effective, decentralised and community based operation and maintenance system has to be developed

9. Environmental Sanitation

Sanitation should include household latrines, institutional latrines, pay and use systems, garbage disposal, low cost drainage, personal hygiene, school hygiene, environmental hygiene, etc.. Panchayats will be in a position to develop and implement programmes with the help of WATSAN committees. Based on working with the community since 1988, the SEU foundation has already developed a panchayat level operational strategy for the implementation of the environmental sanitation programme.

The subsidy should be phased out and it should be replaced by loan and revolving funds. Those who do not have and cannot afford sanitation facilities should be also given priority for including in the programme. The resources from various programmes are to be pooled for total coverage and effective use. A detailed strategy framework has to be developed for covering 70% of the households in Kerala with sanitary latrine in the coming five years and all the households and institutions in the State with effective disposal systems by 2005 In the ninth plan sufficient emphasis should be given to control the water borne diseases in Kerala, for which a different mission and vision in the water supply and sanitation sector is imperative. If there is a will, there will always be a way to resolve and address this issue in a pragmatic manner.

Appendix - C3

Low Cost Water Treatment Plants

N P. Govindankutty and Rajeevan . M.N.

QUALITY DRINKING WATER is a distant dream for several million people living in rural India. This is basically due to the reluctance of the implementing agencies to invest money for treatment of water in rural areas, largely out of fear of failure of cost-effectiveness and upkeep levels. It has been observed that though many cost reducing innovations have resulted from several research activities in India, the results are seldom translated into practice because of the conservatism of practicing Public Health Engineers.

When installed in rural areas and many times in urban areas as well, the conventional water treatment plants (WTP) result in operational and maintenance problems because of lack of necessary infrastructure for repairs. Neither are small conventional WTPs cost effective with the prevailing cost in India being around Rs 12 lakhs/Mld for plants upto 5 Mld For smaller capacities ranging from 2-3 Mld, installation, operation and maintenance of conventional plants are also found to be very difficult.

Isolated attempts have been made in the country to design and install cost effective WTPs However, the practicing engineers have been reluctant to spread the philosophy of minimum mechanical sophistication and maximum reduction in construction costs.

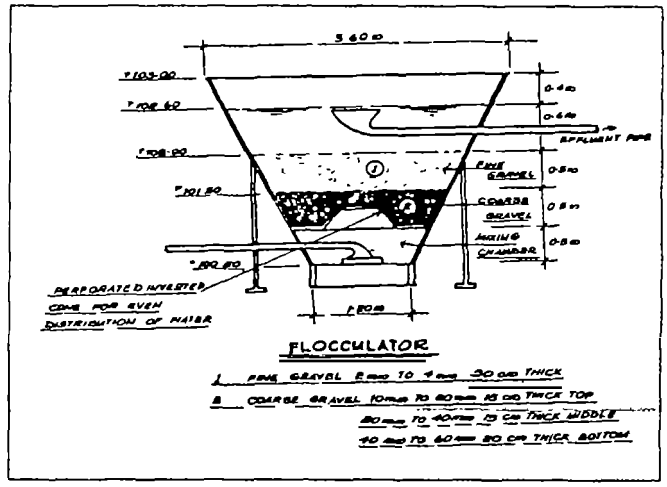
It is quite pathetic to see clanflocculators with non-rotating bridges and flocculator paddles, sludge boiling etc. in several plants in the Indian water treatment scene, even though as early as in 1977, the superiority of horizontal flow settling tanks has been studied and reported by Dr. Agarwal. Dr.Patwardhan, Dr Kardile etc., are also pioneers in the field of cost effective treatment plants Even the advantage of continuous desludging in circular clariflocculators is nullified in rural India due to non existence of facilities for repair and maintenance of mechanical equipment

In the paragraphs that follow, an attempt has been made to discuss and promote the prospects of using minimum mechanical equipment, resulting in maximum cost reduction, simple operation and maintenance, leading to optimum efficiency of WTPs of smaller capacities.

Chemical mixing and flocculation

Mechanical flash mixing is the current fashion and standard as it is cheaper for large plants, compared to hydraulic mixing But for small plants hydraulic mixing is desirable as its superiority over mechanical flash mixing has been shown in studies The main disadvantage of hydraulic mixing is the unsuitability which arises when the actual flow varies from the designed flow. But this can be mitigated by using multiple units in an economical way.

In the design example available with the authors, a single 2 Mld flocculator has been adopted, though 2 units of 1 M1d each can be designed without much escalation in costs The mixing and flocculation is combined in an upflow pebble bed flocculator in the design example. The design - a circular shape adopted to achieve economy in construction - is based on experiments done by Dr. Bhole and S Vaidyanathan. A tapered flocculation has also been attempted.

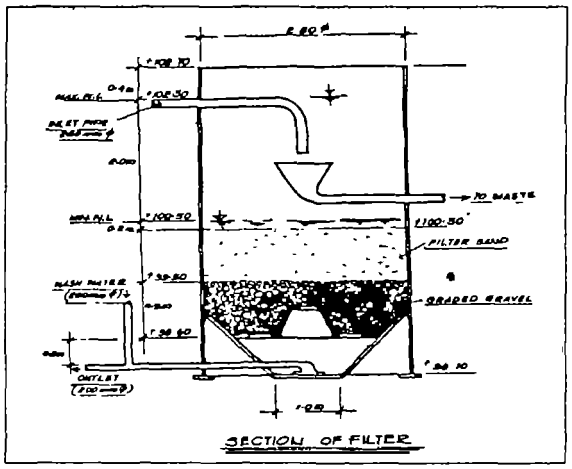


The big advantage of this flocculator is the reduction in detention time and elimination of mechanical equipment. The problem of occasional clogging of the flocculation can be overcome at a nominal additional cost by providing arrangements for high velocity upwash using wash water from filter. The cost of structures and equipment for dosing chemicals is not considered here as this forms only

a small percentage of the cost of the plant. Moreover, it is possible to fabricate economically simple, manually adjustable equipment locally.

Settling tanks

Generally, settling tanks are given large capacities providing longer detention times to avoid disturbances to the settled floc Plate and tube settlers overcome this limitation but involve problems of desludging. One way of overcoming this problem is providing steeply sloping (60° to the horizontal) plate settlers and hopper bottoms to the tanks facilitating continuous desludging This reduces the detention time to about half an hour and also eliminates the mechanical devices for desludging, thus overcoming operation and maintenance problems.



SECTION OF FILTER

Tube settlers, which are quite common in western countries, are not in vogue and are not utilized in an effective way in developing countries such as India, due primarily to the innate conservatism and distrust of innovations by practicing engineers. For small plants, these settlers are quite handy, effective and economical. Adoption of plate settlers results in a saving of 50% in costs when compared to conventional settlement tanks.

Rapid sand gravity filter

The common practice in advanced countries is to achieve higher filtration rates using coarser sand But in India we still follow conservatively low filtration rates (80Lpm/m^2) necessitating larger filters and consequently, higher costs.

Higher rates of filtration using dual media filters have been successfully demonstrated by Dr. Kardile and S.N. Ranade et al. But these have not been widely adopted, perhaps due to operational problems. Since higher rates are possible using coarser sand instead of dual media without much innovation in design excepting higher filterwash rates, we feel that these filters can be made more popular. Constant rate filters with influent flow splitting are proposed because they do not require mechanical equipment like the filter rate controller, loss of head indicator etc.. Besides, development of negative head is totally prevented.

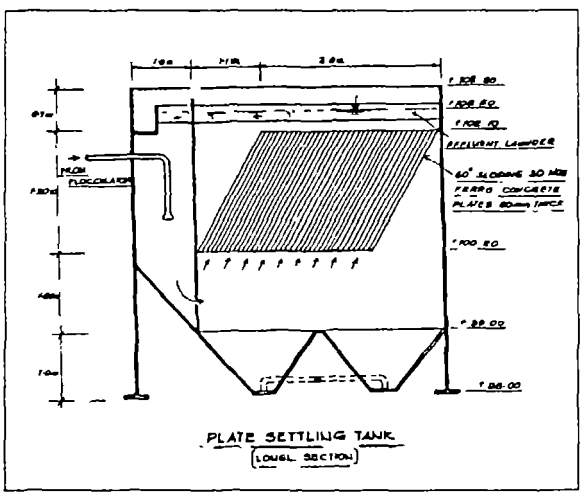


PLATE SETTLING TANK
(LONGL SECTION)

Adoption of a circular shape more than compensates for the extra depth of filter box, due to considerable cost reduction in structural works. A circular shape also helps to adopt an inverted conical flow enabling the use of an economical, simple, perforated cast iron bell for the under drainage. Incidentally , this results in low wash heads as well.

A central circular weir is used for washwater collection at the centre of the filter effecting economy and uniform flow of washed water to the drains 'V' notches are proposed for equal flow splitting to the filter whereas the central circular weir assures even distribution of clarified water over the filters.

High velocity wash without an airwash is proposed to reduce operational and maintenance problems. The filters are not proposed to be covered. The philosophy is to use mechanical equipment to a minimum, effecting considerable savings and avoiding operation and maintenance problems.

Washwater tanks etc.

Generally, the capacity to wash 2 filters simultaneously is provided for the wash water tank. In the design example available with the authors, the capacity of wash water tank is limited to wash only one bed; instead the capacity of the wash pumps has been increased to fill the tanks within one hour. Circular shape is provided for both the clear water reservoir (CWR) and wash water tank (WWT) and provision of the same diameter for both, helps in considerable cost reduction.

Even the staging required for the WWT has been reduced due to the special nature of the under drainage system adopted. The mechanical equipment is restricted to a few pipes, valves, 2 wash water pumps and chlorinator equipment.

Conclusion

We are not propounding new theories through this paper Neither has any original idea developed by us been used in the design of the plant. A large number of experiments are being conducted in several laboratories in India with interesting results But sadly there is a reluctance on the part of the practicing engineers to assimilate the results of these experiments and translate them into practice. What we have attempted is to draw from the experiences of several such researches and to use them in an innovative way to achieve economy in the design of small water treatment plants

If one can draw from the results of these studies and put them into practice in an innovative manner, it will definitely lead to cost reduction, a lesser number of breakdowns, better overall efficiency in the water treatment sector and larger consumer and organisational satisfaction in a resource starved country such as India. We appeal to all practicing Public Health Engineers to shed their conservatism and experiment with the valuable research findings available in the country. Let more people have access to good quality drinking water.

FUNCTIONAL DESIGN OF 2 M.L.D PLANT

Detailed calculations are not given in order to reduce the length of the paper

1. **Chemical Mixing and Flocculation:**
   Chemical mixing and flocculation are proposed in a single upflow pebble-bedded chamber in the shape of an inverted truncated creating a tapered velocity gradient. (See Ref. 6)

1 1 Diameter of inlet pipe.
Adopt 150 mm giving a velocity of 1.36 m/sec and a Reynolds No. of 2 04 000 giving good turbulent condition. The details of the chamber are given in the drawing below.

1 2 Inlet Chamber:
Providing 6 jets of 4 5 cm x 4 5 cm at inlet point the velocity is 1.98 m/sec and Gt will be 6850 giving efficient mixing.

1.3 Flocculator:
The permeability of the gravel will be 504 m/hour and the corresponding G will be 43 8/sec. The detention time in the chamber will be 5.37 minutes.

2. **Clarifier:**
   The design is done based on references 2,5,9,10 and 16 The details are given in the drawing below.

3. **Filters:**
   Two units circular in shape with a high rate of filtration of 120 lit/min/m^2 are adopted for simplicity of operation (See ref: 17) The details are given in the drawing below.

4. **Wash Water Tank:**
   Capacity to wash one filter is given with wash water pumps to fill the tank in one hour. This comes to 40m^3.

5. **Clear Water Tank:**
   45m^3 capacity is provided equal to half an hour's demand.

6. Estimate:

A rough cost estimate amounting to Rs.12 5 lakhs is given below based on market rates available in Kerala.

A.CIVIL WORKS

				Amount (Rs)
1	Flocculator			
	R C C Tank	10m3 Capacity	Rs 2000/M^3	20,000
	Gravel	$3M^3$	Rs 2500/M^3	7,500
2.	Settling Tank			
	R C C. Tank	$65M^3$ capacity	Rs.2500/M^3	1,62,500
	Ferroconcrete plates	4M3	Rs.7500/M^3	30,000
3	Filters R C.C			
	R C C. Tanks			
	2 Nos Filter	$25M^3$ Capacity/E	Rs 2500/M^3	1,25,500
	media	15M3	Rs 3000/M3	45,000
4	Wash Water Tank			
	R C C Tank	$40M^3$	Rs 4000/M^3	1,60,000
5	Clear Water Tank			
	R C C Tank	45M3	Rs 2500/M3	1,12,500
6	Chemical store lab,			
	lobby framed Building	$60M^2$	Rs 3500/M^3	2,10,000
7	Chlorine room & Toilet			
	Built up area	$15M^2$	Rs 3500/M^2	52,000
8	Water Supply &			
	Sanitation	LS		15,000
9	Electrification	LS		25,000
Unforeseen				34,000
	Total			10,00,000

B. MECHANICAL WORKS

1	c i Pipes 150, 200, 250 & 350mm	LS	40, 000 00
2	Valves (100mm 2 Nos, 150mm-1 No		
	200mm-5Nos 250 mm-5Nos 350mm-1 No)	LS	75, 000 00
3	Perforated CI bells @ 300 Kg	LS	10, 500 00
4	Sludge drainage arrangements	LS	25, 000 00
5	2 5 HP Pump sets - 2 Nos	LS	10, 000 00
6	Erection charges	LS	50, 000 00
	Unforeseen	LS	29, 500 00
	Total		2,50,000 00

Grand Total (A) + (B) = **Rs. 12,50,000.00**

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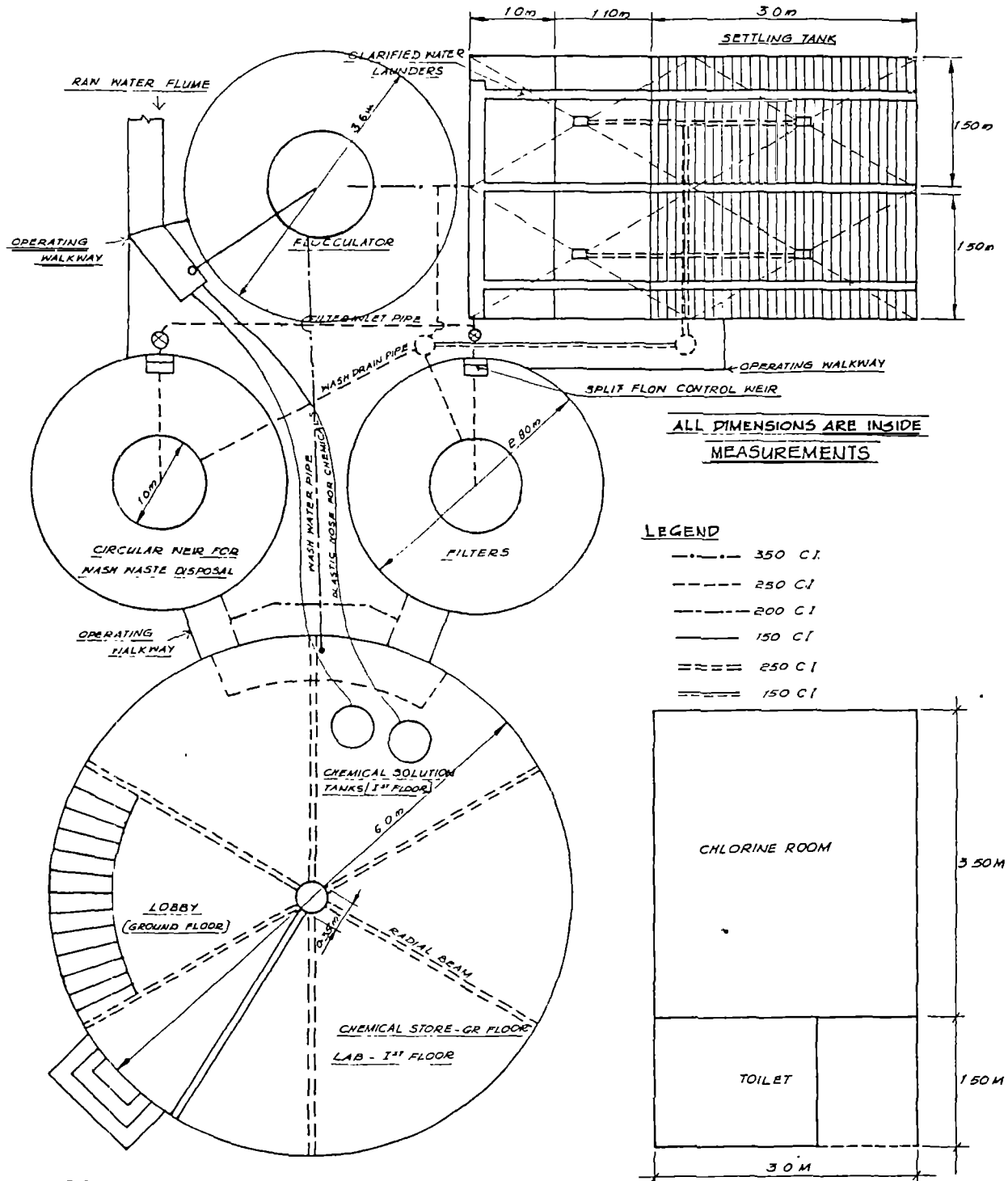


GENERAL LAYOUT OF THE 20Mld WTP

Appendix - C4

Summer Water Scarcity

T. N. N. Bhattathiripad

Drinking Water scarcity is keenly felt in rural areas as well as towns right from March till the on set of South West Monsoon in June. The reasons for summer scarcity can be enlisted but since Water Literacy is very low it will not be appreciated. The main reason is lack of water availability for pumping during summer months.

Rivers are the main source of drinking water in Kerala. Most of the Urban Water Supply Schemes have their drinking water source on river banks. There may or may not be infiltration galleries and collecting wells. If these structures are properly planned and constructed they will give trouble free service for almost a decade and a half. But many a time, there are drawbacks in the construction process and programme. This comes to the fore during summer months. There are remedies in most cases but nobody is serious about works connected with drinking water source.

The 41 west-flowing and 3 east-flowing rivers of Kerala convey 72,000 million cubic metres of water to the Arabian Sea and the neighbouring states. Only 4 to 5 percent of this run off is stored in reservoirs meant for hydel power generation, irrigation and drinking water. The major portion of the run off is during monsoon season and it lasts till the beginning of March. The summer months begin from March and lasts till the middle of June. During this period, water availability is suspect in many a drinking water intake There are some methods to make the source water worthy during summer. But the Irrigation Department and Kerala Water Authority do not show proper interest in such matters. This is why the Drinking Water problem during summer climbs to alarming proportions.

CHECK DAMS/SUB SURFACE DAMS are the main remedies. This has been proved practically at *Njavalin Kadavu* in the Bharathapuzha where a drinking water intake is located on each bank Before the check dam construction, the pumping operation from the intake at Mannur was very seriously affected by summer. After the construction of the check dam, water has always been available in both the drinking water sources.

It is up to institutions like CWRDM to make a study regarding the water balance studies before and after check dam construction. But even though it is an autonomous institution under STEC, the functioning is similar to Irrigation Department and Water Authority. Another check dam will become operational during 1997 summer at Lakkidi, downstream the previous one benefiting Thiruvillwamala and Lakkidi drinking water sources. Both these check dams were funded by Rajiv Gandhi National Drinking Water Mission.

A proposal is with the Kerala Government for the construction of 12 check/sub-surface dams in the Bharathapuzha. But the official apathy hinders the progress of people-oriented schemes. There are a total of 18 check dams in the tributaries of the Bharathapuzha viz., *Korayar* and *Varattayar,* mainly intended for irrigation.

Conservation of water during Monsoon helps to ease summer water scarcity to considerable extent. But this needs people's participation and also close supervision. The districts of Kannur and Kasaragod have carried out some work in this direction because of the initiative shown by the District Collectors and voluntary organisations Kannur and Kasaragod are the two districts prone to draught during summer. Schemes like *Kakkadau* dam and diversion of *Kabini* river are only in the paper and it may take some more time for actual programming and execution.

Kerala has the physical, geographic and climatic conditions favourable for water resources development and alleviation of summer draught. But it badly lacks leadership at the top level which is always manipulated by bureaucrats and politicians who are unaware of people's problems and remedies. This is why Kerala failed in achieving the Water Decade Target and lags far behind in the Water Revolution Decade.

Appendix - C5

Cost Effective Rain Water Harvesting and Sanitation Schemes
Laurie Baker

STORAGE OF RAIN WATER FROM THE ROOF OF A HOUSE.

Instead of filling in the spaces between foundation & plinth wall with soil etc — they can be left empty, plastered — & used as water storage tanks

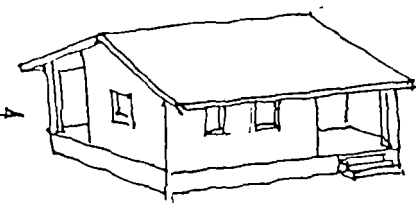
The water falling on the roof is led by gutters to pipes leading down to the tanks.

When water is not exposed to sunlight algae etc are formed & the water tastes & smells unpleasantly —

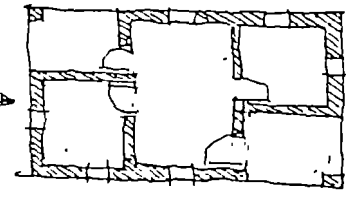
But it can pass thro a small Sand filter pit — or side Tank — & then the water is freed from algae etc & is usable.

The extra cost for this Tank adds almost nothing to the cost of the normally constructed house, & even if the floor slab does add to the total cost — it is nothing compared to the future cost of pumping or carrying water from external sources like streams & wells.

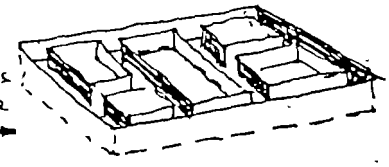
This is a typical small house →



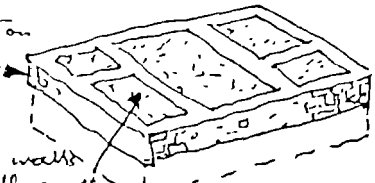
The plan will be something like this →



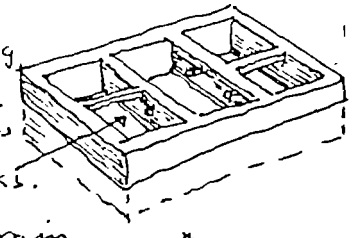
Trenches for the foundations are dug like this →



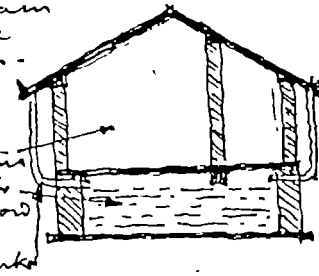
The foundation and plinth walls are built and the spaces between the walls filled in with earth



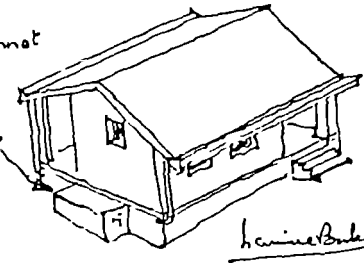
If this infilling is not done & sand excav-ation is done, you get a series of tanks. These can be plastered & rain water can be stored in them.



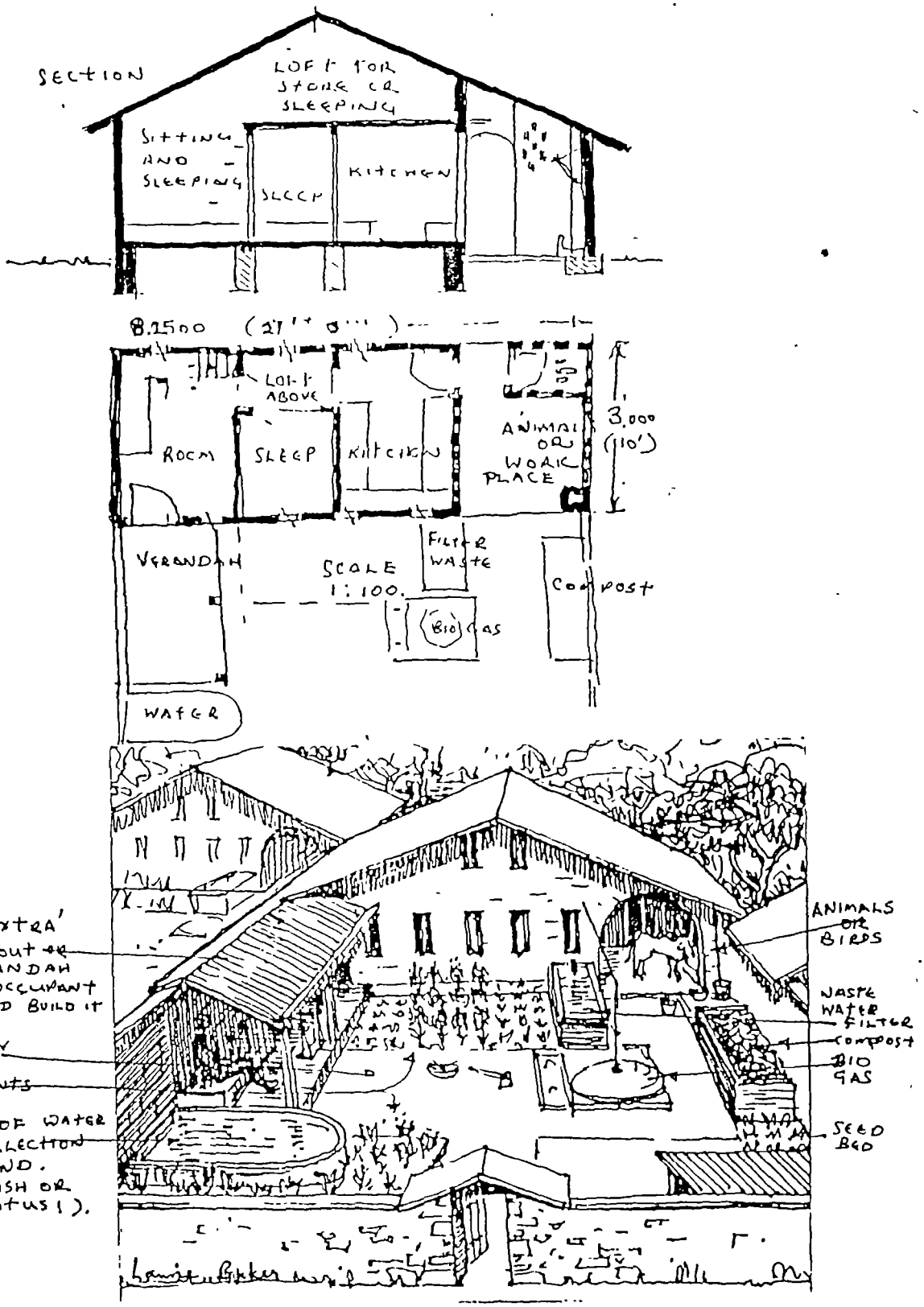
The section thro the house will be like this and the water tanks are below with pipes from roof to tanks



As sun cannot reach the waters — a small Sand filter is required



Laurie Baker


SECTION
LOFT FOR STORE OR SLEEPING
SITTING AND SLEEPING
SLEEP
KITCHEN
8.2500 (27'-0")
LOFT ABOVE
ROOM
SLEEP
KITCHEN
ANIMAL OR WORK PLACE
3,000 (10')
VERANDAH
SCALE 1:100.
FILTER WASTE
COMPOST
BIO GAS
WATER
AN 'EXTRA' SIT OUT OR VERANDAH (THE OCCUPANT COULD BUILD IT
PLAY
PLANTS
ROOF WATER COLLECTION POND. (FISH OR LOTUS!).
ANIMALS OR BIRDS
WASTE WATER FILTER
COMPOST
BIO GAS
SEED BED

A COST EFFECTIVE, MAKE-IT-YOURSELVES SANITARY LATRINE

There is a pit in the ground which has to be covered with a slab. A pan is set into the slab. It is better to have two pits - one for use, & when it is full, the other can be used. the empty one also has to be covered.

Clean water is needed for washing but used water can be collected and used for flushing the pan after use.

The Pit has to be lined with brick to prevent the surrounding soil from falling in. If you are not in a brick district you can use stone or laterite.

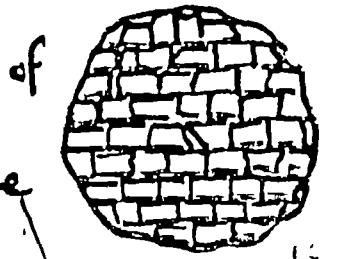
You can put a screen round the latrine for privacy and, if you want, you can add a door and a roof.

1. Dig a hole in the ground four or five feet (1·5 m) deep. Keep all the excavated soil on the ground near the top of the pit.

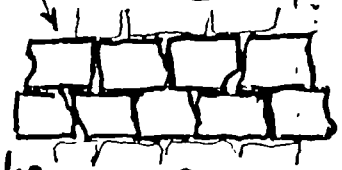
2. If you plan to have two pits, keep them 2 ft or ½ a metre apart so that the soil between does not collapse.

3. Get about 500 broken half bricks. There is no need to buy new whole bricks. You will also need half a bag of cement, two sacks of sand, and a sackful of small broken stones (about the size of a gulab jamon, or smaller.) Keep the cement dry until you need it.

4. Level the bottom of the pit & lay some half bricks, all close together, all over the floor of the pit

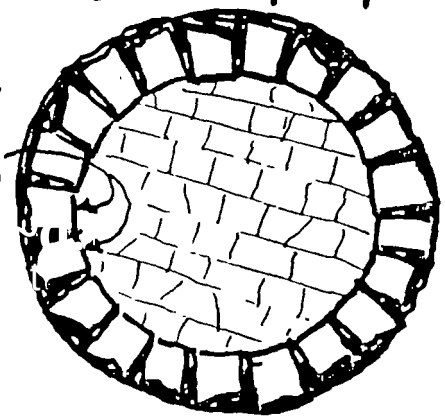


5. Do NOT use any mortar but make sure each brick touches the next brick

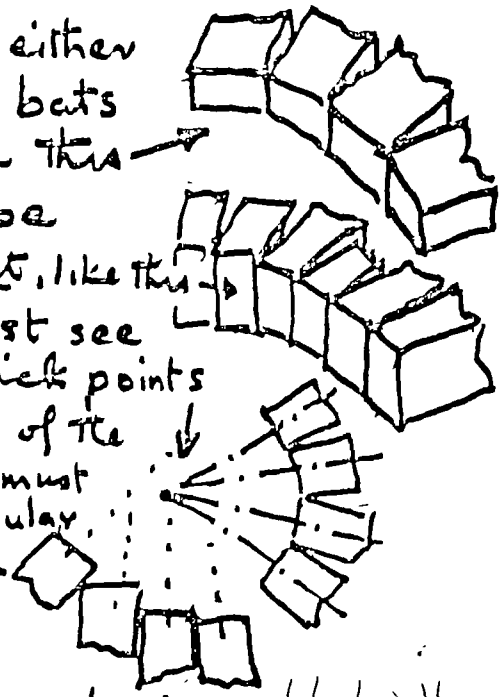


6. Now with a nail or a peg in the middle & a piece of string as a compass, drawn a circle about 6 inches (15 cm) away from the wall of the pit

7. Next, place the brick bats with the good end on the line - and each brick must touch the next brick.

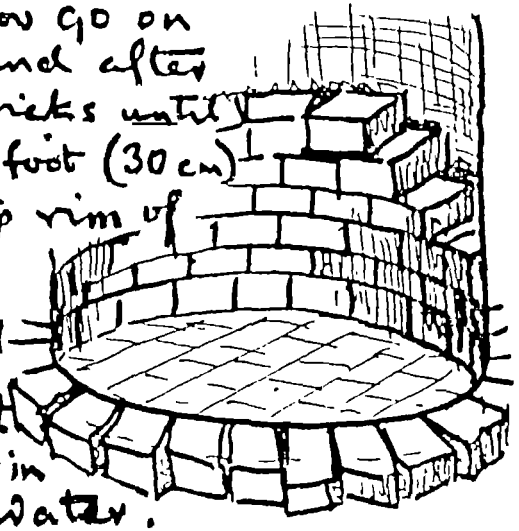


8. You can either lay the brick bats FLAT - like this → or they can be placed upright, like this → but you must see that each brick points to the centre of the circle & it must NOT be irregular, like this →



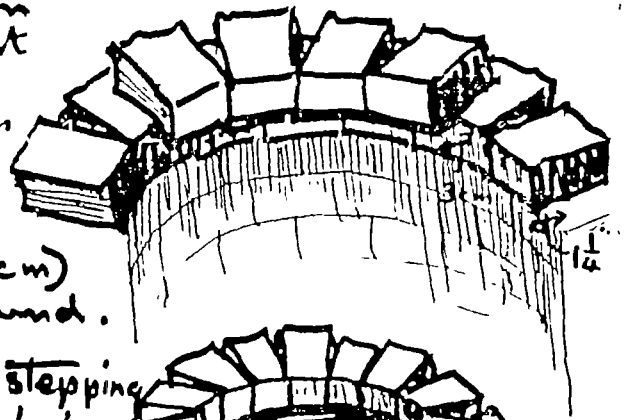
9. Now ~~root~~ push in some of the loose soil from the top & brush it in between & behind the bricks. Pour some waste water over the soil to wash it in & fill the cracks or 'joints' between each brick. You must NOT use cement because the toilet water, when in use, has to soak into the ground surrounding the pit's, thro the dry joints between the bricks.

10. Next, you go on placing round after round of bricks until you reach 1 foot (30 cm) below the top rim of the pit.

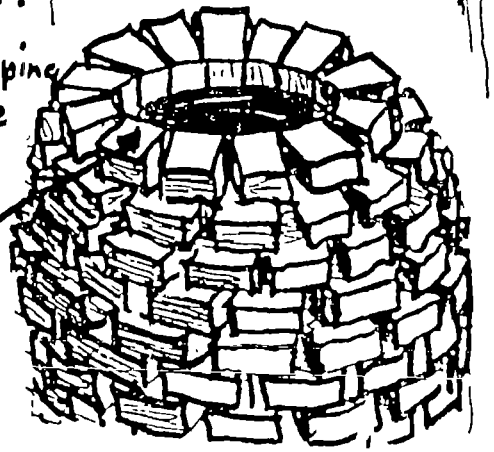


Keep on filling the cracks at the back with soil & wash it in with waste water.

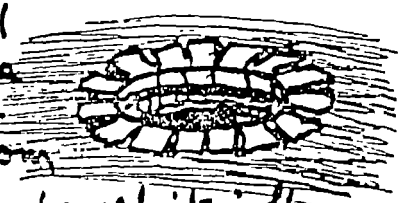
11. Now you have to start making a cone of bricks by stepping inwards by 1½ inches (3 cm) the next round.



12 Continue stepping in until the hole in the middle is only 1½ feet (or 45 cm) in diameter.



13. Finally fill all round the top hole with the excavated soil (which came from digging the pit) & level it off, slightly sloping away from the hole.

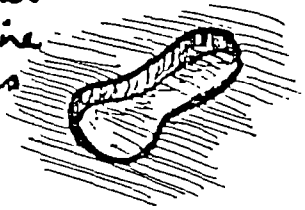


14. The next stage is to make a slab to cover the hole. In the middle of the slab will be the PAN. The Pan can either be made with a mould, or a white ceramic one can be bought.

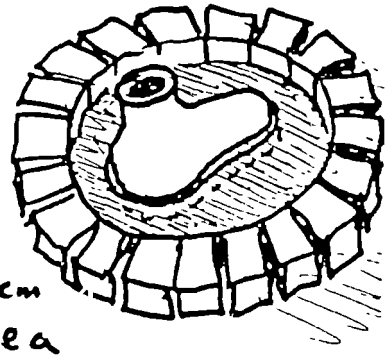
Place the pan, Top-Side-down, on a flat bit of ground →

Draw a line round it & then remove the pan.

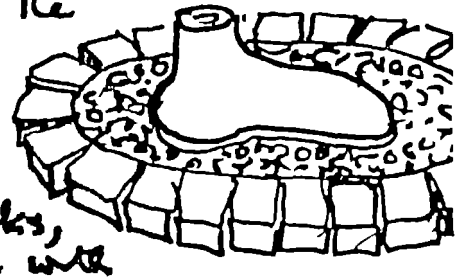
Next dig the soil out from the inside of the line to a depth of 2 inches (5 cm.).



15. Now place the pan back into the 2" deep excavated hole, draw on the ground a circle round the pan (about 2 ft or 60 cm in diameter) & place a line of bricks all round the line.

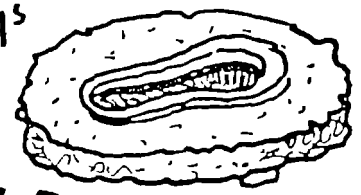


16. Make some concrete. Take 8 handfuls of stone chips, add 4 handfuls of sand and 2 handfuls of cement. Mix it up until you can't see any cement left. Add water (Not too much — so that if the mixture is held in your hand, no water will drain down your hand & arm!). When it is well mixed put it between the pan & level it with the top of the bricks. After an hour you can remove the bricks, cover the concrete with a sack, or straw, & keep it moist for about 10 days.



It is better to do all this in the shade of a tree, or building, to avoid drying out the concrete.

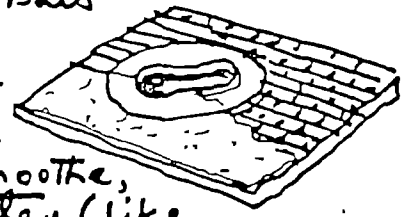
17. After 10 days you can pick up the slab & turn it right-side-up & it is ready to place on top of the pit hole.



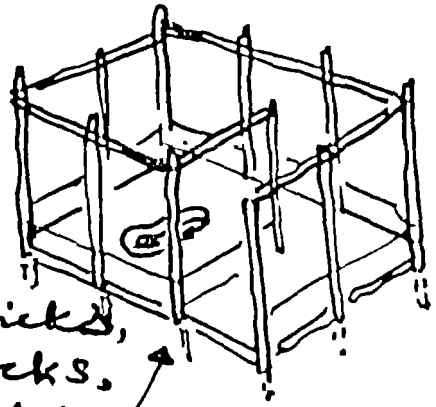
18. Make some mortar (8 handfuls of sand & 1 handful of cement) and put it on top of the top layer of bricks over the pit.

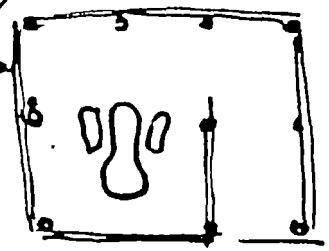
19. Place the slab with the pan over the hole, on top of the mortar.

20. You can now build a flat floor, of brick bats or of concrete, & then plaster it all over. If you want it very smooth, mix cement & water (like thick milk) & spread it all over & make it as smooth as you can before it sets hard.

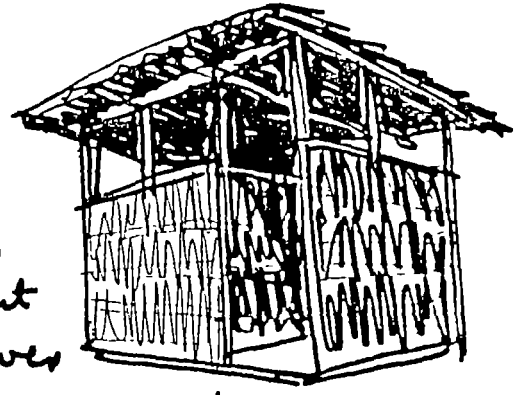


21. You can build a screen around the platform. It can be pukka & made of bricks, or stone or blocks. or you can put in some bulis like this & stretch Sacks, or matting or thatch straw or leaves etc. If the screen is 4 to 5 feet high, that is enough for privacy. A door is not necessary.

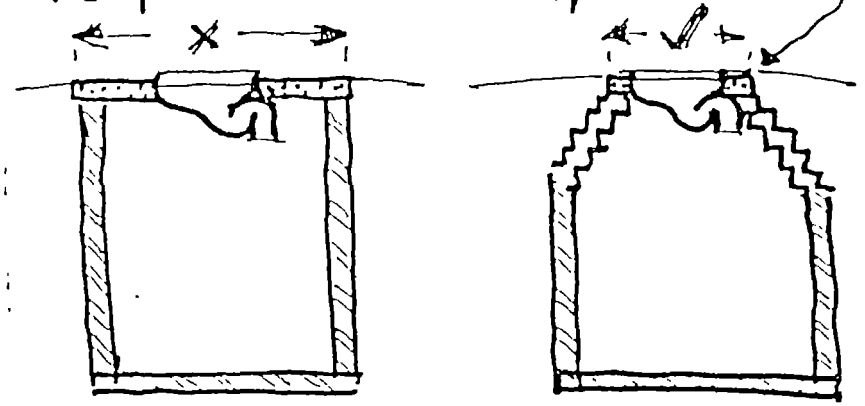




If you want a roof—the corner poles can be longer & you can put on them Whatever type of roof you want, or can afford.

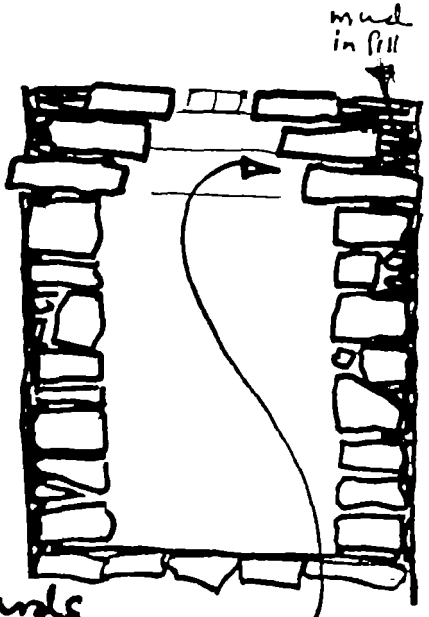


This type of pit and pan is less costly than the usual pattern. The reduction of cost is enabled because the open topped cone has reduced the pit top from about 16 square feet to only about 4 or 5 square feet. This reduced hole is almost covered by the pan & only the narrow slab of concrete round it is extra for it to sit on top of the pit-cone-brick Top.



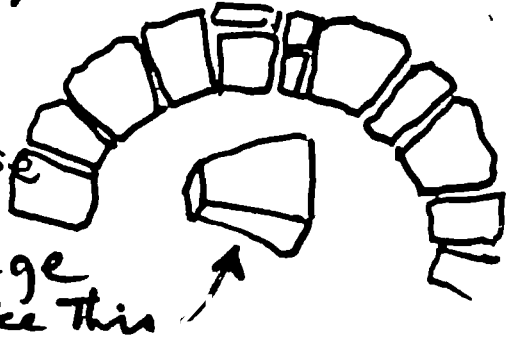
No steel is necessary.
If you have lime in your district you can use it instead of cement.

If yours is not a BRICK area but stone (random rubble) is available you have to dig the pit a bit wider — & then build a "dry stone wall" (ie without mortar)



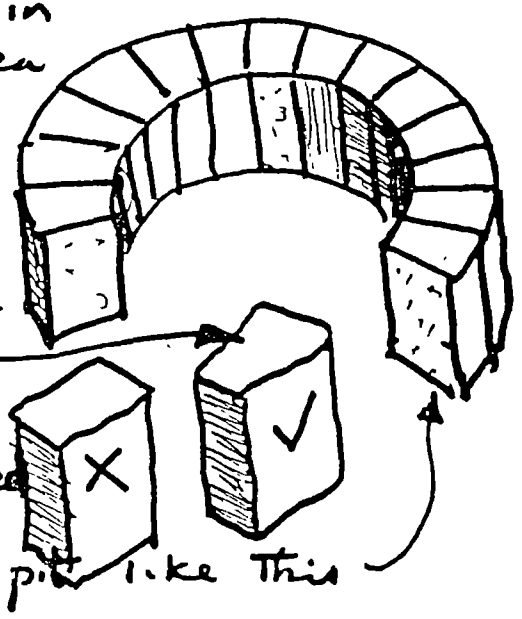
and, again, towards the top — you step the stones inward so that the top hole is about 2ft wide.

Try and pick out stones to use which are slightly wedge shaped — like this



The inside of the pit wall does not have to be perfectly smooth — so you do not have to "work" the stones.

If you live in a laterite area you can get the local mason to shape the stones so that they are slightly wedge shaped — a useful item for lining the pit like this



In conclusion, apart from a pukka ceramic pan, you yourself can make your entire sanitary latrine unit.

Try and place the unit at a lower level than your house & then your waste water can be simply filtered or flow down a pipe to a small tank adjoining the latrine. This water can be used for flushing & cleaning the pan.

Laurie Baker