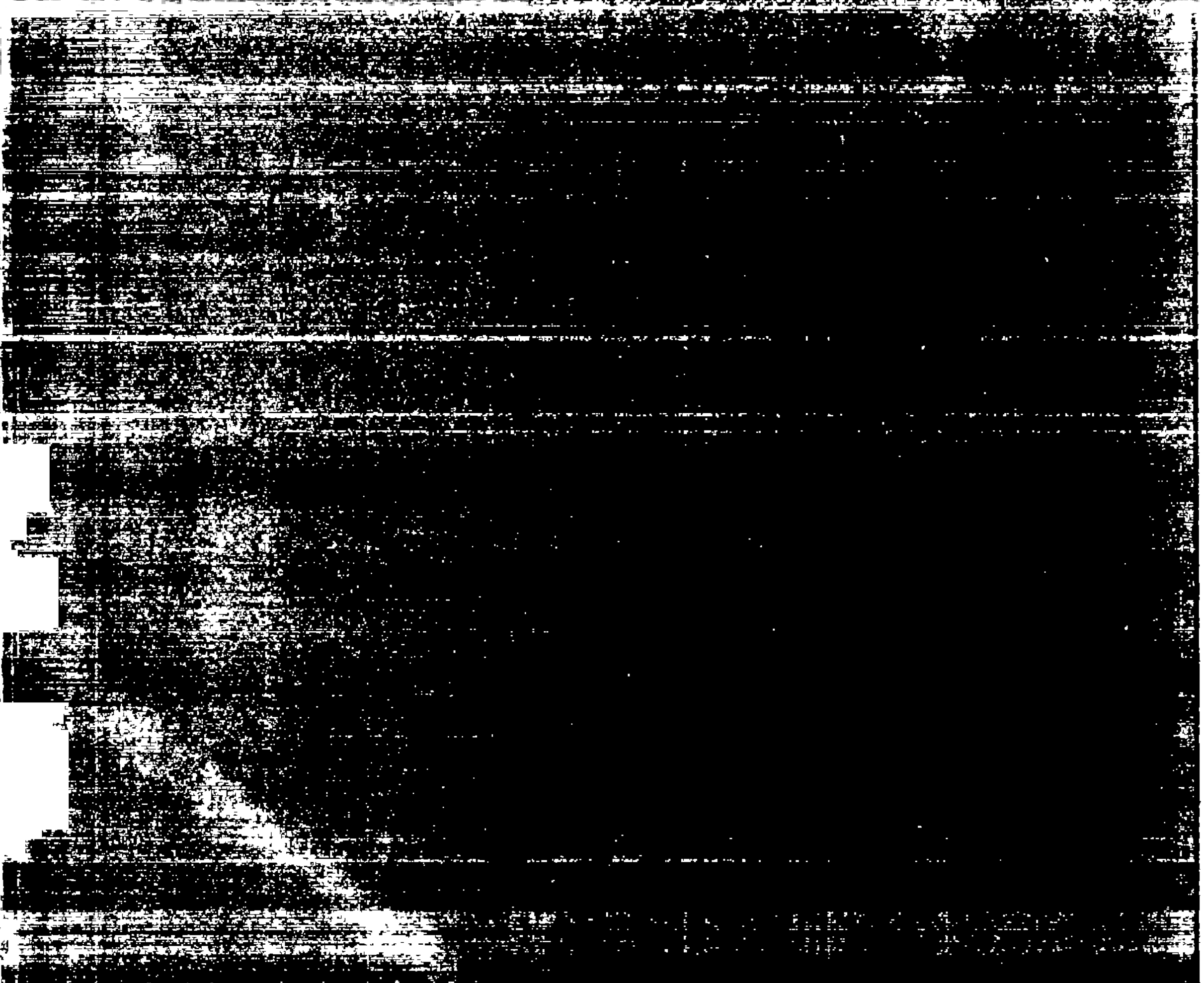
EVALUATION

Drinking Water Projects in India



Danida

1991 / 11

Ministry of
Foreign Affairs

Danida

EVALUATION REPORT:

DRINKING WATER PROJECTS

IN

INDIA

The views expressed are those of the authors and should not be attributed to Danida or to the authorities in the partner country

A report prepared
for Danida
by Denconsult

Danida 104.Dan.4/52-8/eval.

September 1991

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IN

INDIA

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ABBREVIATIONS & GLOSSARY

AE	Assistant Engineers
AEE	Assistant Executive Engineer
ADP	Area Development Programme
AFPRO	Action for Food Programme
ARWSP	Accelerated Rural Water Supply Programme
BDO	Block Development Officer
BIS	Bureau of Indian Standards
BW	Borewell (=Tubewell)
CA	Chief Adviser
CDS	Centre for Development Studies, Trivandrum
CE	Chief Engineer
CGWB	Central Ground Water Board
CI	Cast Iron
CO	Coordinating Office
CT	Caretaker
DANIDA	Danish International Development Agency
DC	District Collector
DD	Design Division
DEA	Department of Economic Affairs, Ministry of Finance, GOI
Dept.	Department
DGIS	Directorate General for International Cooperation (Netherlands)
DHCP	Danida Health Care Project
DHFW	Directorate of Health and Family Welfare
DHS	Directorate of Health Service
DKK	Danish Kroner
DOH	Department of Health
DPD	Danida Project Directorate
DPO	Danida Project Officer
DRA	Drilling Advisor
DRD	Department of Rural Development
DRE	Drilling Division Executive
DTH	Down-the-Hole-Hammer (Drilling Method)
DWCRA	Development of Women and Children in Rural Areas
EC	Executive Coordinator at CO
EE	Executive Engineer
EO	Extension Officer (Social Welfare)
FACAD	Financial Administrator and Chief Accountant Officer of KWA
FD	Field Division
GA & AD	General Administration and Accounting Division
GI	Galvanized Iron
GMP	State Government of Madhya Pradesh
GOD	Government of Denmark
GOI	Government of India
GOK	Government of Karnataka
GOK	Government of Kerala
GON	Government of the Netherlands
GOO	Government of Orissa

GOTN	Government of Tamil Nadu
GP	Gram Panchayat
Gram Panchayat	Council of Village Panchayats
ha	Hectare
HE & T	Health Education & Training
HP	Handpump
HQ	Headquarters
ICDS	Integrated Child Development Scheme
ICMR	Indian Council for Medical Research
IM-II	India Mark - II (Handpump)
IRDP	Integrated Rural Development Programme
IRP	Iron Removal Plant
JE	Junior Engineer
JHC	Janatha Housing Colony
KWA	Kerala Water Authority
LFA	Logical Framework Approach
Mandal	Village Committee
MD	Managing Director
Mech	Mechanical
MHA	Multipurpose Health Assistant
Mld	Million Litres per Day
MNP	Minimum Need Programme
MP	Madhya Pradesh
MWS	Mini Water Scheme
MYRADA	Mysore Rural Development Agency
NEERI	National Environmental Engineering Research Institute
NGO	Non Government Organization
NREP	National Rural Employment Programme
O & M	Operation and Maintenance
ORG	Operation Research Group
OTC	Open Top Cylinder
PA	Personal Assistant
PAG	Project Advisory Group
Panchayat	Local Administration Council for a Rural Area (few villages)
PD	Project Director
PH	Public Health
Ph	Phase
PHC	Primary Health Centre
PHE	Public Health Engineering
PHED	Public Health Engineering Department
PHU	Primary Health Unit
PLANOP	Plan of Operation
PMD	Planning & Monitoring Division
PME	Planning & Monitoring Executive
POO	Plan of Operation
PSC	Project Steering Committee
PTU	Pump Testing Unit
PVC	Polyvinyl Chloride
PWD	Public Works Department
PWS	Piped Water Scheme

R & D	Research & Development
Repr.	Representative
RLEGP	Rural Landless Employment Guarantee Programme
RNE	Royal Netherlands Embassy
Rs.	Rupees
RWO	Rural Welfare Officer
RWS	Rural Water Supply
RWSS	Rural Water Supply and Sanitation
Sarpanch	Village Leader
SC/ST	Scheduled Caste and Scheduled Tribes
SE	Socio-Economist
SEA	Socio-Economic Adviser
SED	Socio-Economic Division
SEE	Socio-Economic Executive
SEM	Self Employed Mechanic
SEU	Socio-Economic Unit
SIDA	Swedish International Development Authority
STA	Senior Technical Adviser
SuE	Sub-Engineer
SWD	Social Welfare Department
SWL	Static Water Level
TA	Technical Assistance
T & M Adviser	Training & Maintenance Adviser
TMD	Training & Maintenance Division
TOR	Terms of Reference
TRYSEM	Training of Rural Youth for Self Employment
TWAD (BOARD)	Tamil Nadu Water and Drainage Board
UAS	User Acceptability Studies
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
VLOM	Village Level Operation & Maintenance
VP	Village Panchayat
VRD	Water Resource Division
WHO	World Health Organization
WRD	Water Resource Division
WRE	Water Resource Executive
WWC	Ward Water Committee
Zilla Parishad	~District Council
ONE LAKH	100,000
ONE CRORE	10 Million
100 RUPEES	Approx. 5.3 US$ or 30 DKK (February/March 1991)

MAP OF PROJECT LOCATIONS IN INDIA

PREFACE

The present evaluation of the Danida supported drinking water projects in India forms part of Danida's current evaluation programme. The programme for 1990-92 includes a global sector evaluation of Danida supported water supply projects in various countries.

The purpose of the sector evaluation is to provide feed-back from experiences gained during more than a decade of involvement in drinking water projects, in order for Danida to formulate future policies and plans for new assistance within this sector.

From the beginning of the 1980s, Danida has supported drinking water projects in the five states of Karnataka, Kerala, Madhya Pradesh, Orissa and Tamil Nadu, as part of its bilateral grant programme with India. The present evaluation covers the projects which have been or are about to be terminated in Karnataka, Madhya Pradesh and Tamil Nadu, as well as the two ongoing projects in Kerala and Orissa. The socio-economic activities of the Kerala project are under parallel financing with the Netherlands. It was decided by Danida that the evaluation should only cover the Danish funded activities around Calicut. The two new integrated projects in Karnataka and Tamil Nadu are not evaluated.

After formulation of the Terms of Reference for the evaluation (Annex II), Denconsult was given the assignment to carry out the evaluation. Danida and Denconsult agreed not to make five separate evaluations but rather to collect experiences around selected issues and questions, and on this basis make a cross-cutting assessment of the five projects. This approach was outlined in a note on issues dated 20 October 1990, and enclosed as Annex III. As a consequence, the evaluation does not go into details about the implementation of each project. It was also agreed not to consider the project activities related to iron removal plants which are still at a planning/-pilot stage in the Madhya Pradesh and Orissa projects.

The following Evaluation Team was formed:

Mr. Henrik Christensen, hydrogeologist
Mr. Kenneth Gray, water engineer
Ms. Elizabeth Kleemeier, sociologist
Mr. Michael Loft, institutional analyst
Mr. Henrik Schaumburg-Müller, economist, team leader

The team received support from Ms. Shamala Devi, sociologist, during its stay in India. Ms. Anna Runeborg reported on health education and sanitation activities in the Kerala project.

Two team members made a preparatory tour to the projects in October/November 1990; subsequently the team visited the projects during the period from 15 February to 15 March 1991. The programme for the team members is given in Annex IV. During their stay in the project states, the team members made field visits to project areas and held discussions with project staff and government officials. The field trips included interviews with beneficiaries as well as project staff and officials at various levels. Annex V supplies a list of persons met during the mission, while Annex VI gives details on villages in the project areas where interviews were made. Due to a fuel shortage, the team could not visit the project areas in North Karnataka.

The variation of the activities of the different projects gave a perspective to the cross-cutting analysis but also made it difficult to compare when circumstances or technologies were very far apart. Another problem for both an assessment of effect and impact was that not only was the support to three of the projects only about to be terminated but the two projects with integrated socio-economic, health education and sanitation activities are likely to be continued for quite some time. For some activities, the evaluation team therefore had to make an assessment long before the support is terminated.

Supplementary documentation was collected in addition to the large amount of material already available. The list of background documentation consulted by the team is given in Annex IX.

The team prepared a paper on preliminary findings and recommendations which was presented to representatives from the Government of India and the Danida Office in New Delhi on 19 March before leaving India. The paper was also discussed at a debriefing meeting on 20 March with Danida in Copenhagen. The responsibility for the findings and conclusions in this report is, however, the evaluation team's alone. The team would like to express its gratitude to all officials, project staff and individuals met for their kind support and hospitality, and for providing valuable information which greatly facilitated the work of the mission.

EXECUTIVE SUMMARY

Project Description

From 1980 to the end of 1990 Danida spent approximately DKK 400 mill. on bilateral projects to provide drinking water to about 7.5 million people in five Indian states: Madhya Pradesh, Karnataka, Kerala, Orissa and Tamil Nadu. The states have been responsible for implementation under Government of India's national rural drinking water programme, one of the largest in the world. Danida had earlier supported the programme through UNICEF, the leading donor agency in the field.

The objective of the first Danida supported projects in Madhya Pradesh, Tamil Nadu, and Karnataka had the general welfare consideration to improve the supply of drinking water for the rural population by supplying and rejuvenating India Mark II handpumps. Danida mainly delivered items such as drilling rigs, pumps, tools, and vehicles to the Indian institutions responsible for implementation and maintenance. Local governments contributed with a large share of total project costs. Gradually, the thrust of these projects shifted from hardware to software, and particularly toward maintenance rather than the provision of installations. Establishing model systems for maintenance became an additional objective. Therefore training also featured more prominently in Danida's support.

By 1982 Danida initiated a second type of project in Orissa and later in Kerala, integrating sanitation, health education, and rural water supply. The distinguishing features of these projects were the emphasis on improved health as overall objective, and institution-building and sustainability as immediate objectives. The project structure included socio-economic units, and a main element in the strategy became full coverage in project villages. Both projects were also extremely ambitious, aiming to cover about 500,000 and 2 million people respectively in Kerala and Orissa. While the project in Orissa focused on drilling of borewells and establishment of handpumps in the coastal belt, the project in Kerala went into construction of large piped water schemes.

Danida-financed advisers were attached to all the projects. In total, long term advisers have been provided for about 73 man-years. More than half of the advisers has been employed by the Orissa project, which also received the majority of expatriate short-term consultancy.

Major Findings

The first projects in Madhya Pradesh, Karnataka and Tamil Nadu have made remarkable achievements, and during the past ten years installed handpumps to serve approximately 5 million people in poor rural areas. The physical implementation targets for these projects have been met. Valuable support introducing innovations and new technology has been provided in all projects. Particularly the support given to the hydrogeological institutions and the drilling programmes has strengthened operations. The two integrated projects are still ongoing, and the extend to which targets and objectives will be fully achieved can only be seen later.

For the ongoing Kerala project, the physical targets are likely to be met. For the Orissa project, the current technical problems make it uncertain when the project will provide the designated project area with drinking water. For both ongoing projects, the integrated activities have been performed for a number of years now and some impressions can be made, but in general it is still too early to document to what extent their immediate objectives will be met.

Implementation in all projects has taken much longer than expected. Especially for the Orissa and Kerala projects, this delay has political, economic, and social implications.

Danida's focus on handpump maintenance was correct, because this is becoming increasingly important in India, with more than 1.5 million India Mark II deepwell handpumps installed. In the absence of a sustainable maintenance system on a national scale, India stands to lose this tremendous investment. Danida also made the correct decision in focusing its maintenance assistance at the lower tiers of the maintenance system. However, with hindsight, one can see that insufficient attention was given to the training of block-level mechanics, spare part procurement and distribution, and policy dialogue with the water departments at the planning stage of the projects.

The caretaker training components have been successfully implemented, in that the intended large number of caretakers have been well trained. However, caretakers have not performed the expected roles in the maintenance system. In general the three tier maintenance system, of which caretakers form the third tier, has not worked efficiently for various reasons. The SEM system in Orissa shows potential as a low cost and efficient alternative to the three tier system, but the system has so far only been tested under field test conditions.

The Orissa and Kerala projects have initiated many health education activities, although the long-term impact of these is uncertain. Moreover, the education activities have not been based on a long-term strategy for institutional sustainability and a policy commitment by local authorities to participate. Important implementation initiatives have also been taken by the two projects with respect to sanitation, but again the prospects for the sustainability of these activities are uncertain. Until now there has been little opportunity to demonstrate that integration of water supply, sanitation, and health education improves health, or that adding the integrated activities results in a more effective project than one supplying clean water only.

Project designs have been characterized by vagueness as to which activities are meant to be institutionalized and which not. When project design identifies institution-building as an objective, it fails to present a strategy to that end.

Danida has justified, perhaps implicitly, its bilateral support to the drinking water programme in India on the premise that it can demonstrate new techniques and approaches which are more efficient, deliver benefits more equitably, better reach the larger objectives (such as health), or all of the above. So far, the projects have only partially lived up to this expectation, although there have been made valuable innovative contributions to the development of the sector within each of the projects. The hydrogeological support has in many cases also constituted an innovative component in respect of software as well as hardware.

Recommendations and Lessons Learnt

The Evaluation Team feels that any recommendation for Danida support to the drinking water sector in India must take as its point of departure the tremendous need to maintain the huge investment already made in provision of drinking water from handpumps. Although maintenance needs will increase dramatically in the coming years, a well functioning maintenance system, supported by policy reforms, has yet to be established.

Efforts to expand and institutionalize the Self Employed Mechanic (SEM) maintenance system - and various variants including systems with women's participation - should receive particular attention. Where opportunities are found to institutionalize the SEM system, support should also be given to spare parts distribution and local staff training.

The purpose of Danida assistance should continue to include testing and demonstration of innovative activities which can be made sustainable, and which are not already adopted by the central and state governments on their own. To pursue an innovative strategy not only requires funds and flexibility in approach, but also availability of sufficient expertise in planning and implementation. Danida must also consider from the outset how an innovation will be expanded to district or state scale. Assistance should not go for so-called pilot projects at village or block levels which, when replicated, will require a disproportionate amount of resources to sustain at a larger scale.

A project approach alone will in many cases - particularly for maintenance activities - not be sufficient to support development and change within the sector. The policy framework has to be clarified for example with respect to the financial and institutional responsibility for maintenance, and the choice between piped versus handpump technologies. There is also a need to look at the division of labour between the public and the private sector most obviously in relation to maintenance and sanitation activities.

The Evaluation Report provides additional concrete recommendations on how Danida can continue and improve its support to the sector. However, future assistance will not only require careful planning and realistic project strategies, but also an improved policy framework for a sustainable development of the sector. As adjustment and reforms of sectoral policies might be a precondition for effective intervention at the project level, Danida should not consider assistance only to projects but also be prepared to support sectoral or sub-sectoral programmes with technical and financial assistance which will strengthen the capacity of the institutions (or sub-institutions) in the states to introduce innovations and improvements in their general development programmes within drinking water and related activities.

1 SECTOR BACKGROUND

1.1 National Policy on Rural Water Supply

The Indian Constitution lists water supply as a responsibility of the states. Given that party politics are largely organized along national lines, that equity considerations have a prominent political position, and that providing public services is a means to transfer benefits to voters without purchasing power, it was only a matter of time before a national water supply policy was bound to evolve.

The Government of India became formally involved in rural water supply in 1954, but with little financial investment. This changed with the Accelerated Rural Water Supply Programme (ARWSP), introduced under the national Fifth Five Year Plan (1974-78), and continued up to the present. The central government through ARWSP provides 50% matching funds, and up to 75% in special problem areas, to states which implement a rural water supply programme conforming to certain criteria. The state "counterpart" programmes are referred to as the Minimum Needs Programme. The latter involve the following:

1. **Problem villages should be served first:** Currently "problem villages" are defined as those either without a water source or with one that is unacceptably distant; or water with an unacceptably high fluoride or iron content. The last survey in 1985, identified 162,000 problem villages.

2. **The present service level norm is one handpump per 250 persons, capable of providing 40 litres per person per day.** In the short-term, governments may provide just one handpump per problem village in order to "cover" all of these. Once all problem villages have received something, implementation can then shift to meeting this "full coverage" target.

3. **The scheduled castes and tribes (SC/ST) receive first priority.** Areas predominantly inhabited by SC/ST should receive first priority; and within villages, the ST/SC community should receive the first improved source. From 1990-91, the central government will reserve 25% and 10% of ARWSP funds for SCs and STs respectively.

More public funds have been invested in tubewells and handpumps in India than in any other country. Figures 1.1 and 1.2 illustrate respectively the expenditures and estimated number of beneficiaries over the last one and a half decades.

Figure 1.1 - Annual funding of the Drinking Water Programme, India 1974-1989

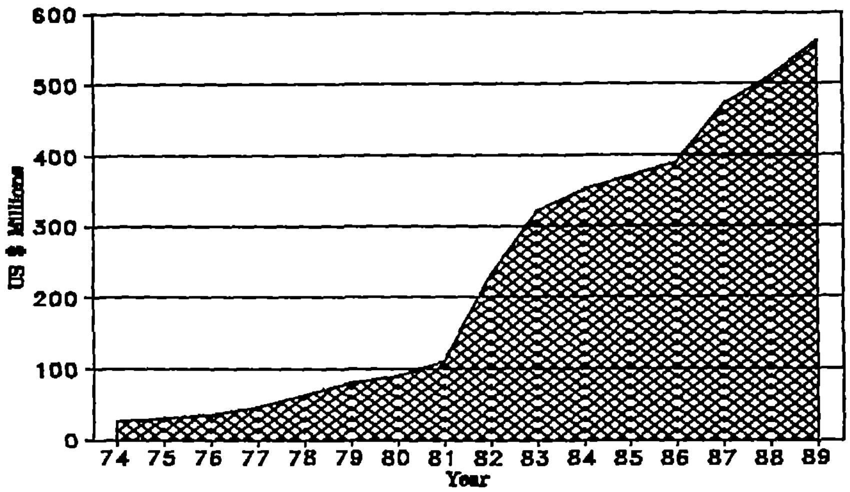
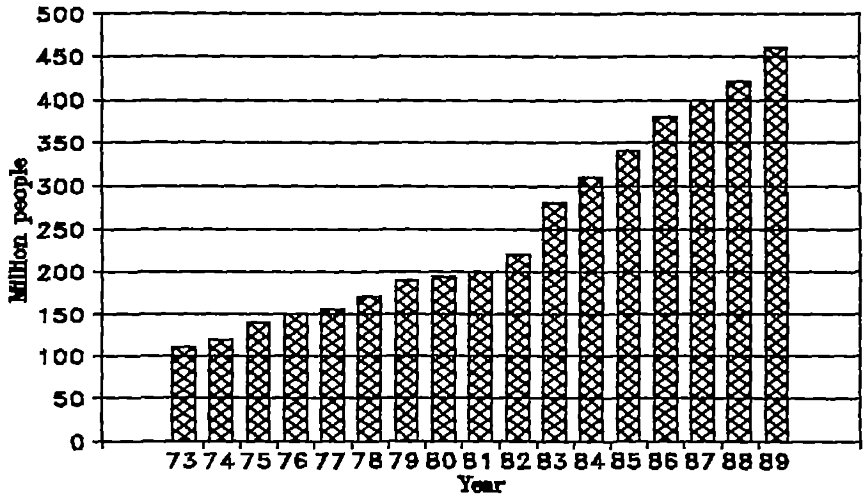


Figure 1.2 - People Served by Drinking Water Programme, India 1973-1989



The agencies in charge of providing water supply schemes in the individual States are the Public Health Engineering Departments (PHED) or some kind of Water Authority of those States. At the central level the Rural Water Supply and Rural Sanitation Programme was in 1985 transferred to the Department of Rural Development under the Ministry of Agriculture. The reason given was to accelerate the implementation of the programme and facilitate its integration with other rural development programmes. The following year the National Drinking Water Technology Mission was established under the same department. The intention was to mobilize all possible sources of technical know-how to give the programme the extra push needed to reach the Decade targets. Since its establishment the Technology Mission has functioned as the main dialogue partner for the donors in the sector, and been the main agency at the national level responsible for technical and policy improvements and co-ordination.

About 70% of India consists of hard rock terrain in which prospecting for water was always considered extremely difficult, and much of which is drought-prone and disease ridden. In the early summer of 1967 a drought emergency in the northern states of Uttar Pradesh and Bihar prompted voluntary and international relief agencies to fly in some "down-the-hole" (DTH) hammer pneumatic drilling rigs for water bore wells. They turned out to be able to drill holes in India's rock shield. These new rigs could produce a bore hole in a day while the best conventional equipment available until then would have taken several weeks.

In the early seventies the water supply programme had run into its second hurdle: the pumps installed on the bore wells were simply not working. Spot surveys showed that around 75 % of the pumps were out of action at any one given point in time. The installed cast-iron handpumps, which for generations had served single household rural homesteads in Europe and America, could not stand up to the constant use (10-15 hours per day in the dry season) by an entire village community.

A sturdy deep-well handpump, less subject to breakdown from heavy or careless use, was evidently in demand, but at the same time it would have to be easy and cheap to mass produce by local industries. Such a pump, made in steel and named India Mark II, was first field tested in 1976. There had never been a India Mark I version. The suffix II was given in reverence for its precursors produced in various workshops and small scale factories supported by church missions and voluntary agencies, and where some of the deciding design criteria adopted by the India Mark II model had been introduced.

With support from UNICEF, mass production started in 1977-78 in a factory in Madras at a capacity of about 7,000 pumps a year. Ten years later the total production capacity had reached 200,000 a year, with 43 registered and quality controlled companies, by which time the pump was being exported to countries all over the world.

In contrast to rural water supply, rural sanitation has received less attention in terms of resource allocation, and political commitment. When the Water and Sanitation Decade was launched, the target was set at providing 25% of all rural households with sanitary latrines. At the time, the coverage was less than 1% but very little is mentioned in the national plan (VII Plan). To back the declaration with resources GOI introduced the Central Rural Sanitation Programme in 1986. A little more than Rs. 100 million were provisionally allocated. The expenditures are borne directly by GOI, as opposed to the matching grants of the ARWSP. The sanitation schemes include subsidies to latrine construction favouring the poorer sections. More states are now more

actively supporting latrine programmes, and receive donor support like the World Bank support to the programme in Kerala.

1.2 Foreign Assistance to the Rural Water Supply Programme

Foreign assistance has been an important factor and played a crucial role in the process. From the introduction of the new drilling techniques, design development, production standardization, to financial support and delivery of physical equipment, the International Community has been an avid supporter. The most prominent of the international organizations in this respect was UNICEF given its financial contribution and its role in promoting deepwell drilling, and developing the standardized Mark II.

The rural water supply and sanitation programme has also received support from three principal bilateral donors. The **Netherlands** has basically been providing technical and financial support to pipe schemes, with handpump installations included recently. **SIDA** has been working through UNICEF, by funding substantial parts of its "Master Plan of Operation" within the framework of the 6th and 7th Five Year Plans. DANIDA originally also worked through UNICEF. This was discontinued when DANIDA launched its own direct support to the programme, namely the projects which are the focus of this evaluation.

1.3 Policy Challenge of the Nineties: Maintenance

The establishment of about 1.5 million handpumps in rural India is a remarkable feat by any standards. Even though one of the primary design criteria for the Indian Mark II Handpump was sturdiness, the need for repair and replacement of the first generations of handpumps will raise. Together with India Mark II, UNICEF advocated the so called three tier maintenance system with district mobile vans, block mechanics and village caretakers. A system the states with support from GOI and UNICEF was supposed to introduce for maintenance of the new standardised handpumps.

Sufficient resources were, however, never made available for maintenance as expressed in the Seventh Plan (85-90): "While impressive results have been achieved in providing water supply facilities in the rural areas in the Sixth Plan, the maintenance of these facilities, mostly the handpumps, has been badly neglected". The main practical consequence taken by that plan is the budgeting of 10 % of MNP for O & M. The states are supposedly responsible for financing maintenance, but in general have failed to match the increasing number of new pumps with additional resources.

The question facing the Indian polity is therefore how long it should continue its programme of intensifying establishment of water supply points while paying scant attention to the foreseeable accelerated failings of the established ones. Maintenance is not merely a question of shifting numbers from one vote to another on the budget for the water supply programme. In the process one will have to face fundamental issues of managerial and institutional restructuring. This may well turn out to be the major challenge of the Rural Water Supply Programme in the nineties.

The political support to the overall objectives of providing water to India's rural inhabitants remains quite steady with the five year plans allocating about 2% of the total plan budget. However, today provision of handpumps is not the only element in that programme. Small piped schemes with power pumps for villages with more than 1000 inhabitants constitute an increasing share of the investments in rural water supply. The local demand for power schemes is increasing. This might be a serious competitor for resources to handpump maintenance as piped schemes can be seen as a substitute for handpumps which are not functioning.

2 DANIDA SUPPORTED RURAL DRINKING WATER PROJECTS

In the 1970s, Danida supported village drinking water supply in India through major financial contributions to the UNICEF handpump programme. In the 1980s, the agency began a bilateral programme in this sector. Over time, two thrusts emerged in this latter assistance: support to state drilling and handpump maintenance programmes, and to integrated area projects.

Since 1980 Danida has supported 12 different drinking water projects in the five states. In the late 1980s Danida started planning of two new integrated projects in Karnataka and Tamil Nadu. They are not covered by the present evaluation. Table 2.1 summarizes the allocations and periods of the Danida supported projects covered in this evaluation. Further details are provided in Annex I.

Table 2.1 - The Danida Supported Projects

PROJECT NAME	YEAR OF APPROVAL BY DANIDA	PLANNED DURATION: YEARS	DANIDA ALLOCATIONS DKK MILL.
Tamil Nadu			
1. Rural Drinking Water Supply - Deep Bore Well Project	1980	3	16.0
2. Handpump Rejuvenation Project	1982	2	7.9
3. Consolidation of Rural Drinking Water Projects	1986	3	10.7
Karnataka			
1. Janatha Housing Colony Drinking Water Project	1980	4	19.7
2. Handpump Rejuvenation Project	1982	2	58.3[1)]
3. Consolidation of Rural Drinking Water Projects	1986	3	26.1
Madhya Pradesh			
1. Handpump Rejuvenation Project	1982	3	58.3[1)]
2. Consolidation of Drinking Water Project	1987	3	6.0
Orissa			
Preparation Phase of Rural Drinking Water Project	1982	1	10.5
Interim Phase	-	1½	-
Phase I	1985	1½	69.8
Extension Phase	1987	½	14.0
Phase II a	1987	1½	180.0[2)]
Phase II b	-	1½	-
Kerala			
Drinking Water Supply Project	1985	4	132.5

Notes: [1)] Figure covers both projects in Karnataka and Madhya Pradesh.
[2)] Figure covers phase II both a and b.

Danida's expenditures to the projects in India constitute about 20% of Danida's global spending on drinking water projects, and the evaluated projects represent about 15% of Danida's spending in India.

2.1 Drilling and Maintenance Projects

The national handpump programme in India has been one of the most successful rural water supply programmes in the world, in that about 1.5 million deepwell handpumps have been installed, and most of them are reported to be functioning. UNICEF played an integral role in supporting this programme, and Danida naturally looked for a way to create a similar successful role for itself when, in 1976, it started the planning of the first bilateral projects for rural drinking water. Danida support thus began along lines very similar to initial UNICEF support in the early 1970s: the supply of rigs, other equipment, and handpumps to speed up drilling in hard rock areas.

In 1980, Danida began to assist drilling tubewells for power pump schemes in two districts of Tamil Nadu State, and tubewells with handpumps in four districts of Karnataka State[1]. The objective was to support the Accelerated Rural Water Supply Programme, through tackling special problem areas: habitations requiring boreholes of 200 meters or more in Tamil Nadu; and in Karnataka, the Janatha Housing Colonies (for scheduled castes), many of which would not otherwise receive separate water supplies because of their small size. The principal input in both projects was drilling rigs. In addition, the projects provided advisers and hydrogeological equipment, and the Karnataka project supplied 4,200 handpumps.

By 1982, however, Danida had become more concerned with handpump maintenance. The new emphasis again reflects the influence of UNICEF on Danida thinking[2]. The former agency had gradually shifted its focus from drilling and the provision of rigs, to establishing a routine preventative maintenance system based on the India Mark II. A bilateral donor like Danida could contribute to the latter objective by (a) providing India Mark IIs to "rejuvenate" (replace) non-standard handpumps, and (b) supporting the implementation of the three tier maintenance system. This approach shaped the character of three new projects just starting up in Karnataka, Tamil Nadu, and Madhya Pradesh. The targets in these projects were to rejuvenate a total of about 20,000 handpumps, provide other maintenance hardware, such as tools and vehicles, and make a modest beginning in software support to the three tier maintenance systems the state governments had agreed to implement.

In 1986 Danida decided to consolidate its assistance to Tamil Nadu and Karnataka by combining the hitherto separate drilling and rejuvenation projects into a single project in each state. The projects contained the same type of assistance as the previous projects: hardware and advisory support to drilling and maintenance continued as before. In addition, training of caretakers and

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1 In Tamil Nadu, the Danida districts are South Arcot and Salem. In Karnataka, Danida assists Kolar, Chitradurga, Bijapur, and Gulbarga Districts.

2 Representatives from UNICEF also participated in some of the project appraisal missions.

mechanics became a major element: each project was supposed to train a caretaker for every handpump in the Danida-assisted project districts.

The caretaker training target also expanded considerably in the second phase of the Madhya Pradesh project, which was appraised in 1986. The first phase had aimed only at training 350 caretakers in one district. In the second phase, the support to establishment of the maintenance system concentrated on four districts.

The targets for caretaker training were unprecedented. GOI and UNICEF had supported training of about 6,000 caretakers in Tamil Nadu, scattered throughout the state. On the basis of this experience, the agency had promoted the concept of a three tier maintenance system, and succeeded in having it adopted as a national strategy at the 1979 Madurai Conference on handpumps. But it had subsequently not been tried to implement fully the strategy on anything like the scale which Danida would now attempt.

In short, one thrust to Danida support to the drinking water sector was to provide a variety of hardware and software input to support drilling and handpump maintenance. Drilling equipment and handpumps were the largest component in terms of cost, but still small compared to what the state governments were spending on hardware. The Danish investment in caretaker training, on the other hand, was large relative to what other donors and the Indian authorities were doing, even though a small proportion of the Danida bilateral programme in the sector.

Just when Danida support to handpump maintenance was going to scale, Danida staff had lost faith in this as a long run strategy. The same Danida missions which planned the consolidation of projects in Karnataka and Tamil Nadu categorically stated that future support should go to area-focused integrated rural water supply, sanitation, and health/hygiene education programmes[3]. At the same time as the old approach was continued in a consolidation phase of ongoing projects, it was recommended to start off in a new direction.

2.2 Integrated Area Projects

It appears to the Evaluation Team that the impetus behind Danida's interest in integrated water supply, sanitation, and health education programmes came from the International Drinking Water Supply and Sanitation Decade. Whereas Danida's concern with drilling and handpump maintenance can be traced through more than a decade of experience with the UNICEF programme and then bilateral projects, the references to the need for integration in the project documents from the early 1980s are not based on analysis of the experiences of earlier projects or the situation in India in general. This coincides with the period when the particular slant given to the Decade - health as the main objective, integration of health education and sanitation

[3] See pp. 4-5 in Tamil Nadu: Appraisal of Continuation of Rural Water Supply Projects, and Pre-appraisal of integrated Water and Sanitation Projects (February 1986), and p. 5 in a report of the same title and date for Karnataka.

activities, participation as a means to these ends - was having a major influence on how donors designed their rural water supply programmes worldwide[4].

The aims of the new projects in Kerala and Orissa were twofold: construct new installations to provide safe water; and induce behavioral changes so villagers would collect and consume safe water. It was obviously the latter which distinguished the new projects from their predecessors in other states.

To achieve the first aim, Danida agreed to assist three piped schemes in Kerala, and handpump installations, rejuvenations, and piped schemes in Orissa. Compared to the earlier projects, the new ones had very ambitious targets with strategies of full coverage of water to areas with very large numbers of people. In the case of the Orissa project, the designed target population was almost 2 million people in 20 Blocks, and in Kerala about 500,000 people should be covered.

The Orissa project also contained a pilot activity to test an alternative to the three tier approach to handpump maintenance, what developed into the SEM system evaluated below. The 1983 appraisal also suggested an operation and maintenance system for piped schemes, based on collecting 40-60% of the revenue for recurrent expenses from household connections, and the rest eventually from local government (gram panchayats). The Kerala project included a similar strategy for raising maintenance revenue through 40% household connections.

To achieve the second aim: behavioral change, each project contained a socio-economic section, the major innovation which distinguished these projects from earlier ones in the other three states. Even a major donor in the sector like UNICEF had never attempted to field staff active at the village level to look at the socio-economic aspects of project design, implementation, and impact.

These sections had responsibilities in four areas:

* **socio-economic considerations in planning and design:** to allocate installations so that all habitations were served; to locate installations within a habitation so as to encourage the use of this water and to ensure good drainage.

* **health education and sanitation**: to implement activities which in particular would increase the utilization of safe water, encourage the proper storage of water, avoid sanitation (drainage) problems which could result from the new water supplies, and promote latrines which used water for flushing.

* **operation and maintenance**: to increase the role of communities in caring for the handpumps, standposts, and their surrounding areas.

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4 In 1981 the Government of India adopted a target of 25% rural latrine coverage by 1990. The strategy which grew out of this was subsidized latrine construction. Both the target and the strategy may have influenced the design of Danida projects. On the other hand, the government does not have the emphasis, so characteristic of the new Danida approach, on the integration of health education with water and sanitation. This supports the hypothesis that the new projects were largely a consequence of the Decade.

* **monitoring and feedback**: to provide the project with feedback, for instance, on how water installations were functioning and being used; and to maintain a socio-economic data bank, possibly to use for assessing impact.

The first area of responsibility is a particularly significant one, because it embodies a Danida priority which differs from that of most state governments: full coverage of water installations. A typical state government approach to implementation would be to provide a single handpump to every problem village, and then, after all problem villages had received this, make a second "round" to provide more adequate coverage. Similarly, the distribution lines on a piped scheme might be rather limited, leaving unserved habitations within the scheme's designated boundaries.

Such an approach was not compatible with the integrated concept of the new projects. All the households in the project areas had to receive safe water combined with programmes subsidizing latrines and promoting health education. If instead, many households within a village would not have genuine access to safe water until every village had received something, there would be no integrated delivery of services[5].

2.3 Project Objectives and Assumptions

As the two first projects for Karnataka and Tamil Nadu, approved in 1980, concentrated very much on hardware supply (rigs, handpumps and means of transport), the objectives were formulated rather simply. The overall objective was to improve the (protected) drinking water supply to the rural population. The 1980 Appraisal Report from Karnataka further assumed that this overall objective would lead to specified social, economic and health benefits. The immediate objectives were expressed more as targets to rejuvenate or establish a certain number of handpumps or borewells.

In the documents for both projects, the need for maintenance was clearly recognised. But the explicit assumptions were that not only would the local institutions implement the activities for which Danida provided the hardware, but the state governments had also already established, or had agreed to establish, the three tier maintenance systems recommended by UNICEF.

The overall objective remained the same for the three rejuvenation projects approved in 1982. However, these projects now included some assistance for maintenance. When the three projects were extended in a consolidation phase, maintenance and institutional aspects became a major concern. It is also emphasised that training should strengthen the understanding of the relationship between safe water and improved health. The immediate objectives were both to establish a maintenance system, and to have these systems serve as demonstrations and become a general model for handpump maintenance in the concerned states. The projects should develop training programmes and train trainers. It was assumed that the local governments should

[5] There were technical reasons for advocating complete coverage as well. First, a single handpump in a village will probably be overused, and therefore wear out much faster. Second, moving rigs into a village to drill just one borehole raises the cost per borehole, because of the greater diesel costs, and wear and tear on the rig from moving it around so much.

implement the various activities including the training programmes. These objectives were retained when projects were extended again in 1986.

However, when the projects were about to close in 1989/90 there was a significant change in how the documents described project objectives. Overall objectives are now described as: "To contribute to improved health of the rural population, especially aiming at the weaker sections by ensuring stable and continuous safe drinking water". The intermediate and immediate objectives are also given in more detail, emphasizing sustainability and institution development.

Besides the absurdity of reformulating objectives when projects are about to close, there is very little explanation given on why the new objectives are included, and how their achievements are supposed to be monitored. For both the health and institutional objectives, lack of formulated strategies during most of the projects' lifetime, weakens the impression that they should be taken seriously.

The Orissa project, by contrast, had a much more specific development objectives from the outset: "Improved health and betterment of the quality of life for the rural population of Orissa, achieved through provision of water supplies and other health interventions provided by sector-responsible institutions in a cost effective manner, on the basis of the felt needs of the communities". Several elements are now included in the development objective: health, institution development, costs and participation. The immediate objective for the Orissa project was formulated as: "Sector-responsible institutions established, capable of planning, executing, operating and monitoring rural water supplies in a cost-effective manner, supported by sustainable health interventions provided by relevant authorities, and thereby ensuring utilisation of the installations by the rural population".

These ambitious objectives rest on a large number of assumptions, most of which are implied rather than expressed, in project strategies. One set of implicit assumptions relates to the health improvement aspects. Experience has proved it difficult to monitor health improvements from drinking water projects, and it has been assumed that the population will refrain from utilizing other local untreated water resources. Another set of assumptions relating to the institutional aspects also remains implicit, as approaches - particularly with respect to health institutions - are not developed. The development objectives of the Kerala project are identical to those of the Orissa project.

3 IMPLEMENTATION AND PERFORMANCE

3.1 Hydrogeological Support

The projects have provided hydrogeological support to the implementing agency in four of the five states: Karnataka, Kerala, Tamil Nadu and Orissa.

In general, the objectives of these activities have not been clearly defined. For this and other reasons, fundamental activities were left unattended until the end of the project, which in some cases has had serious consequences.

3.1.1 Hydrogeological Equipment and Institutional Training

In all of the four states, the hydrogeological support comprised hardware as well as software components. In the beginning of the projects, hardware was generally supplied for geophysical siting of wells drilled by the Danida rigs.

In Tamil Nadu and Karnataka, the approach changed gradually over the years and assistance became oriented towards a general strengthening of the capability of the hydrogeological wing of the implementing agency. These activities did not accelerate until the latest stages of the projects but the team finds that the process is well on its way and that there is a sound basis for continued support during the ongoing integrated projects.

Due to the high yield required for the Cheekode scheme in Kerala, the siting of wells for this scheme was strongly supported by the intervention of short term consultants. The hydrogeological input to that project was further strengthened due to the professional background of the Senior Technical Adviser. In connection with the investigations, a substantial amount of hydrogeological training has taken place and manuals for field work and data processing have been prepared by the Danida consultants and advisers. The success of training activities was reflected by the fact that it was possible for the Danida expatriate staff gradually to change its approach to the hydrogeological investigations from an executive to an advisory role.

The Project Directorate in Orissa has a separate Water Resources Division. It appears that the support provided has not been sufficient to assure the required capability of the WRD to cope with the hydrogeological problems of the project.

The team finds that in all of the projects very little attention has been given to the possibilities of interaction with other relevant institutions. In Kerala, for example, the possibility of fruitful collaboration with the professional competent Groundwater Department exists. In this case, little effort has been made in the project preparation to adapt the institutional side of the hydrogeological input to the already existing resources in the state.

Similarly, in Orissa too little attention has been given to the possibilities of collaboration with the Lift Irrigation Corporation. The Department has carried out investigations within the project area but the collected data is not available at the Danida Project Directorate. In addition, the data collected by the project has not been communicated to the Lift Irrigation Corporation rendering the maps and reports prepared by the Corporation less useful.

Furthermore, a large water supply project in a complex area like coastal Orissa would normally require a thorough hydrogeological study prior to implementation. A competent institution for collaboration in such a study is available in India: The Central Groundwater Board (CGWB). Like the Lift Irrigation Corporation, this institution has not been involved in the Orissa project so far. Some involvement is likely to occur in the forthcoming investigation phase, but the institutional aspect of collaboration still appears to be undefined, which is unfortunate, considering the fact that collaboration with an institution like the CGWB would only be fruitful if based upon long term planning and detailed organizational set-up.

Table 3.1 summarizes the geophysical equipment provided to the projects.

Table 3.1 - Danida Supported Geophysical Field Equipment

Equipment /Area	Karnataka	Tamil Nadu	Orissa	Kerala
ABEM SAS 300 Terrameter	33	8	2	
Digilog (India)	20			
Khodays (India)	5			
ABEM SAS 200 Logger	2	6	2	
Johnson-Keck DR-74 and SR-3000 Logger			8	
Geoprobes Systems (India) GPL-88 Logger			2	
ABEM Trio 24 channel Seismic refraction equipment	1	2		
Electromagnetic equipment (VLF)	1	2		1

The supply of equipment for geo-electrical soundings was relevant and the choice of SAS Terrameters was appropriate. The equipment is reliable and requires very little maintenance or repair.

Seismic equipment has been supplied to the projects in Karnataka, Tamil Nadu and Orissa. The supply of seismic equipment to the projects in Karnataka and Tamil Nadu seems unjustified as the use of seismic methods is generally not relevant for the siting of handpump wells in hard rock areas. The use of this type of method is time consuming and costly and may require the use of explosives. Furthermore, the data interpretation requires extensive training. Not surprisingly, this equipment has never been put into appropriate operation.

In Kerala where high yielding wells are required for the Cheekode scheme, the use of the seismic method could have been considered a desirable option due to the detailed information obtained by this method but seismic equipment was not supplied for this project. The use of the seismic method was tested by the consultant carrying out the siting of wells for the Cheekode scheme using equipment brought from Denmark for this particular assignment. The team was informed that the results obtained, as compared to those obtained by the sole use of geo-electrical soundings, were not found to justify introduction of this more expensive method.

A hydrofracturing unit was supplied to the Tamil Nadu project. The system applies high water pressure to sections of the well during a short period. Treatment of unlined wells in hard rock formations generally results in increasing well yield.

One hundred and thirty-nine wells have been treated so far and the results seem promising. The procedure followed is appropriate (double packer system, geophysical well logging, pump test before and after treatment) but the results cannot be fully documented as data are still being collected. Danida support to this activity has a clearly innovative aspect and introduction of this tool will undoubtedly be a benefit to the receiving organization.

Pump testing units were supplied in Kerala (1988) and Tamil Nadu (1990). In Kerala the unit has been used according to its capabilities for testing of the Cheekode borewells and data from these tests were processed by Danida consultants. Apart from this, the unit has been used by the KWA to carry out a number of tests outside the Danida project area but data from the majority of these wells were not processed. Thus it may be concluded that the KWA has got very little benefit so far from the pump testing unit.

No conclusion can be drawn yet regarding the pump testing unit in Tamil Nadu. The success of this unit will depend on the hydrogeological support to the TWAD under the ongoing integrated project.

Apparently, no strategy has been formulated or agreed upon regarding the work of the pump testing units and little consideration has apparently been given to the long term consequences for the receiving agency regarding requirement of personnel, consumables and spare parts. Institution building related to the operation of the pump testing units is likely to take place on an ad hoc basis and considering the short time of operation so far the team is not in a position to evaluate the relevance of supplying the mentioned units.

For all the projects, the professional staff has been trained regarding the procedures for hydrogeological investigations and the use of geophysical methods through attendance at high level training courses.

3.1.2 Hydrogeological Data Banks

Over the years, all of the projects have collected large amounts of information regarding investigations and construction of water installations. However, appropriate data storage and retrieval systems have not been established in any of the projects. Thus, none of the projects has been in a position to make optimal use of the collected data.

No strategy was formulated at the project preparation stage regarding use of the collected data. In the absence of such an essential management tool, no adequate monitoring of technical project performance and results was carried out. Monitoring of investigation performance, construction, well functioning, well use, water quality, etc. has not been carried out at a level which could provide the required exact knowledge about the projects.

The lack of exact processed information has seriously hampered the possibilities for virtually all review missions to carry out their work. As the review missions have been forced to base their decisions and recommendations on insufficient monitoring information, the recommended actions have often been irrelevant or inadequate and therefore often neglected.

A number of Danida missions to the projects have recommended the establishment of data banks but the objectives for establishing these were not clearly defined and consequently the usefulness of such systems was not understood by the project personnel until the latest stages of the projects.

In Orissa, systematic data storage has taken place but convenient data retrieval facilities were not established. Data was filed according to type of information and therefore convenient access to the system cannot be made on the basis of well location (well number). The data intended for data bank use has been piled up, awaiting for a computer system to be established. The planned computerization of data has apparently been the reason for not establishing a workable manual data bank. Computerization of the Orissa data was initiated in 1991.

In Karnataka and Tamil Nadu, the first steps have been taken to establish hydrogeological data banks covering all wells constructed by the implementing agency. The process is guided and supervised by the Danida hydrogeologist of the ongoing Tamil Nadu integrated project. The team finds that the approach is appropriate and sufficient resources in terms of manpower, know how and equipment for the first phases of operation are allocated. The outcome of the first activities carried out is very promising but expansion of the system to efficient state coverage may require Danida support for many years to come.

The team finds that an efficient data storage and retrieval system should be considered a basic project requirement and sufficient resources should be allocated for establishing such systems at the beginning of the projects. Early intervention of short term consultants for implementation and modification of project data banks in order to ensure optimal use of data collected by the projects would in many cases be a very cost efficient input to the projects.

Project data banks should contain all data types relevant for monitoring of project activities and not be limited to hydrogeological data only.

Data banks should be initiated as small and simple data storage and retrieval systems allowing for later extension and modification as required. It is essential that the system proves its usefulness from the very beginning of the project. The systems should be based on manual filing systems. If computerized data handling is included, the set up should be simple, at least in the first phases of operation.

Resources should be allocated for training of the potential users of the data banks. Training of the data bank personnel only will not be sufficient to ensure optimal use of the systems.

3.2 Construction and Rejuvenation of Water Installations

3.2.1 Site Selection

Socio-Economic Considerations

In the integrated projects, Danida insisted that all households within the project area should have access to a handpump or standpost within a reasonable distance. This meant providing at least one handpump per 250 persons in a village; and more if outlying habitations with smaller populations would otherwise have to walk too far, or if certain castes would not be permitted to use a nearby handpump. In the case of piped schemes, it meant designing distribution lines and standposts to reach all the habitations (technically capable of being served) within the scheme's boundaries.

The socio-economic sections had the responsibility for carrying out this aspect of site selection: their role was to determine the allocation of handpumps and standposts to villages and habitations, based on considerations of geographic and social access. It was also their responsibility to determine, through consultation with the community, the location of the installations within the habitation. For instance, they should not be put in places with poor drainage, or where women would be reluctant to go (e.g., certain public places).

To do this in Orissa, the Socio-Economic Division (SED) first carried out a Village Inventory (also referred to as Block Inventory). Between 1984 and 1986, socio-economists visited each village in Phase I and Phase IIA blocks, gathering data on population, spatial lay-out, institutions, economic structure, caste structure, traditional water supplies, etc. (They also gathered information on local artisans which would later be used to select SEMs.) Sketch maps were produced at the same time. SED estimated the number of pumps needed in each village, based on this information.

Later, when the field division of the project informed SED that drilling was about to begin, socio-economists would revisit the village to select the specific sites for the allocated handpumps, and make specifications for platform construction. The SED team informally engaged villagers in conversation to get their opinions and ideas about possible sites, and then evaluated the suggestions according to given guidelines before selecting the location. Once selected, the socio-economists would specify in which direction the spillway should go and its length, to insure proper drainage. Six months after the handpump had been installed, and after a technical check, the socio-economists would return to find out whether users found the installation and its water acceptable.

In Kerala, there was not as extensive a collection of primary data as in Orissa. Instead, the Socio-Economic Unit (SEU) relied on existing data which could be collected from block and other offices. (Further information would be gathered at the time of actual site selection.) On the other hand, the mapping was done quite rigorously, with surveyors carrying out field surveys to draw maps to scale, and the SEU(N) staff securing proper location of habitations and land marks[1].

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1 This mapping was necessary because design maps were out of date and incomplete with respect to roads, habitations, etc.

Community participation in site selection was much more formalized in Kerala than in Orissa. The SEU formed committees in the wards of each panchayat to suggest and decide upon the locations for each standpost. Each committee was then given two days training. In a subsequent committee meeting, the various locations were discussed and visited. Selected sites were to be visited by a KWA engineer before being definitively approved.

Both socio-economic sections succeeded in implementing the full coverage concept advocated by Danida. Clearly this would not have happened in the absence of the sections. In Kerala, KWA had originally designed the distribution lines to follow main roads, thus not serving more distant habitations. In Orissa, when the dispute with PHED arose over further drilling, the department proceeded without Danida approval, and supplied only one handpump per village. In other words, PHED units did not consider social and geographical access with the same care that SED did in allocating installations. (But SED carried out site location, if not allocation, for these Phase II B blocks.)

The Kerala project experienced some difficulties in coordinating the socio-economic approach to site allocation with technical considerations. First, the SEU identified some habitations for service where this was not feasible for technical reasons, or because the amount of pipe necessary to reach the areas was prohibitively expensive. (In some of these cases handpumps will be installed instead.) Second, the pace of site selection activities far outstripped the ability of the project to deliver water.

The two approaches to site selection in Orissa and Kerala can hardly be compared as they concern two very different technologies and local conditions. Some differences can however be considered. The Orissa socio-economists consulted the communities about location, but reserved the final decisions regarding both allocation and location for themselves. In Kerala, the actual decisions were taken by the communities through the committees. It was observed that this could lead to location of a standpost which would be difficult to connect to the pipe system. The very active involvement of the users at an early stage of the large piped schemes also contain the risk of generating false expectations. However, the Orissa model hinges on having a well-managed socio-economic section with large numbers of well-trained staff. It may not be possible to graft such a structure onto the government departments, such as PHED, responsible for rural water supply[2].

The most visible achievement of the SED in Orissa was the drainage around the handpumps. These were positioned, and their spillways designed, so that waste water went into existing drainage ditches or gardens. Given that proper drainage is the single most important variable determining the environmental sanitation around a handpump, this is no small achievement. (It is of course also an achievement of the project field division, which so faithfully followed the specifications from SED.)[3]

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[2] In summer 1990, PHED was split into two sections: an urban and a rural section, Rural Water Supply and Sanitation (RWSS), in the Department of Rural Development. The project is now under RWSS.

[3] One can say nothing as yet about the appropriateness of site location in Kerala, as the water has not yet come.

Handpump Wells in Hard Rock Areas
In the hard rock areas, i.e. in Karnataka and parts of Tamil Nadu, the Danida supported projects have supported only the hydrogeological aspect of the well site selection procedure. Optimal siting from a socio-economic point of view has not been aimed at in any systematic fashion.

Siting of handpump wells was done by the geologists of the implementing organization, who are supposed to consider sociological as well as hydrogeological and other aspects.

The number of wells to be sited in each village is determined by the implementing agency, based on information received from the local offices. The yearly action plan, after approval by the Engineer in Chief, contains the number of wells assigned to each village. Regarding the Janatha Housing Colonies, one colony is generally down for one well.

In the field work the geologist follows certain guidelines for selection of sites, given by the implementation agency. He consults the villagers, mainly the local leaders, selects one or more potential areas for location of a well, considers the settlement pattern of the population, the accessibility and the drainage conditions, land ownership, etc. In the selected area he carries out a limited number of electrical soundings in order to confirm the site or to select the most promising site.

The geophysical surveys are carried out rather rigorously and the amount of field work carried out seems sufficient for siting of this type of wells. However, difficulties often arise in the coordination of site selection and drilling activities. More planning of the activities is required in order to optimize the results, and more follow-up on the geologists' part would be desirable.

Wells for Mini Schemes and Piped Water Supply in Hard Rock Areas
In schemes with transmission mains and water storage facilities, the geologist has a much larger degree of freedom in the selection of well sites. As the yield requirement is bigger for this type of well, more elaborate geophysical field surveys are justified. It is the impression of the team that an adequate amount of geophysical field work is generally devoted to these surveys but sufficient knowledge and experience is not always available for the interpretation of the acquired geophysical data.

In the Cheekode scheme, Kerala, where yield is a critical factor, particular investigations have been carried out with the assistance of short term Danida consultants. The efforts in this respect are considered adequate and leading to successful results.

Wells in Sedimentary Areas
Selection of sites for wells in sedimentary areas of Tamil Nadu is based on a thorough understanding of the geological conditions and the geologists' field activities related to the drilling work is intense (borehole logging, well design, etc.).

In Orissa, site selection is based entirely on the work of the SED. No consideration has been given to other aquifers than the deep ones and with the information presently available on the geology of that project area, the project is not in a position to provide any adequate hydrogeological input concerning selection of sites for deep wells.

3.2.2 Drilling and Well Design

Drilling Rigs

In accordance with the geology of the project areas, drilling was carried out using the "down-the-hole hammer" method in the hard rock areas of Karnataka, Tamil Nadu and Kerala, while the mud rotary drilling method was used in the sedimentary formations in Tamil Nadu and Orissa.

The drilling rigs supplied to the projects are shown in Table 3.2 Danish manufactured rigs (Knebel) were supplied to the projects in Karnataka and Orissa in the early years of the projects, while the drilling rigs supplied later were Indian-made or imported Ingersoll Rand drilling rigs.

Table 3.2 - Performance of Danida Drilling Rigs up to end of 1990

Rig	Type	Year of Commission	No. of Boreholes	Metres drilled	Remarks
Karnataka					
TH55 (0763)	DTH	1983	815	52,240	
Knebel HY79 (009)	DTH	1983	6	453	"cannibalized"
Knebel HY79 (010)	DTH	1983	172	12,578	plus cleaning
Knebel HY79 (011)	DTH	1983	258	12,501	plus redrilling
Knebel HY79 (012)	DTH	1983			cleaning only
TH55 (2850)	DTH	1988	335	26,845	
ITH-10 (88144)	DTH	1988	269	17,658	
TOTAL, Karnataka			**1,855**	**104,617**	
Tamil Nadu					
Rotamec TNX 2310	DTH	1983	686	62,344	
Rotamec TNX 2311	DTH	1983	408	40,718	
IR TH60 TNX 2633	combination	1984	318	17,810	
IR TH 60 TNX 2635	combination	1984	331	22,027	
TOTAL, Tamil Nadu			**1,743**	**142,901**	
Orissa					
Knebel HY-76	mud rotary	1983	89	19,363	
Knebel HY-77	mud rotary	1983	120	19,077	
IRTH-10	mud rotary	1988	47	7,364	
Mahew	mud rotary	1984	134	4,526	
TOTAL, Orissa			**390**	**50,330**	

Notes: (1) Figures received from the projects in February-March 1991.
(2) Number of wells drilled by Knebel 009 prior to "cannibalization" not available.
(3) Total number of wells drilled in Orissa project including handdrilling: 4,290.

The selection of Danish drilling rigs was not based on thorough studies of the requirements and possibilities concerning the operation, maintenance and repair of the rigs but apparently on pressure to use Danish supplies. **In the Karnataka project**, where the operation and maintenance of the rigs take place within the PHED organization, the use of Knebel rigs has been a disturbing factor, hampering the possibilities of carrying out a smooth drilling operation.

The procurement of the Knebel rigs in Karnataka took place through UNICEF despite the recommendation of the latter not to use this type of rig in India. Procurement took more than two years, thus causing a substantial project delay even before commencement of the drilling operation.

During the drilling operation in Karnataka, numerous breakdowns occurred due to various technical difficulties in operating the Karnataka Knebel rigs. Several breakdowns have been very long lasting due to the complexity of the rigs and the necessity of importing parts from Denmark. In 1984/85 one of the Knebel rigs were "cannibalized", thus supplying parts for the remaining three rigs. For the rest of the project period, a maximum of three Knebel rigs have been available. It was later decided to rejuvenate all of the four rigs, introducing a number of simplifying modifications and replacing worn out parts. As of March 1991, the rejuvenation of the rigs is almost complete and the team finds that by the forthcoming end of the project the rigs may be considered in good working condition. Stock of spare parts for the Karnataka Knebel rigs is reported to be sufficient for approximately two years of operation.

With the different organizational set up in **Orissa**, the operation of Knebel rigs in that project has apparently been facing less problems. The rigs are powerful and well suited for their purpose and as long as Danida is operating through the DPD, the problems of import of spare parts may be overcome. Maintenance takes place on separate contracts with selected garages in Bhubaneswar. However, it is observed that the use of imported rig carriers (Magirus and Mercedes) is causing unnecessary maintenance difficulties.

Imported Ingersoll Rand rigs are reasonably maintainable as the manufacturer is strongly represented in the country. The later procured small drilling rigs, manufactured by Ingersoll Rand, India, are well suited for their purpose. They represent less capital and maintenance cost and length of breakdown periods may be minimized.

Performance of Drilling Rigs

Table 3.2 shows the number of wells and number of meters drilled by each of the Danida supplied rigs.

In general, the project targets expressed in number of wells have been achieved. However, the required time and the cost have largely exceeded what was anticipated at the planning stage of the projects. The particularly low number of wells completed by the Knebel DTH rigs reflects the above mentioned difficulties in operating these rigs.

In 1988 a computerized rig monitoring system was introduced, covering all state operated water supply drilling rigs in India. Monthly targets are assigned for each rig, depending on type and capability of that particular rig, season, etc. Performance of each rig is reported monthly and processed centrally by the Department of Rural Development, Delhi, producing summaries countrywise and statewise each month.

Properly maintained, the system may constitute an excellent management tool, allowing optimization of resources. With further development of the system, it will be possible to evaluate the performance of each drilling rig over a given period of time. This facility is not yet available.

The mechanized rigs supplied for the Orissa project were primarily intended for use in the exploratory drilling programmes. The idea of this programme was to supply basic hydrogeological information for use in the implementation of the drilling programme for water supply wells. It is observed however, that the exploratory aspect of the drilling operation has been limited to the mere determination of prescribed drilling depth for the following handset drilled wells when a new area or village was entered. No map has been produced, showing the location and fundamental findings from the exploratory drilling campaigns. Information gathered during this work can only be retrieved from the individual records.

The majority of water supply wells in Orissa has consisted of simple handset drilling, carried out by a number of private contractors.

In the Kerala project, all drilling activities are related to investigation boreholes and high yielding production wells for supply of the Cheekode pipe scheme. Drilling was carried out by private contractors under the supervision of the KWA, assisted by Danida advisers and consultants.

Well Design

In the hard rock areas of Karnataka and Tamil Nadu, a simple and well-known borewell design was used. Drilling was performed unlined through the overburden formations, casing was installed and drilling continued in smaller diameter in the hard rock. The lower section of the well was left open.

Attempts to adapt the well design to local conditions have been very scarce. In Karnataka, a number of well failures are reported, mainly due to siltation problems and aggressive water. The siltation problem may in many cases be attributed to the casing pipe not being sufficiently lowered into the less weathered parts of the rock. Wrong use of slotted casing pipe may be another cause of siltation.

The simple well design chosen is very cost-effective but it implies for each well a compromise between the wish of making a sufficient yielding well and the risk of siltation. In order to optimize the output from a drilling operation of this nature - i.e. to obtain the largest number of wells with sufficient yield and clear water - it is necessary to accept a certain number of failures due to siltation. Depending on the severity of the problem, these wells may require redrilling, flushing, or other remedial action.

At the termination of the Karnataka project, it is not possible to assess the magnitude of the siltation problem, due to the lack of monitoring data. According to information received by the team, this type of problem occurs mainly in the wells drilled during the first years of the project.

Nor is it possible to assess the magnitude of the corrosion problem. Due to the lack of reliable information on the user acceptance of the wells versus groundwater aggressiveness, the Danida Review Mission, November 1988, recommended a pilot study to be undertaken with a view to introducing PVC well casing instead of steel casing. The team was informed, that this activity was not taken up because of a general PHED unwillingness to use PVC as casing material.

Optimal well design for handpump wells has been further hampered by the development of a widespread resistance against 4½" wells. Hoping for a later replacement of the handpump with a submersible pump, many villagers request wells to be drilled in 6" diameter as no submersible pump suitable for 4½" wells is yet available in India.

General acceptance of an increase in drilling diameter would cause an unjustifiable increase of the cost of handpump wells as very few of these wells are located at sites suitable for extraction of larger quantities of water. Furthermore, the mentioned attitude causes a severe problem due to the lack of 6" equipment presently available with the Knebel rigs.

For the Cheekode scheme in Kerala, a simple large diameter borewell design was adopted. Those wells are properly designed for their purpose, the number of wells is limited and drilling supervision is intense. Furthermore, corrosion problems in the wells are less important in respect of water taste as the wells are high yielding.

In Orissa, the decision to exploit deep aquifers was taken without thorough investigation of possible alternative sources, or of the consequences of using deep aquifers. Simple methods of deep drilling were available in the area but it was found that they needed "improvement". The drilling design which was adopted represented a mixture of simple and advanced technology which apparently had never been tried in any part of the world. This might have been an acceptable approach, provided the implementation speed had been limited and adequate quality control and close monitoring had been performed.

The well design was changed several times during the implementation phase, primarily aiming at lowering the construction cost per well. The changes in well design also intended to cope with serious water quality problems observed in the area. However, it has never been possible to document any improvement in water quality of the wells following the design changes.

The wells drilled by the hand set method were never properly developed. A certain cleaning of the well was performed with a handpump but this procedure is absolutely unacceptable for a well drilled with bentonite mud. No attempt has been made to investigate the pattern of water flow into the wells. As the wells were never developed, it is most likely to suppose that inflow of water takes place through defective joints and possibly through limited parts of the screened section. With such a flow pattern and under the given hydrogeological conditions, frequent cases of wells with poor water quality should be expected and life expectancy of the wells would be low.

In addition to this, severe corrosion of the pump parts occurred, leading to deterioration of handpump water quality. As the corrosion problem was not dealt with by installation of non corrosive pump parts, the problems related to the well design were not treated separately and in the end the water quality problems of the project were considered as being extremely complex.

3.2.3 Handpumps, Pipes, and other Supplies

The bulk of the handpumps procured and supplied by Danida for each of the projects consisted of the standard, deepwell India Mark-II, manufactured according to the Bureau Indian Standards specification (IS:9301) and inspected for quality prior to dispatch from the factories. One

exception to this, however, was the first batch of around 1,500 handpumps procured for Phase I of the Orissa project in 1985 which were painted red rather than hot dipped galvanized as called for in the specification. The Project Director at the time did not believe that galvanizing was necessary to protect against corrosion. As a result of this decision, all of these pumps became quickly corroded and many of the head assemblies have already had to be replaced.

At the same time, a decision was taken to procure and install several hundred Inalsa suction handpumps to rejuvenate a number of 1½ inch diameter tubewells fitted with local cast iron No. 6 suction handpumps. These tubewells were too small to be used with the India Mark-II which requires at least a 4 inch well casing to accommodate the cylinder. The project hoped to introduce something better than the No. 6 which, however, was locally manufactured in Orissa and for which spares where readily available. The Inalsa suction handpump was rather new and unproven[4], expensive compared to the No. 6, and required a completely different set of spare parts (which had to come from Delhi) and different installation and maintenance procedures.

The Orissa project is a clear example of incorrect technology choices leading to serious long-term problems. The three-year project preparation phase (1982-85) was meant to provide sufficient time for the Project Directorate (which included the Danida advisers) to develop strategies and techniques to overcome the hydrogeological and water quality constraints (see section below) in the coastal blocks. In spite of this, the decision was taken to mainly use the standard, deepwell India Mark-II (except for the painting mentioned above) with galvanized iron (GI) riser pipe in an area which by then was known to have shallow (less than 7 metres) and intermediate (7-15 metres) static water levels (SWL) and a complicated groundwater chemistry.

In the Karnataka project, 400 extra deepwell, heavy duty India Mark-II handpumps were procured presumably for static water levels below 45 meter. Six of these pumps were found in the Chitradurga Division store still in their packing after several years. The Evaluation Team was told that these pumps were meant for Bijapur District in the north and were sent to Chitradurga by mistake. Three other such pumps were also seen in the Malur Sub-division store in Kolar District. A Danida review of the project in February 1986 noted that the 400 pumps were distributed to the four districts without prior assessment of the actual need. It appears that the project did not follow up to ensure that the pumps were redirected to where they were needed. If these extra deepwell handpumps are installed at only 30-40 meter cylinder settings (as was observed in one case), then the heavy, counter-weighted handle is not balanced and will bang down hard on the bottom stop which will lead to premature bearing failure, destruction of the head assembly and break-up of the platform.

The team also observed in Karnataka (Chitradurga and Kolar) the use of 6 meter random length 32 mm GI riser pipe for the India Mark-II instead of the standard 3 meter length. Although these pipes were procured by the PHED, they were used together with Danida provided handpumps which makes pump maintenance more difficult and dangerous. After ten years of close association with the handpump programme in Karnataka, the project should have been able to convince the PHED to make such a small change in their riser pipe procurement.

[4] Ten Inalsa pumps had been field tested for only one year together with the modified WASP, Wavin, and Tara handpumps.

Another important aspect of any handpump programme is the construction of the platform and drain. Since most of the Danida provided handpumps were meant for rejuvenation of existing tubewells, the site was already fixed. Proper drainage was difficult in many cases since the majority of the old tubewells had been poorly sited in depressions or in places where drainage was difficult. More attention should have been given to reconstruction of platforms with the handpump firmly embedded in concrete as well as the construction of large soak pits where drainage was a problem. The Evaluation Team found uniformly good installations only in the Orissa project where most of the handpumps were installed on new tubewells.

Each of the projects provided tools for the installation and maintenance of the India Mark-II. Some complaints from the mechanics were noted about the heavy weight of the tools and problems with the self-locking clamp and heavy duty pipe vice. However, only the Madhya Pradesh project appears to have devoted time to try to improve the tools developed by UNICEF. Those efforts though did not prove to be particularly successful.

All the projects supplied various types of locally manufactured Indian vehicles including drilling rig carriers (except Orissa where two carriers were imported), support trucks, mobile handpump maintenance vans, jeeps, motorcycles, and bicycles. By and large, models were chosen which fit into the existing state fleets, thereby avoiding too many different makes and the importation of spare parts. In Madhya Pradesh, the project customized the body of the standard three-ton Tata truck to make it more suitable for mobile maintenance; this included pipe racks, tool boxes and bench with pipe vice. Driver training was included with some of the vehicle procurements but seems to have been missed in the case of motorcycles.

The procurement of all hardware for the Orissa and Kerala projects was done directly by PHED and KWA respectively without strict independent third party quality control. This was the case with the Danida supported piped water schemes where PHED and KWA procured the transmission pipe, power pumps, generators, casing, cement, etc. and local contractors did the construction. (The exception to this in Orissa was the Danida procurement of drilling rigs and the quality control of India Mark-II handpumps which is paid for by UNICEF on behalf of the state governments). Money was advanced by the respective projects and tendering and award of contract to the lowest bidder carried out by PHED and KWA. Standardization of equipment did not figure in this procedure.

3.2.4 Research and Development

Orissa was the only project to have a research and development (R&D) component as an integral part of its programme. The R&D focused on a variety of design and technical aspects of handpumps, iron removal and drilling. During the project preparation phase, field testing was initiated to find a suitable replacement for the No. 6 cast iron suction handpumps installed on tubewells scheduled for rejuvenation. However, as mentioned in section 3.2.3 above, the Inalsa suction pump was chosen before conclusive rest results were obtained. In addition to the search for a better suction handpump, a shallow or intermediate (low-lift) version of the India Mark-II handpump was also being considered for new tubewells since static water levels were normally less than 15 metres. However, the standard deepwell India Mark-II was chosen when implementation began in 1985.

The decision to include an R&D component in the Orissa project was correct and necessary, but it was not until 1986 that systematic and rigorous field testing and monitoring (including publication of results) began. R&D became more urgent with the realization in late 1987 that the water quality in a large number of completed installations was deteriorating and utilization was falling. Promising results have been obtained with a low-lift version of the India Mark-II (lighter T-bar handle, third plate flange, and open top cylinder) and with a suction version of the India Mark-II (cylinder in the pedestal and 1½ inch PVC riser pipe). Further work needs to be done on non-corrosive elements such as PVC rising mains, brass and plastic cylinders, and field testing the Indian version of the Tara direct action handpump (which is a low-lift pump with mainly non-corrosive, below-ground components). The research and development currently underway in the Orissa project is helping to overcome the water quality problems associated with tubewells in the coastal blocks of Orissa and can also benefit other areas of the country with similar hydrogeological conditions and problems.

One of the most successful development efforts to come out of the Danida-assisted projects was the development of an improved pump bucket by the Karnataka project working together with a local India Mark-II handpump manufacturer in Bangalore. Through the initiative of one of the project advisers, a canvas reinforced nitrile rubber pump bucket was developed which greatly increased the life of the buckets (the fastest wearing part on the pump), thereby reducing the maintenance requirement. These buckets are now being widely used in Karnataka, procured by the Orissa project, and promoted by the UNICEF throughout the country. However, their specification needs to find its way into the BIS specification for the India Mark-II.

The design of underground structures of deep tube wells in Orissa has been the subject of a number of research and development activities. The project has devoted much attention to the development of a well design suitable for the conditions in the project area. However, the real conditions during implementation of a well construction operation may differ significantly from what is observed under a test programme.

Due to this fact, combined with the lack of quality control during the subsequent construction works and the lack of control of finalized constructions, the research and development activities were less fruitful in regard of assuring the construction of high quality wells in Orissa.

A number of adjustments/developments regarding the tube wells have been investigated (use of rubber packers, banning of metal spanners, improvement of pipe joints, etc.). It must be concluded, however, that the various designs used up to 1989/90 were not sufficiently adapted to the field realities and a large number of wells are most likely not constructed in accordance with the design. Furthermore, the wells were often left under mud pressure during long periods and appropriate development of the screened section was not carried out, the wells only being cleaned by handpump.

The R & D activities were rendered particularly difficult by the fact that the necessary data regarding the functioning of the wells were not collected. Thus, the causes for inflow of saline water into the well and the poor flow conditions at screen level were not fully understood until the Technical Tubewell Study was carried out in 1988-89.

The main conclusions from the development activities undertaken so far appears to be that well design should be the simplest possible: The ideal well is drilled in small diameter (4½"), no reaming, no gravel pack and no large diameter top casing in wells where pumps suitable for 2" casing can be used.

The team has not looked into the aspects of research and development of iron removal plants in any of the projects.

3.3 Maintenance

3.3.1 Danida Input

The project documents are filled with innumerable and confusing references to two-tier and three-tier maintenance systems, often with quite different systems grouped under the same rubric. In fact, any maintenance system includes four or more tiers. The upper tiers are responsible for policies; spare part procurement, quality control, and onward distribution; recruitment, deployment, and supervision of engineers; vehicle purchase; and the release of funds. Lower tiers have the more operational responsibilities of spare part storage and distribution to site; deployment and supervision of mechanics; training of personnel at the lowest tiers; operation and maintenance of vehicles; public relations; and maintenance and repairs to the tubewells and hand-pumps.

The general DANIDA strategy has been to support the lower tiers with some physical inputs, and above all caretaker training. Table 3.3 indicates the forms which DANIDA support has taken at each tier in each state. Although the strategy in Orissa does not include training caretakers, the focus remains on building maintenance through support to the lowest levels. The table indicates as well the other, relatively minor, differences in DANIDA support to the various states.

Table 3.3 - Danida Input to Handpump Maintenance

DANIDA INPUT TO HANDPUMP MAINTENANCE (excluding Handpump Rejuvenation)				
Tier	Karnataka	Tamil Nadu	Madhya Pradesh	Orissa
State				
Circle/Zone				
District		jeeps		
Division		motorcycles		stores
Sub-division			mobile vans, training	stores
Block	mobile vans, tool kits, cardex, motorcycles, office & store equipment, training	stores, bicycles, tool kits, cardex, training	motorcycles, tool kits, number monitoring system training	stores, SEM tool kits & bicycles, training
Village	caretaker training	caretaker training	caretaker training	health education programme

Note: The basic administrative unit in India is the state which is divided into districts, and districts into blocks. The water departments divide districts into one or more divisions, and divisions into sub-divisions covering one or more blocks.

The type of Danida support to maintenance has affected the way in which the state water departments distribute maintenance responsibilities among the various tiers. For example in Karnataka, where DANIDA supplied mobile maintenance vans, these have been deployed in each DANIDA-district block to handle all repairs, as well as fishing and riser pipe replacement. In Tamil Nadu by contrast, Danida did not supply vans. Since the state has purchased only enough vans to supply one to each division, they are reserved for the relatively infrequent repairs of fishing and pipe replacement, and a block mechanic is supposed to handle the more common major and minor repairs.

Initial differences among states in the way in which the water departments organized maintenance, combined with the impact of Danida assistance, have produced five types of maintenance systems in the four Danida states. The following Table 3.4 indicates these differences by showing who in each state has been assigned the responsibility for performing the functions basic to any handpump maintenance system.

The five systems presented in Table 3.4 can be simplified to two basic types of maintenance systems.

1. The Self Employed Mechanic (SEM) system in Orissa, in which a village artisan (normally a blacksmith or bicycle mechanic) is employed on a contract basis (two tier)

2. The combination of a mobile maintenance van crew, government employed block mechanic, and voluntary village caretaker (three tier)

This latter system has two variants, one in which the caretaker has multiple functions, and the second where the caretaker simply informs the block level about pump problems.

Table 3.4 - Assignment of Maintenance Responsibilities in Danida Project Areas

Maintenance Function	So-called Three Tier		So-called II Tier		
	Tamil Nadu	Madhya Pradesh (Chindwara/Raipur)	Karnataka	Madhya Pradesh (Bilaspur/Bastar)	Orissa
Spare part procurement	District Assistant Executive Engineer	District Executive Engineer*	Zilla Parishad (District) Executive Engineer	District Executive Engineer*	Divisional Executive Engineer**
Spare part stores	Division/Block	District/Sub-division	Division/Block	District/Sub-division	Divisional Sub-divisional, Block, SEM
Pipe Fishing and Replacement	Divisional mobile van crew	Sub-divisional mobile van crew	Block mobile van crew	Sub-division mobile van crew	Block crew or SEM
Below-ground repairs	Block mechanic	Block mechanic	Block mobile van crew	Block mechanic	Self-employed mechanic
Above-ground repairs	Block mechanic	Block mechanic	Block mobile van crew	Block mechanic	Self-employed mechanic
Preventive Maintenance	Caretaker	Block mechanic	Mobile van crew Caretaker	Block mechanic	Self-employed mechanic
Reporting HP Problems	Caretaker	Caretaker	Caretaker	Informer	User
HP Area Sanitation	Caretaker + community	Caretaker + community	Caretaker + community	None	Complementary HE programme
Safe Water Message	Caretaker	Caretaker	Caretaker	None	Complementary HE programme

* State Engineer-in-Chief procures pipe.
** The Training and Maintenance Division in Bhubaneswar supplies spares directly to Phase I block stores.

In practice, the maintenance systems have not been fully implemented as intended, as the following sections describe.

3.3.2 Block Mechanics and Mobile Vans

The original concept of the three tier maintenance system contained the following three levels:

1. A multifunction caretaker (one per handpump) who was responsible for preventative maintenance, reporting problems to the second tier, environmental sanitation around the handpump, and propagation of health messages,

2. Government-employed block mechanics to handle above-ground repairs, at the ratio of one mechanic per fifty handpumps, and

3. Mobile vans with a crew of four, supervised by a junior engineer, to do below-ground repairs, at a ratio of one van per 500 handpumps.

In Tamil Nadu, Madhya Pradesh, and Karnataka, the principal problem in implementing this system has always been one of deploying sufficient block mechanics and mobile van crews:

* **Madhya Pradesh** has been the most successful in approaching the ideal ratios. Nonetheless the Evaluation Team found in Raipur District, on average, one mechanic per 93 handpumps and one van per 1,400 handpumps.

* In **Tamil Nadu,** South Arcot District, the team encountered an average of 345 handpumps per mechanic and one van per 2,300 pumps. In the two (out of four) divisions of Salem District visited by the team, the ratio of mechanics to handpumps was 1 to 182, with one van per 2,275 handpumps. (However in the latter district, roughly 60% of the tubewells had become seasonal or dry, reducing the ratio of functioning installations to mechanics and vans.)

* In the DANIDA districts of **Karnataka**, the system is somewhat different, with a mobile van in each block staffed with a crew of one inspector-cum-mechanic and several helpers. In the three blocks where the team interviewed the Assistant Executive Engineers, it found an average of 738 handpumps per mechanic and van.

The situation hidden behind these ratios is even worse than they suggest. Vans and mechanics are also used to service power schemes, and in areas with large numbers of these, it means that more than half the time of vans and mechanics is diverted from handpump maintenance. For instance, in South Arcot District, the five vans look after 2,500 power schemes as well as 11,585 handpumps. In Kolar Division (Karnataka), five mechanics on vans care for 249 power schemes in addition to the 3,602 handpumps.

In the original three tier concept, mobile vans where supposed to do all below ground repairs, even such simple tasks as changing the pump buckets in the cylinders. This idea has fallen by the wayside, most notably in that mechanics change buckets with the help of villagers or daily wage helpers. The team found vans being used for transporting pipe, lifting pipe out of extra deep tubewells, fishing fallen pipe using tripods, and transporting block mechanics.

3.3.3 Self-Employed Mechanics (SEMs) in Orissa

The team found an unusually high percentage (95%) of functioning handpumps in Phase I and Phase II A blocks in Orissa. Four factors account for this:

* **high quality of initial platform construction**: In Orissa, the handpump pedestals are firmly embedded in the concrete platform. This prevents premature and repeated breakdowns which result from the handpump shaking.

* **high water table**: Although the tubewells are deep, the static water levels are high in the Orissa project area, which allows the cylinders to be placed at shallow and intermediate depths. This makes for less stress, and resulting wear and tear, on the handpump components.

* **SEM system**: One mechanic is deployed for every 20 to 25 handpumps. The assigned handpumps are usually within three kilometres or less of the mechanic's home, which allows him to service them by bicycle. As a result, adequate preventative maintenance is performed on a monthly basis.

* **high level of project supervision and control**: The project ensures careful selection of the SEMs, pays their fees directly into their bank accounts, and assists the junior engineers with the supervision of the SEMs.

The SEMs are generally blacksmiths and cycle mechanics, earning less than 800 rupees per month. They earn 250 or so rupees per month (10 rupees per handpump) for visiting each handpump once a month, and responding to any problems reported by the villagers. The project also provides them with training, tools, a bicycle, and a yearly bicycle allowance of 120 rupees. This SEM system contrasts with the TRYSEM (Training Rural Youth for Self-Employment) system tried elsewhere in India, under which unemployed rural youth were trained as handpump mechanics, given bank loans to purchase tools, and assigned an average of 50 handpumps. In the latter system, handpump repairs had to provide the principal source of income for youths who had no previous experience as entrepreneurs. In Orissa, established artisans with a regular income are given an opportunity to supplement it.

The SEM system has been an experiment. What has been proved so far is the following:

* local artisans can be trained as India Mark II mechanics,

* the supplemental income is sufficiently attractive for the SEMs to do the monthly preventative maintenance repairs on 20-25 handpumps located close to their homes,

* the special India Mark II tools can be transported by bicycle; and pipe can be transported by bicycle, trolleys, and other local means,

* few mechanics need help from a higher level (junior engineer and crew at block level); assistance from the block level is primarily the provision of fishing tools, occasional assistance with threading pipe and removing worn bearings, and help with community relations related to poor water quality, and

* all repairs can be done without a mobile van.

3.3.4 Handpump Caretakers

Above all else, DANIDA emphasized caretaker training in its support to handpump maintenance. DANIDA paid for the training of 50,000 multifunction caretakers in eight districts of Madhya Pradesh, Karnataka, and Tamil Nadu, plus the orientation of over 10,000 single function

caretakers ("informers") in Bilaspur district of Madhya Pradesh. Project staff in the three states did a commendable job in developing training courses and materials, and in seeing that these were put to use on such a mass scale.

The caretaker training programmes in each state developed along slightly different lines, each with its particular strength. To a limited extent, these differences in methodology may explain some differences observed by the team in regard to the way in which caretakers performed. For instance in Tamil Nadu, women caretakers seemed much more willing to use the spanners themselves for preventative maintenance, rather than asking the help of their husbands and sons as was the case in Karnataka. Some approaches also appeared to be more sustainable (Tamil Nadu) or cost effective (the informer system in Bilaspur District). But such differences were relatively minor. The team found the performance of caretakers to be fairly consistent across states, and thus regardless of the particular organization, content, or length of the training.

The particular functions assigned to caretakers varied among the projects (see Table 3.4 above). All caretakers were expected to report breakdowns; this was the only function given to informers. In Tamil Nadu, caretakers were to perform preventative maintenance; in Madhya Pradesh and eventually Karnataka, this function was taken away. The following four paragraphs summarize the Evaluation Team's assessment of caretaker performance in regard to each function.

Caretaker Role in Preventative Maintenance: The role of DANIDA-trained caretakers in preventative maintenance has been disappointing. A number of block mechanics - when prodded - said that repairs had decreased because of the caretakers, but no data exist to confirm this assertion. The Madhya Pradesh project stopped distributing spanners because implementors found no benefit. In those states where spanners were provided, the Evaluation Team saw little in the field to suggest that caretakers were regularly performing preventative maintenance, or that what was being done had resulted in fewer breakdowns.

Caretaker Role in Reporting: Caretakers, block mechanics, engineers, and block development officers consistently mentioned the reporting of handpump breakdowns via pre-printed, stamped postcards as the most important role for the caretaker. In fact, this was the only caretaker function cited, unless the Evaluation Team suggested other possible ones. Clearly, many caretakers do send in these cards. This achievement is tempered by the following:

* Not all caretakers perform even this simplest of tasks. One caretaker reported that the pre-stamped postage was not enough and the card was returned!

* In some districts, postcards had previously been distributed to local leaders. It was not possible to tell if the relatively elaborate caretaker system had been a significant improvement over this earlier and much easier to implement approach.

* In all blocks visited, reports through other means, such as letters and personal visits to the office, continue to be an equally or more frequent mode of communicating break-downs.

* Although breakdowns are reported, the repairs are not necessarily made more quickly, due to low capacity in the other tiers of the system. In this context, a postcard sent by a woman caretaker seems less likely to "win" a repair than a visit by an angry sarpanch (elected village leader).

* Some districts have no provision for reprinting the postcards when present stocks are finished (cf. Salem in Tamil Nadu, and Bilaspur in Madhya Pradesh), for purchasing stamps, or for paying the additional postage on pre-stamped postcards when postal rates are hiked.

Caretaker Role in Sanitation Around Handpump: Few of the caretakers interviewed by the team reported much tangible success in this respect; more frequently they complained about the verbal abuse which they received from users when trying to convince them to bathe and wash elsewhere ("Who are you to tell me what to do. This is not your father's pump.") One could argue that such conflict is at least the start of a dialogue about sanitation and water, but as one caretaker said, "You think they give me time to explain (about disease and water). They start fighting immediately". In any case, as far as the Evaluation Team could observe, the single most significant factor explaining the cleanliness of the handpump area is the quality of siting and platform construction. In Orissa, where handpumps had good drainage and well-constructed platforms, sanitation around the handpumps was far better than in the other project areas visited.

Caretaker Role in Delivering Messages about Safe Water: A handful of caretakers mentioned having attempted to educate users about safe water and water-related diseases. Whether even these few persisted in their efforts is not evident. It seems unlikely, therefore, that the caretakers had much effect on increasing the utilization of handpump water over what would have been the case in their absence. With or without caretakers, village women continue to make decisions about drinking water sources based on distance, taste, colour, smell, and suitability for preparing certain dishes, and of course the likelihood of falling ill.

3.3.5 Spare Part Procurement and Distribution

The Evaluation Team found the states to be procuring good quality India Mark II spare parts from approved manufacturers (by and large with pre-delivery quality assurance inspections). In Karnataka, where decentralization had empowered mandals to procure their own spare parts, this prerogative was taken away when the mandals began purchasing non-standard (inferior) spare parts on the local market. Although mandals still had to pay for the spare parts out of central grants or their own revenues, the spare parts themselves had to be purchased from the divisional store.

Mandals and panchayat unions in Karnataka and Tamil Nadu respectively had difficulty in procuring spare parts due to financial constraints. In both states these local bodies are given grants by the state for handpump maintenance. This produces the situation that spare parts may be in the stores, but the local governments cannot afford to purchase them. Tamil Nadu is moving to address this problem by establishing divisional stores where, in effect, panchayat unions can purchase spares on credit.

Generally, the supply of spare parts to stores at the lowest levels (sub-division and block) was poor. This was even the case in Orissa, where project finance and support for spare part procurement is strong. The team observed that the DANIDA-constructed block stores in Tamil Nadu were sometimes adequately stocked, but other times without sufficient supplies of fast-moving parts. In Madhya Pradesh, the spare part situation was good when the team visited, except for a lack of galvanized iron (GI) rising main pipe (unavailable for six months). However PHED officials complained there about the uncertainty of spare part supplies, due to irregular financial allocations.

A system to monitor consumption of spare parts has been designed and just introduced for Madhya Pradesh; so far, PHED has made no effort to process the information. However, the Madhya Pradesh project made a thorough numbering and registration system for all handpumps in the project area - a basic requirement for operating any maintenance scheme. Given that the project is about to end, it is unlikely that PHED will follow through with its introduction. In Tamil Nadu (all 70 blocks of Salem and South Arcot) and Karnataka (only Malur block of Kolar), the projects provided a cardex system and training in its use. However, the team founded in parts of Salem District that the system had never been used because it duplicated the government system. In other parts, the assistant engineers dutifully continued to complete the cards despite this duplication of effort. In Karnataka, the cards had not been filled in since the initial training session. The Orissa project has introduced registers for monitoring the use of spare parts at the SEM and block levels. Although the team found the registers complete, the spare part situation was nonetheless as described above.

3.4 Integrated Activities

3.4.1 Health Education

The purposes of the health education components in the Orissa and Kerala projects are

* to increase access to and consumption of safe water through educating the users about the benefits of safe sources, and the proper storage and handling of water.

* to improve sanitation in the village, particularly around the water installations, through education and community mobilization.

In Kerala, the Socio-Economic Unit (SEU) is supposed to develop strategies for achieving these ends that could be adopted in KWA, other government departments, and NGOs. In Orissa, the project was supposed to work through NGOs.

In Orissa, the project contracted two NGOs to design and implement health education activities[5]. Out of this experience, the Socio-Economic Division (SED) developed guidelines - a strategy - for health education campaigns, and developed materials for this purpose. In Phase II, three NGOs were contracted to implement the strategy in four blocks[6].

To implement the strategy, each block was divided into implementation zones: the NGO would mount the health education campaign in each zone over a period of 4-5 months, and then move onto the next zone.

The campaign in each zone had two prongs. First, in each village, the project would recruit several men and women volunteers. The women would visit each household in the village several times, talking to the women there about the proper storage of water, the reasons for using tubewell water rather than other sources, etc. Interspersed with these home visits would be discussion groups in which the animator would go over the same points, using flash cards to provoke questions and discussions. The men volunteers would organize sanitation drives, for instance to make drainage channels, fill in soil around the handpump platform to prevent erosion, etc.

The second prong was a cultural show, consisting of an exhibition, plays, and a film on safe water, sanitation, and disease. One such show was held for every 1,000 inhabitants. One job of the volunteers was also to encourage people to attend this.

When the Evaluation Team questioned a few villagers in Phase I and IIA blocks, no one failed to remember the film show and exhibition. The women, and even some of the men, recalled the visits by the volunteer and what she talked about. Such retention several years later is impressive. Of course, people's attitude and behaviour in regard to the use of safe water has not necessarily changed as a result. The SED staff working on health education hoped that the programme had contributed to awareness, but were pessimistic about any long run impact without follow up. SED's studies on the immediate behavioral impact are discussed further in section 4.2 on Functionality and Utilization of Installations.

The Evaluation Team, in talking with villagers, was not able to form an impression of changes in awareness and behaviour that could be attributed to the health education component. For instance, women who covered water storage containers said that this had been their practice before as well; but they were more conscientious now. In a discussion with a group of women, most seemed to understand the relationship between water and certain illnesses; but the most articulate among them had learned this in school.

Under the circumstances, the Evaluation Team can only make a few observations and cautious conclusions. The health campaign transmitted a message about handpumps and safe water more widely than did the caretakers. This contributed something to community awareness. But a long run impact or sustainable changes cannot be expected from a "one shot" injection of health

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[5] The National Institute of Social Work and Social Sciences (NISWSS) was assigned Chandbali and Delang blocks, and Gram Vicks was assigned Rajkanika block.

[6] NISWSS was assigned Brahamagiri and Kanas blocks, SODA worked in Rajnagar block, and SAMMAN worked in Aul block.

education. If the NGOs had been organizations normally working in the project area in the field of health, this might have been the case. However, the NGOs functioned exactly like any contractor, leaving the area and activity once the contract was over. Therefore a result of these activities depends on future follow-up project activities.

In Kerala, the immediate objectives of the health education component are to develop and to implement a health education programme, while the long term goal is to make a sustainable and replicable strategy for health education which could be transferred to local NGOs and government agencies. These objectives are common for the three socio-economic units of the project which include two financed by Dutch funds, while only the unit in the North of the project (SEU-N) is financed by Danida funds and included in the present evaluation.

For the SEU-N the strategy has been to let the unit carry out the activities with the involvement of existing institutions and Panchayats. Many of the educational activities have the specific purpose of motivating households to build and use latrines. They thus form part of the sanitation programme, discussed in the following sub-section.

The activities which have been carried out include: (1) running of various orientation seminars, discussions, exhibitions, etc. for health service personnel; (2) translating or writing various educational materials; (3) "networking", getting to know, assist and work together with the staff of the various institutions involved in health education activities, and mobilise Ward Water Committee members; (4) implementing activities such as chlorination campaigns, health education in primary schools, etc.

Up until 1990, health education was concentrated in the two Panchayats where the sanitation programme was under way. Since then, health education in some form has been done in 14 Panchayats. The project estimates that approximately 200,000 people have thus been exposed to health education messages.

A local consultant visiting the project area on behalf of the Evaluation Team reported that some awareness related to water, health and sanitation had been created as a result of the activities in the two Panchayats. Socio-Economic Unit initiatives in most cases have been met with enthusiasm by the authorities and local bodies.

3.4.2 Sanitation

Sanitation in the two projects has so far largely concentrated on the promotion of pour flush latrines[7]. The project inputs have been the provision of materials (including transport) for pan and slab fabrication; the training and payment of masons; supervision; and the various input for educational campaigns to promote latrines in the targeted areas.

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[7] The health campaigns in Orissa included a village sanitation drive, as explained in the preceding section. The Kerala project has plans to include environmental sanitation in the broader sense in the future.

In Orissa, the approach was to target 22 villages in 4 districts for the latrine programme. So far, a total of 1,800 latrines have been built in these villages. Table 3.5 gives the figures on coverage within these villages. Between 44% and 88% of households have received a pan and slab from the project; between 15% and 70% of these latrines are used regularly.

Table 3.5 - Orissa Sanitation Programme Coverage

Project Block	Project Village	Households with Project Latrines as % of Total Households in Village	Households Regularly Using Project Latrines as % of Total Households in Village	Sanitation Project Villages % of Total Villages in Block
Chandbali	Uttar Khamar	88	70	1
	Bahu	55	18	
	Baliapal	51	51	
	Average	**65**	**46**	
Delang	Benupada	61	34	4
	Dihasahi	65	15	
	Rainsol	60	33	
	Singhakuda	63	22	
	Palli	75	not available	
	Average	**65**	**23**	
Satyabadi	Bahat	81	47	7
	Dahalapada/Basantpur	73	42	
	Markandapa	56	26	
	Talapatana	48	23	
	Utarpada	80	47	
	Padampur	80	34	
	Madhipur	83	35	
	Average	**72**	**36**	
Kendrapada	Chandanpur	54	34	5
	Goudapada	69	45	
	Anadasoh	62	40	
	Musadiha	74	43	
	Gangapada	44	25	
	Khamarkeshpur	85	18	
	Chandpur	77	51	
	Average	**66**	**37**	

In Kerala, the approach of the SEU(N) has been to target two panchayats during phase I. The unit has so far constructed 2,200 latrines, or 17% and 26% of the households in the respective panchayats. Other programmes and private initiative had covered 69% and 67% of the households before the Danida supported project started.

Latrine construction per se is a target, not an objective. The objective of the latrine programmes includes motivation of households and strengthening of the capacity of communities to build latrines. To achieve the latter, the Orissa project has trained masons and village volunteers, hoping that these people would then turn pan and slab fabrication into a private enterprise. This has happened in one out of the three demonstration villages in Chandbali block. Information is not available from the other three blocks, or from Kerala. Although a positive development, this is not strong evidence that the project is strengthening capacity on a significant scale. As for

project impact on motivation, it is not possible to make a judgement in the absence of data from either of the ongoing projects on rates of latrine construction and use in the post-project intervention periods.

Both projects have subsidized latrine construction. As a policy, this is very expensive if one considers going to scale: providing every household in the project blocks and districts with a latrine. It is also unsustainable unless one finds an institution capable of providing these subsidies for the foreseeable future (see also Chapter 6). Even with the subsidy GOI-policy, any subsidy as a temporary measure simply begs the question of

(1) when to end them,
(2) will people be motivated to construct unsubsidized latrines, and
(3) will producers be able to survive the end of subsidies?

3.4.3 Integration

The justification and rationale for integrated rural water, sanitation, and health education projects has been that they would have a greater impact on health, than a rural water supply scheme alone. This is predicated on the assumption that certain additive and interactive effects result from simultaneously implementing activities in these three sectors. While that may or may not be true, the Danida supported projects have not yet reaped any such benefit. We can conclude this - even in the absence of information on the health impact of the projects - for the following reasons:

* **The activities in the three sectors have not for the most part been implemented together:** In Orissa, except for two Phase I blocks, the health education and sanitation activities have been implemented in different blocks. The sanitation component has been implemented in two Phase IIB blocks, where only one handpump per village was provided. In other words, sanitation activities since 1987 have been carried out in areas where people had not really received safe water. In Kerala, no water has yet been provided.

* **The lag between the provision of water, once this takes off, and the integration with latrine components will widen considerably:** The present strategy for latrine construction and promotion seems feasible only on a limited scale, confined to a few villages or panchayats.

* **Health education activities are not having a sustained impact:** Impact on health is a long run achievement, but the staff who are implementing the health education activities in Orissa feel the present strategy will have only short term effects. If the impact of the health education input fades relatively soon, there is no possibility for an interactive effect from the combination of health education, sanitation and water supply.

4 ACHIEVEMENT OF OBJECTIVES, EFFECTS AND IMPACT

4.1 Provision of Water

The physical construction targets for handpump installations and piped water schemes in Madhya Pradesh, Karnataka, and Tamil Nadu were met, although not within the time-frames planned. The remaining two projects (Kerala and Orissa) have not yet fully met their targets, and have therefore had their implementation schedules extended.

The targets and achievements for each of the projects in regard to new handpump installations and rejuvenations are given in Table 4.1.

Table 4.1 - Danida Handpump Project Targets and Achievements

	New Installations		Rejuvenations	
	Target	Achievement	Target	Achievement
Karnataka	5,300	5,249	6,500	6,500
Tamil Nadu	none	not applicable	2,500	2,293[1)]
Madhya Pradesh	none	not applicable	11,800	11,800
Orissa[2)]	5,658	about 60% of target	1,000	about 40% of target

1) Balance of 207 handpumps were used as spare parts for maintenance.

2) These figures are from the Plans of Operation for Phase I (1985) and Phase II (1988); however during implementation, rejuvenation targets were reduced and new installations increased.

The handpumps installed during the past ten years in the above projects have provided water to approximately 7 million people. These projects included construction of piped water schemes as part of their objectives. Whereas Danida very much followed UNICEF's lead with regard to its handpump projects, the design, procurement, and construction of piped schemes by and large followed the procedures and norms already adopted by the respective water departments. The exception to this was the use of groundwater rather than surface water for the source of one of the three Kerala schemes.

The following paragraphs provide some observations on the provision of water in the pipe schemes assisted by Danida:

Tamil Nadu - The Evaluation Team failed to find a clear strategy or plan with regard to support for piped water schemes in Tamil Nadu. The purpose of the "Deep Tubewell Drilling Project" which commenced in 1980 was just that: drilling 320 deep tubewells for 1360 habitations in areas where water tables were very deep and presumably handpumps could not be used. No plan of operation or progress reports were found, beyond a statement indicating the number of bores drilled by the four drilling rigs provided by Danida. Thus, in the written documents, there is no indication as to how many pipe schemes have actually been constructed.

Surprisingly, the "Consolidation Project" which commenced in 1987 continued support to the drilling rigs without any plan of operation being prepared until November 1989 (one year before the project ended). Beyond setting targets for the number of bores to be drilled by each of the four rigs, there is no discussion or plans as to what is to happen to the successful bores.

It was clear from discussions with the TWAD Board engineers and Managing Director that TWAD has now returned to its earlier pre-Water Decade preference for concentrating on the construction of piped water schemes rather than handpump installations. All the old problems with rural piped schemes such as higher costs per capita, cost recovery, lack of reliable power supplies, inadequate water quantities and pressure, and more difficult and costly maintenance seem to have been forgotten. Danida's support to drilling in the Tamil Nadu project did not address any of these issues.

Orissa - The Orissa project is basically a handpump project with piped schemes provided only when a habitation cannot be served with a handpump. To date, three piped schemes have been completed (Balikuda (1988), Chandbali (1985), and Tulanga (1985)) serving approximately 25,000 people. However, only the Tulanga scheme has been handed over to PHED for operation and maintenance.

The team inspected the Chandbali scheme and found that water was supplied only two hours in the morning and evening and one hour at noon. Water was pumped (with chlorination) directly from the tubewell to the standposts with no reservoirs for storage or to equalize operating pressures. However, the Chandbali scheme is reportedly the only piped water system in the state to have a standby generator.

The manuals for planning and design, construction and operation & maintenance of piped water schemes called for in the Plan of Operation (Phase I) were finished in November 1987. The three schemes mentioned above were completed or started before these manuals were prepared, and hence do not necessarily follow the guidelines in the manuals, such as for reservoirs and 24-hour service.

Kerala - The three piped water schemes which were proposed and recommended in 1983, agreed to in 1986, and commenced in 1987 are not yet providing any water (although they are 70-90% completed). As can be seen from Table 4.2, these are massive regional schemes covering a 1996 design population of 423,000. Together with the six schemes being constructed under Dutch assistance in southern Kerala, they represent a technical approach to rural water supply completely different from the other four project states visited. One reason for the KWA approach to make piped surface water schemes has been that the groundwater is saline in large parts of the coastal belt in Kerala.

Table 4.2 - Summary of Danida Assisted Drinking Water Schemes in Kerala

	Kolacherry		Edappal		Cheekode, phase 1	
	Original project	90% coverage	Original project	90% coverage	Original project	90% coverage
Project date (original)	1983	Sep-89	1982	Sep-89	1987	Sep-89
AREA: Area covered, km² No. of Panchayats	 250 8	 250 8	 125 5	 125 5	 43 3	 43 3
POPULATION DATA: CENSUS DATA (1981-Census): Population (total pop.)	 169823 (1981)	 169823	 127111 (1981)	 127111	 56271	
PROJECTED FIGURES: Growth rate (% per 10 years) Target population, 1991 (90%) Target population, phase 1 (90%) Target population, ultimate (90%)	 (20%-17%-16%) 183409 (1991) 198999 (1996) 248922 (2011)	 198999 248922	 (24%-19%-16%) 141856 (1991) 155332 (1996) 195818 (2011)	 155332 195818	 (24%-19%-16%) 62798 68764 (1996) 86687 (2011)	
Population densities: (total pers./km²)	884 (1996) 1106 (2011)	884 1106	1376 (1996) 1735 (2011)	1376 1735	1783 (1996) 2248 (2011)	
TECHNICAL DATA. Source Treatment type Capacities (m³ per day)	 Pazhassi Dam Full 11000 (1996) 13700 (2011)	 do. do. 11000 13700	 Bharathapuzha R. Inf.gallery, chlor. 8600 (1996) 10800 (2011)	 do. do. 8600 10800	 Borewells 13 nos Chlorination 3570 4500	
No. of service reservoirs Reservoir sizes No. of boosters No of break pressure tanks	5 750-1000 m³ 2 1	7 50-1000 4 1	3 750-1000 m³ 0	3 750-1000 0	10 20-500 m³ 7 3	
Transmission mains, gravity (km) do. , pumping (km) Distribution mains (total km) Connecting pipes (total km) No. of standposts	34.6 km 4.2 km 154.1 km 61.5 km 615	34.62 5.42 482 - 900	21.7 km 128 3 km 69.0 km 460 Nos	21.7 225.0 90.0 600	22.7 km 0.0 64.7 km 20.3 km 203 Nos.	22.7 181 33.8 338

Source. DANIDA Project Adviser, Calicut, 1991.

The Kerala schemes were from the appraisal stage proposed with a 90% coverage of the population in the scheme areas, and designed to have up to 40% of the population served with house connection. Knowing that house connections would require more water, the designs for water capacity were based on an average per capita consumption of 50 litres per day + 10% for leakage etc. It was found important to encourage implementation of metered house connections in order that the economically better-off households would pay for the water, and the poorer sections collect free water from the street taps, without putting a too large burden on the panchayat's economy.

During the site selection activities, when the locations of habitations were surveyed, it was found that the originally proposed designs would not cover 90% of the population if people should not be living too far away from the public taps. In many cases the designs only included distribution lines along the main roads, while people were also living in the interior. The original designs had most likely been made to meet a GOI per capita costs norm of Rs. 300.

The above situation was pointed out to KWA by a joint Indo-Dutch-Danish Review Mission in October 1989 which resulted in additional distribution networks, booster pumping stations, and reservoirs, together with some handpumps, being incorporated in the schemes.

This of course greatly increased the costs and extended implementation. However, a more disturbing note was raised in a "Review of Design Aspects for the Distribution System of 3 Piped Water Schemes in Kerala" (Devi, R., IIT Delhi, 1990) which observed that "The schemes anticipate domestic connections to cater up to 40% domestic demand in most branches. It is hoped that the extant spatial disparity in population and its projected growth have also been taken into consideration. The observations during the field visits leave a lurking apprehension that higher than average growth[8] and excessive use in thickly populated lower areas would lead to the eventual deprivation of water for the numerically smaller residents at higher localities, who, by and large, may come from the weaker sections of society" (pp. 7-8).

Although KWA engineers told the Evaluation Team that real 90% coverage would mean less or no water available for house connections, pressure would probably be brought to bear on them to make connections. And as stated above, this just might mean no water for the weaker sections of the population at the end of the line.

4.2 Water Quality

Project objectives related to water quality primarily aim at the improvement of health conditions of the receiving population. Broadly, they may be summarized as follows for all of the projects under consideration:

(1) The water should be safe.

(2) The water should be acceptable for the population in respect of appearance, taste and smell.

Undoubtedly, the projects have succeeded in constructing a very large number of water installations, providing chemically and microbiologically safe water. The majority of wells constructed by the projects - with the exception of those rejected because of saline taste or for other reasons - may be considered safe in these respects.

Properly constructed, drilled wells are generally considered free from pathogenic bacteria and other harmful microbiological elements. Contamination from the immediate surroundings of the well should not occur if sealing of the well is carefully carried out and the drainage arrangement is correctly designed. However, data to substantiate this assumption are very scarce for the given projects.

Compared to the original water supply in the project areas, it may be concluded that the Danida supported projects represent an important improvement of the microbiological water quality. This will only have the desired health impact, however, if the old water installations are abandoned for drinking purposes, and the water is not contaminated during transportation and storage.

[8] The Evaluation Team noted the construction of many new houses in areas anticipating water from the three schemes.

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The chemical water quality problems identified in the project areas are mainly:

(1) Water quality leading to corrosion problems.
(2) Salinity.
(3) High natural iron concentration.
(4) High fluoride concentration.

Unfortunately, no adequate water quality monitoring has taken place in any of the projects, and none of the projects are at present in a position to give satisfactory answers to water quality questions.

As the situation has grown particularly acute in Orissa, the project has recently initiated a Well Status Survey. This appears to be the first qualified attempt to carry out complete data collection of water quality in project wells in an adequate and systematic way. The work carried out so far seems very promising and the team finds that the approach regarding water sampling, analysis and interpretation should constitute a model for further work in this project and similar ones.

It should be noted that, prior to the above-mentioned survey, neither the choice of parameters to judge the chemical water quality (e.g. total iron, chloride) nor the procedures for sample analysis (pH determination not carried out in the field, etc.) have been suitable for the purpose.

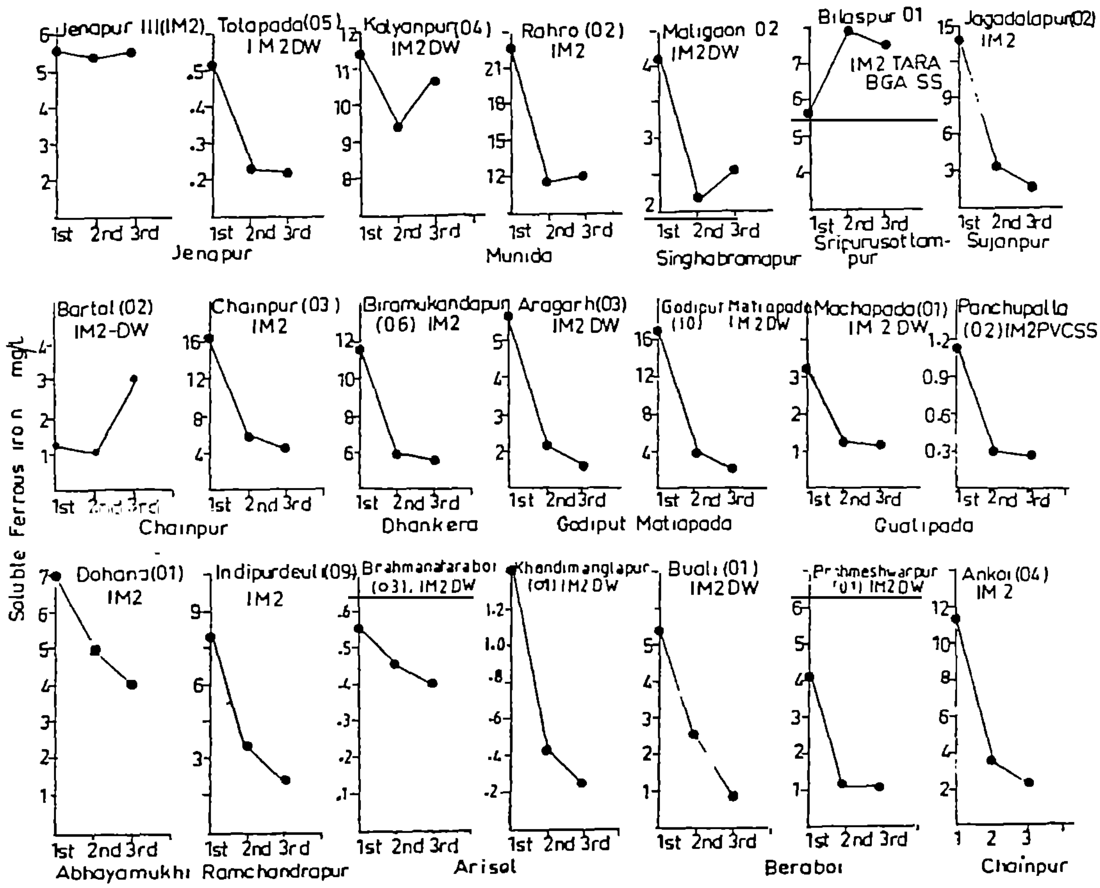
Water Quality Leading to Corrosion Problems

Some of the major water quality problems in Orissa are related to the corrosion of pump parts, mainly the riser pipes and connecting rods. Corrosion in the project area takes place because of general groundwater aggressiveness, because of salinity (chloride/CO_3 ratio) or as a result of the presence of H_2S. The latter may be present due to bacterial activity. Severe corrosion is widespread in the project area, leading to abandoning of the wells because of bad taste of the water and black slimy substances in the water if bacteria are present.

Corrosion takes place 24 hours a day. When the well is pumped in the morning, the water may have an unacceptable appearance and taste. While pumping, fresh water enters the well and after a certain period of pumping, the water quality may become acceptable. A well with corroding pump parts is likely to be used less, and if it falls out of use during a period of time, the corrosion processes may lead to a situation where the well can not be put into use again, unless a flushing and cleaning operation is undertaken.

The Well Status Survey clearly demonstrated the corrosion problem by sampling water from a number of wells during pumping (see fig. 4.1). The first sample from each well generally has a high iron concentration. The concentration level decreases while pumping, showing that a substantial part of the iron observed in the beginning of the test is not naturally occurring in the groundwater but originates from corrosion processes.

Figure 4.1 - General Decrease in Ferrous Iron Content Observed in Water from Orissa Wells During Pumping



Source: Ongoing Status Survey.

Note: The high iron content in the first sample is due to corrosion of pump parts.

The problem of corrosion in Orissa was shown by the Functionality Study in 1987 and the occurrence of corrosion of pump parts has become more and more evident ever since. However, the steps taken by the project in order to cope with the corrosion have been very small, considering the magnitude of the problem.

Various non-corrosive pump assemblies have been tested (see section 3.2.4) and the project is now in a position to initiate installation of such assemblies on a larger scale. However, the period of time from identification of the problem until the time of implementation has been remarkably long.

Suggestions to cope with the corrosion problems separately have often been referred to as "trial and error" or "ad hoc" solutions. The team profoundly disagrees with that attitude. The effects of corrosion are readily recognizable and the measures to overcome the problem are well known.

The team finds it extremely important that large scale implementation of non-corrosive pump parts be initiated soon in order to allow the rest of the water quality problems to be solved in an efficient manner.

Salinity
Salinity problems have been recorded in many wells in the coastal areas of Orissa. The Technical Tubewell Study (based on a total sample size of 125 wells) estimates that approximately 16% of the Phase I wells have a salinity problem. The proportion may increase with time to around 20%.

The study showed that the salinity is caused by poor design and construction of the wells: leaking casing pipes or joints combined with poor flow conditions through the screened section due to lack of development, faulty screen installation, etc. The increased salinity occurs mainly in the areas where water is pumped from fresh water aquifers located underneath strata with saline water.

High Iron Concentration
Groundwater with high natural iron concentrations occur in many places in the project areas. During field visits, the team frequently observed that wells were not being used for drinking because of a slight iron taste. In these cases, the population often wrongly assumes that the water from the new installation is less healthy than their traditional source, leading to a continued use of the latter. Thus it may be concluded that project objectives have not yet been fully achieved.

Increased iron concentration will generally not be harmful to the human body, but at high concentrations (especially if Mn or certain other elements are present) a bad taste will develop. Discoloration of food items and staining of clothes may also make the water unsuitable for cooking and washing purposes. If use of the water is rejected on a permanent basis for these reasons, installation of iron removal plants may be considered.

Being beyond the scope of the TOR, the team has not looked in detail into the aspects of installation of iron removal plants in the projects. However, it is generally observed that no workable strategy has been formulated regarding this issue. The team fears that in some cases iron removal plants are even being erroneously fitted to wells where the natural iron concentration of the water is not high but the pump assembly is corroding.

High Fluoride Concentration
Fluoride in higher concentrations may be harmful to the human body. The occurrence of high fluoride concentrations does not normally give rise to rejection of the well by the users as it has no effect on the appearance, taste or smell of the water.

Fluoride problems are reported in Tamil Nadu, Karnataka and Kerala, resulting in brown staining of teeth. The magnitude of the problem cannot be assessed in relation to the water installations of the projects as no relevant data have been collected.

Particularly regarding the investigation wells in the Cheekode scheme in Kerala, the team finds it somewhat surprising that fluoride levels have not been checked in connection with the hydrogeological investigations.

4.3 Functionality and Utilization of Installations

None of the projects in Madhya Pradesh, Karnataka and Tamil Nadu made any systematic effort to monitor or study the functioning or utilisation of the water installations. Without information on these basic aspects, it is impossible to assert to what extent the projects will achieve their ultimate objectives, be they health or other welfare improvements for the population.

Some observations made by the Evaluation Team during field visits with respect to handpump functioning have already been given in section 2.2 on maintenance. Further analysis of this aspect has to rest on studies from the project states, one source being the studies undertaken by the Orissa project. The first two studies deal with the functioning while the third also provides information on the utilization of the water. It is unfortunate that utilization studies are scarce as they provide the main indicators on how people benefit from the water installations.

1. **Assessment of Delivery and Functionality of Inputs Through a Tracer Study in Water and Sanitation Sector.** Operations Research Group, New Delhi, 1990

This study, one in a series sponsored by UNICEF, contains the statistics given in the following table:

Table 4.3 - ORG Estimates of Functioning Handpumps

State	% Handpumps Functioning	% Handpumps with Good Yield	% Handpumps which Villagers Report Good for Drinking/Cooking
Karnataka	93%	78%	91%
Tamil Nadu	94%	43%	82%
Madhya Pradesh	97%	70%	85%
Orissa	98%	97%	85%

Source: ORG Study (1990). Pages 12 and 20.

The figures in the above table give a very positive picture of the functioning and yield of handpumps. However, the study does not break down these percentages by year of installation. About 70% of the handpumps in the study were less than five years old. Without preventative maintenance, one would expect the India Mark II to start breaking down with increasing frequency after five years. Under the circumstances, the ORG study establishes that the India Mark II is a sturdy pump, but not whether the maintenance systems are capable of keeping the handpumps in functioning condition after the critical five-year point has been passed.

The ORG study also indicated that a high percentage of handpumps yielding water were found suitable by villagers for drinking and cooking (cf. final column in above table.) This suggests that water quality has not been a widespread problem. The study did not contain any information on

the percentage of households which use handpump water for drinking and cooking, and whether they rely entirely on handpump sources or use traditional sources as well. These latter data are necessary in order to establish the utilization rates of handpumps, and form an impression of their health benefits.

2. Evaluation of Handpump Programme in Karnataka. M. Nageswara Rao. Bangalore, 1990

This study was sponsored by Karnataka PHED and UNICEF. The figures were based on a sample of 341 handpumps in 167 habitations. It appears that about 150 of these handpumps, in 50-60 habitations, were within the Danida project districts. The following table gives the sample statistics from the project areas on functioning handpumps as a percentage of installed handpumps.

Table 4.4 - Rao Study Estimates of Functioning Handpumps and Utilization of Other Sources in Karnataka

District*	% Handpumps Functioning	% Households Using Other Sources	
		Regularly	Occasionally
"Kolar"	74%	13%	28%
"Chitradurga"	85%	5%	22%
"Bijapur"	86%	36%	41%
"Gulbarga"	82%	15%	22%
State Average	81%	35%	18%

* This study divided the state into zones for sampling purposes. The statistics from the zone which falls within the Danida project districts are reported in the above table.

Source: Rao Study (1990). Pages 35 and 95.

These numbers are not quite so high as in the ORG study, but nonetheless present a very positive image of the status of the installations. The Rao study did attempt to give percentages on functioning handpumps by year of installation. Due to the small size of the sample, though, the resulting figures look somewhat odd: 85% of the handpumps installed 16-18 years ago are functioning well, compared to 63% of those installed within the past 1-3 years. Similarly, the study finds almost no difference in functioning between handpumps installed almost a decade ago, and those installed since 1987. Thus this laudable attempt to distinguish between the effect of handpump sturdiness, versus the maintenance system, on the functioning of the installations has not succeeded.

The Rao study sample was confined to villages which did not have an alternative source of saf‹ water such as a power scheme. Thus the figures in the last column of the preceding tabl‹ presumably indicate utilization of traditional, unsafe sources. In Bijapur, 77% of households us‹ traditional sources either regularly or occasionally, compared to 27% in Chitradurga. Therefore the likely impact on health from the provision of handpumps varies widely. (It should be kep in mind that the sample on which these figures are based was extremely small. It is quite possibl‹ that the sample statistics do not correspond to any real difference among districts in regard tc utilization.)

3. **Various Utilization and Functionality Studies.** Socio-Economic Division, Orissa Project

A study in 1987 reported that 98% of the handpumps installed by the project in Phase I were giving water. The same study reported that 82% of the 1,495 project handpumps were used for both drinking and cooking. For Phase IIA blocks a functionality study from 1989 showed the handpump installations being used by 75% of the target population.

In a study from 1988 SED made a commendable effort to judge the immediate behavioral impact of the health education programmes combined with the provision of handpumps in a utilization study. This study showed that 82% of the sampled household in Phase I blocks used handpumps for drinking, versus 58% of sampled households in two non-project villages. Of course, any greater relative use of handpump water is presumably due to project blocks having more handpumps, not to the health education activities. Also the researchers did not attempt to estimate the overall percentage households using handpump water in each area; the report simply gave the percentage from the sample. Thus the difference between 82% and 58% may simply be an artifact of the particular sample, and not represent any genuine change in the use of handpump water.

Whether the functioning and utilization of the project handpumps in Orissa look as bleak as it obviously did to the 1989 Danida Review Mission depends much on expectations and priority of objectives. Even provision of good quality water combined with health education may not have much health impact in itself but can have other significant welfare implications.

As has been observed in many other reports, there is a tremendous variation in the availability of water sources in India both over the year and within short distances. In some project areas there is plenty of water available to the households just outside their door for part of the year while in other areas or other seasons of the year, water becomes a scarce commodity being sold at a market rate, and the public handpump with clean water can become the only source within long distances.

The available data present a favourable impression of the situation with regard to handpump functioning. However, this is partly a result of incomplete analysis and poor reporting on sample size and standard deviations. The picture appears somewhat less favourable with regard to the utilization of handpump water. Again, and for the same reasons, the true situation may be even less rosy.

4.4 Participation

The form which participation takes in a rural water supply project varies, depending on factors such as

* the political context and government policies in the sector,
* project design,
* decisions taken during implementation by project implementors,
* and the choice of technology.

These four variables in particular had a significant impact on participation in the Danida supported drinking water projects.

In addition, participation varies in form depending on its intended role in the drinking water project. In principle, communities can participate in five different dimensions of rural water supply projects:

* **planning and design,**
* **construction,**
* **benefits,**
* **finance,** and
* **operation and maintenance.**

Participation in construction might refer to digging a well or a trench, or helping construction teams. The project or the government would solicit such participation as a means to lower the costs of the programme. Similarly, participation in planning and design, finance, and operation and maintenance are also generally means to an end: functioning and utilized water installations. Participation has helped achieve this if, for example, the handpumps are located in a more convenient place, or preventative maintenance is done more regularly, as a result of community involvement.

In a broad sense participation can also mean to participate in the benefits from a project but then it becomes an objective rather than a means. It is achieved if the project target groups receive the intended (or possibly unintended) benefits from the project. For example, women have participated in a project in one sense if it lessens their work burden. Communities have participated if they receive a safe and reliable source of drinking water, or improved health.

The following subsections review the experiences with participation in these five dimensions of Danida drinking water projects.

4.4.1 Community Participation

Planning and Design: There was little scope for community participation in planning and design in the Madhya Pradesh project, since no new drilling was involved[9]. The design of the Kerala and Orissa projects incorporated a major effort to involve people in site selection, through creating socio-economic sections. The experience with this was generally positive, but perhaps not institutionally sustainable, as discussed in the Section 3.2.1.

In Tamil Nadu and Karnataka, site selection followed normal government practices. The 1984 UNICEF study cited general problems with site selection in the national handpump programme, mistakes which the Karnataka project undoubtedly made as well. Indeed, the Evaluation Team saw examples of this, for example, handpumps too close to contamination sources such as open wells, or in areas without drainage. Community participation would not have prevented these problems, but perhaps others such as locating handpumps in public areas where women are reluctant to go. (The Evaluation Team has insufficient information on the piped schemes in Tamil Nadu to comment on community participation in their design and planning.)

Construction and Rejuvenation: Drilling and rejuvenation programmes, and handpump installation do not have much scope for community participation. Thus the initial decision to choose handpumps-on-tubewells limited the scope for the community in the construction process. Indeed, this was obliquely one of the selling points of the whole programme: high speed drilling could produce tubewells at a terrific rate in the vast hard rock areas of India. (The compelling reasons behind this choice of technology were discussed in Section 1.1, giving the background on policies and the UNICEF programme in the sector.)

Benefits: In the early 1970s, Danida adopted as a policy for its assistance programme that benefits should reach the poor directly. Poverty alleviation programmes were common among donors in this period, because it appeared that benefits from economic growth often did not trickle down to the poorest. Projects for rural drinking water supply were an investment towards this objective: more safe water would directly improve living conditions for the poorest and most disadvantaged groups in society. The drilling and handpump programme in India was particularly attractive from this perspective, because it promised to produce very quickly a huge number of sources in rural areas.

Danida insisted on a special effort being made in the Kerala, Orissa, and Karnataka projects to reach the poorest and most disadvantaged. The policy of full coverage, and the work of the Socio-Economic Division, has succeeded in doing this for the two integrated projects. Targeting the Janatha Housing Colonies in the Karnataka project brought benefits directly to over 11,000 communities of scheduled castes and tribes. Whether the impact on the poor from Danish assistance is sustainable now depends on the maintenance systems in the three states.

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9 Conceivably communities could have helped decide which handpumps to rejuvenate; but presumably, every community would ask for all the non-working handpumps to be replaced. This is pretty much what was done anyway.

The Evaluation Team does not have sufficient information on the tubewells drilled in Tamil Nadu to know who was served. Presumably government norms were followed in allocating the power schemes for which the Danish tubewells were used. Some of them may well have gone to serve the scheduled castes/tribes first; the government had a policy to give these communities priority[10].

Finance: The government promised free water to the people. The handpump programme has been built up on the assumption that the state or central government pays for installation. Originally, local government (gram panchayats) had responsibility for maintenance. State water departments took back this responsibility when most of the pumps were found to be out of order. Even where the state has given back the responsibility for maintenance to local government (mandals in Karnataka, and panchayat unions in Tamil Nadu), the money comes mostly from state grants[11].

There also appears to be an unwillingness on the part of users to pay for the water promised them by the government. A study for UNICEF in 1990 reported that 66% of their respondents were willing to pay something towards maintenance[12]. However, the Evaluation Team feels that asking people a hypothetical question about contributing money does not really prove that they would do so in practice. The Orissa project did a study of willingness to pay, and concluded that it was unlikely.

Operation and Maintenance: Characteristics of the national programme have limited the scope for community participation in the operation and maintenance of handpumps:

Design of the India Mark II: The India Mark II was developed for sturdiness, not simplicity of repair. PHED and other agencies had taken back the responsibility for maintenance from the panchayats in the early 1970s. Consequently the designers assumed that competent professional mechanics from state water departments would be responsible for repairs. The objective, therefore, in designing the Mark II was to prevent the frequent breakdowns which had characterized cast iron handpumps such as the Mahasagar and Patel. Any government maintenance system would be overwhelmed by massive repair needs.

As a consequence of these assumptions and objective, the India Mark II has some features not entirely amenable to community-based maintenance:

* **The rising main pipes have to be lifted out of the well in order to get at the buckets and valves:** This has two disadvantages. First, several people are required to perform even the simplest and most common below-ground repairs and maintenance. The latter are therefore somewhat more complicated to organize, than if a single mechanic could do this on his or her own. Second, the chances of accidentally dropping the heavy and cumbersome pipes down the tubewell are greater. This can put the installation out of

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10 Granted, it is more likely that a handpump would be allocated to a harijan community than a power scheme.

11 The Evaluation Team does not have good data on the amount paid for spares by mandals and panchayat unions out of their own revenue. The contribution may be more significant than implied here.

12 Indian Market Research Bureau, "Water, Environment, and Sanitation: A Knowledge, Attitudes, and Practices Study in India, 1988-89." See also UNICEF 1990, "People, Water, and Sanitation: What They Know, Believe, and Do in Rural India."

operation for undue lengths of time, until someone comes with fishing tools. It can even jam a tubewell permanently.

* **Optimal maintenance and repair requires special tools:** UNICEF developed and promoted a "special tool" set for the India Mark II consisting of about ten tools. Principal among these were lifting spanners and a self-locking clamp for pulling out the rising main.

* **Mechanics should receive specific training in maintenance and repair:** Even with training, a common reason for dropping rising main pipe is mechanic error.

These design features of the India Mark II do not preclude village level maintenance, but they do make such a system more expensive and complex to establish.

The three tier maintenance system introduced a role for the community by designating a member of the community - the handpump caretaker - as the first tier. The caretaker as originally conceived had the single function of informing the block about pump breakdowns. The effectiveness of this form of participation has been discussed in Section 3.3.4.

The SEM system has been the one attempt in the projects to implement a significantly different alternative to the three tier system[13]. If this system could be institutionalized, it would lessen the community's dependence on water department staff, that is, the block mechanics and mobile van crews. However the SEM system in its present form remains a government maintenance system: the community would still depend on state government and the water department for financing (most notably the SEM's fee), tools, and training.

4.4.2 Women's Participation

Selecting women caretakers was the largest and most visible effort to increase women's participation in the projects. Following on various Review Mission recommendations, the caretaker training programmes in Karnataka and Tamil Nadu made this a requirement for selection; in Madhya Pradesh, implementors made every effort to get women, resulting in about 80% women caretakers in Raipur District. Although caretakers have not played an effective role, as discussed in Section 3.3.4., the Evaluation Team found no evidence that this was because they were women.

As women are not blacksmiths or cycle mechanics, they cannot participate as SEMs in the Orissa system. The Evaluation Team learned about experiments in other states with means to involve women in a variant of the SEM system. In a Rajasthan project, three women were trained to work as a team, carrying out the same functions as a SEM in the Orissa system. Another approach tried elsewhere was to give women's cooperatives the "contract" for handpump maintenance; they then hired men as mechanics. In certain tribal areas, where men are often

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[13] All the other maintenance structures supported by Danida have depended on caretakers, block mechanics, and mobile van crews to perform all the basic maintenance functions except spare part procurement and distribution.

migrant labourers, women have been trained as mechanics because they are the more stable labour force[14]. All three approaches are still in the pilot phase, but the Evaluation Team talked to persons familiar with and optimistic about this role for women. If the experiments do succeed, women will have the opportunity to receive remuneration for their participation in operation and maintenance, rather than having to volunteer their time as they do in the caretaker programme.

[14] Social norms in tribal areas permit women to play such a role, which will definitely not be the case everywhere in India, for example parts of Orissa.

5 DANIDA PROJECT SUPERVISION AND MANAGEMENT

In principle, the responsibility for project management rest with the recipient institution(s), while Danida provides professional support. In reality, management responsibility is often shared depending on funding arrangements, provision of advisers, and Danida's procedures for monitoring and supervision.

Danida has a variety of means through which it supports and/or intervenes in project management. The actors for Danida interventions in the projects are the following:

- Danida project advisers
- Danida representatives at the New Delhi office
- Danida country office in Copenhagen
- Danida's technical advisers in Copenhagen
- Danida or joint review missions and other supportive missions.

The following comments are based mainly on information from project documents and reports, and from the discussions with project and local officials. A more general assessment of all Danida interventions would require a detailed and lengthy study of project files.

5.1 Funding Arrangements

Two basic funding arrangements have been used. Under one, Danida reimburses through DEA, GOI local governments for expenditure incurred. In practice, Danida advanced funds in order to speed up implementation activities for the projects in Kerala and Orissa.

Under the second arrangement, Danida covers the expenses directly and maintains the accounts. This arrangement is possible when Danida purchases and pays directly for delivery of hardware or services, or is represented locally by an adviser. This method of direct funding has been used for part of the expenditures for all the five projects. In Madhya Pradesh, Karnataka and Tamil Nadu it was not foreseen that the advisers would get the expenditure responsibility and have the additional tasks of bookkeeping and procurement. In more recent projects, direct funding is being used in case of imports and innovative activities. For innovative activities, direct funding is gradually being stepped down, as the local authorities are ready to take over.

In addition to the above, Danida has directly covered expenditures for advisers and for short-term expatriate consultancies. These expenditures are neither shown in the project budgets nor included in the country allocations. Particularly Orissa has used this way of funding support missions.

It has been a cumbersome and for some advisers a time-consuming procedure to have the sales taxes and import duties reimbursed for purchases made by Danida funds. The decision in the Kerala project to reimburse 85% of the expenditures has cut through the problems non-reimburseable sales taxes. Also the import of Danish equipment such as rigs has caused delays, and later it has in most cases been a problem, requiring both man-power and financial resources, to import spare parts.

5.2 Advisers

From the start there has been provision for advisers in all the projects in the five states. Over the years up to March 1991 there were 22 long-term advisers with the projects. In addition the projects have also made use of short-term consultancies both by expatriates and locals. Annex VII provide detailed information on long-term advisers and short-term consultants which could be retrieved from project files in Danida, Copenhagen[1]. The information may not be complete, and is likely to lack details on short-term consultancy. The information does not cover local staff employed at the projects.

As shown in Table 5.1 half of the long-term advisers have been employed in the Orissa project since its beginning in 1982.

Table 5.1 - Technical Assistance Advisers to the Danida Supported Projects

	Karnataka	Kerala	Madhya Pradesh	Orissa	Tamil Nadu
Long-term advisers: No. of advisers	3	4	2	14	4
Man-months	162	105	78	376	152
Short-term expatriate consultancy:					
No. of consultants	0	5	0	15	1
Man-months	0	19	0	appr. 72	3

At one time, six advisers worked with the Orissa project. The project has also used short-term expatriate consultants. For both Orissa and Kerala, most of the short-term consultancies were provided by Danish consultancy companies. In Madhya Pradesh there has only been one adviser at the time, and only two over the lifetime of the project, and in Karnataka and Tamil Nadu two advisers at the time. In addition to the above technical assistance input, all projects have used short-term local consultants often to provide major technical input and support to the projects. Detailed figures for local short-term consultants are not available from all projects but the Orissa project has been the main user.

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[1] The division between advisers and other project staff may not always be clear. Here the pragmatic distinction has been made to include advisers for which Danida HQ were responsible for the advertising and made a file.

Table 5.2 below summarizes the background of the long-term advisers.

Table 5.2 - Long-term Advisers, Professions and Experiences[1)]

Type of Adviser	Number	Specialized theoretical qualification	Practical qualifications	Training/-teaching experience	Long-term working experience in developing countries[2)]
Drilling	6	5	6	2	5
Hydrogeology and water resources	2	2	2	2	2
Other technical advisers	3	3	3	0	3
Maintenance & training[3)]	7	2	5	n.a.	6
Socio-economist	6	6	4	3	6
Chief adviser[3)]	5	2	5	1	4

Source: Danida H.Q. files.

Notes: 1) Include only adviser with more than 6 months' continuous employment.
2) Long-term working in developing countries means of a continuous stay for more than one year.
3) For Chief advisers and Maintenance advisers specialized theoretical qualifications means a degree in management and teaching/training respectively.

The table shows that almost all advisers had working experience in developing countries, and in similar types of jobs. Specialized theoretical qualifications rate low for maintenance/training and chief advisers. In the table special theoretical qualifications cover degrees in teaching/training and management respectively, which were not necessarily mentioned in the job requirements. Few of the advisers had earlier experiences in training or teaching but again this was not a job requirement from Danida's side.

Only four out of the twenty-eight long-term advisers were Indian nationals. These advisers had stayed for a longer period with the projects than the average expatriate adviser. One could have expected more local advisers, as India has a very large pool of well-trained technical and social science professionals. Local professionals have, however, been increasingly employed as consultants. All projects have at one time employed sometimes fairly large numbers of local staff, financed directly by Danida. The local staff employed as trainers did not always have the relevant professional background.

Besides providing technical assistance, the advisers have also made it possible for Danida to follow the implementation of the projects closely. As the advisers in many cases have been the main link between Danida and the projects, they have either intentionally or unintentionally become more deeply involved in executive and management functions. In the case of Orissa, the chief adviser directly responsible for a large budget was bound to play a role as project manager. In the cases of Madhya Pradesh, Karnataka and Tamil Nadu such a situation was not foreseen. It was only when implementation ran into problems and delays that the advisers took on major budgetary and implementation responsibilities. The advisers became not only executives but also administrators of very practical and routine project matters like accounting and procurement. As the project offices were barely staffed or equipped for these functions, the balance between advisory and executive functions was sometimes in favour of the latter.

The Evaluation Team does not have material for a detailed assessment of the technical assistance input but can only make a general observation. In spite of the heavy input of long- and short-term technical assistance by consultants, the Orissa project did not avoid running into major technical difficulties. In some projects, the role of the expatriate as an executive appears to have been more important than performance of traditional technical assistance functions.

5.3 Monitoring and Supervision

Danida's monitoring and project management responsibilities are shared between the country desk office, the professional technical advisers in Danida Copenhagen, and the water project unit at the Danida Office in New Delhi, the latter staffed with two Danish professionals and two local officers[2]. The staff in New Delhi have in recent years followed the projects closely, and provided support particularly in the planning process and when there was need for "trouble shooting".

In recent years, more Danida functions have been decentralized to the local Danida offices. However, many decisions, particularly the professional and technical ones are still made in Copenhagen. The Evaluation Team got the impression that, as a result, decision-making was at times rather cumbersome. For example, production of project planning reports involved both Delhi and Copenhagen. In general, one can raise the question why so much direct management and supervision from Danida's side is necessary when all the projects have been provided with experienced and highly paid advisers?

Projects and/or advisers forward progress reports. The progress reporting appears to have been highly irregular in the earlier years of the programme except for the projects in Orissa and Kerala. Also the reports contain mostly quantitative information. Without qualitative assessments, they provide only a limited background for raising and solving project problems which requires other forms of communication between the project and Danida.

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[2] From 1.3.91 only one local officer/professional.

The strong Danida presence and role within the projects has resulted in flexibility and efficiency, particularly for implementation of new and innovative activities. There are many examples of this: 1) Planning effective coverage of 90% for the piped water schemes in Kerala, 2) Introduction of an investigation phase after it was found that the failure rate for wells in the Orissa project was unacceptably high, 3) Direct and consistent training of large numbers of caretakers for entire districts in Madhya Pradesh, Karnataka and Tamil Nadu.

The review missions, a normal feature of the Danida project cycle, form one of the most important means of project intervention and supervision. They can be joint reviews with participants from India, but in most cases they have been performed with members appointed solely by Danida. The review missions normally had an internal Danida technical adviser as team leader. There was only one Review Mission to one of the projects in the first six years of the programme up to 1986. Only afterwards did the reviews become a common and important feature. The lack of reviews together with the highly irregular progress reporting from the projects give the impression that Danida in the early years of the programme did not take much interest in following the implementation in Karnataka, Madhya Pradesh and Tamil Nadu. That situation changed when the projects came closer to their closing dates.

The reports from the review missions include recommendations some of which provide useful supportive advice for those who implement the project, but all of which intervene management and implementation issues. The nature of the recommendations in the Review Mission's reports raises two sets of questions.

First, there is no clear distinction between a recommendation made within the framework of the basic project documents like the Appraisal Report and the Plan of Operation, and one made outside the project framework suggesting new project strategies and activities. While implementation of the first kind of recommendations need only simple and informal procedures, the latter requires more formal decision-making and changes in work plans.

Second, the status of the review reports' recommendations can be unclear. While the reports are widely circulated it is not always obvious to the project staff which of the recommendations should be implemented. Recommendations in review reports are rarely addressed to a specific agent/institution. The recommendations are made by the review team, and do not necessarily represent Danida's viewpoint. Enquiry among Danida advisers about the latest round of Review Missions indicated that the status of the reports' recommendations were far from clear to them. However, in the Kerala project, had there been a procedure for making the recommendation valid. The report was submitted to the concerned parties. Unless objections were received, the recommendation should then be followed in the project implementation. However, the recommendation was within the agreed plans for the project.

The latest review report from the Orissa project contains 22 pages of recommendations. One can wonder why it was necessary to make so many recommendations just 15 months after the Plan of Operation for Phase II had been approved by Danida. The recommendations appear to have mixed validity. One recommendation in the report is that the Plan of Operation shall be revised in accordance with the Logical Framework Approach. A major recommendation is that the handpump programme shall be brought to a temporary halt because of the observed water quality problems in Phase I areas. This was clearly a recommendation changing the plans for project implementation. Danida as well as the project have afterwards followed this recommendation.

Apparently, the report has as another main recommendation, which suggests condemning of certain public wells, and fitting open wells with handpumps after the former have been made sanitary (p. 40). There is no mention of any implications for the project of such far-reaching recommendations, and there has apparently been no communication to the project on the status of these recommendations.

When the Review Missions take up a large number of issues both within and outside a plan of operation, and the relevance and realism the recommendations vary, the supportive nature of a review can be lost.

6 ANALYSIS OF INSTITUTIONAL SUSTAINABILITY

6.1 Institutional Strategies

Sustainability may be defined as the continuation of the flow of benefits from a project after the input from the donor has ceased.

The continuous flow of such benefits may either come from the durability of installed capital assets, or from the establishment of a predictable pattern of human activities. The technical term for the process of establishing continuous patterns of behaviour is "institutionalization", and the end result is "institutional sustainability"[1].

In preparing a strategy for a particular project, one fundamental question is whether or not a particular activity, or cluster of activities (i.e. a component) is meant to be institutionalized. Another strategic question is whether the project activities in question are to be organized inside or outside the context of existing institutions.

A cross-tabulation of these two variables as shown in Figure 6.1 below defines four basic implementation strategies in relation to existing institutions.

Figure 6.1 - Institutional Strategies

Are the Project Activities Organized within an Existing Institution?

Is institutionalization an objective?		Yes	No
	Yes	2. Assimilation Strategy	3. Grafting Strategy
	No	Catalyst Strategy 1.	By-pass Strategy 4.

The institutional strategies mentioned above range from almost total overlap between the design of project organization and the existing indigenous institutional set up (1), over varying discrepancies(2-3), to no interaction whatsoever (4). In order to provide reference points for the following assessment of the institutional sustainability of major project components the proposed terminology is elaborated a little below.

[1] This semantic specification has proved necessary, since "institutional sustainability" on occasions mistakenly is understood to be the issue of whether a given formal (legal) institution per se is viable or not.

The catalyst strategy is followed if the project component does not entail any significant institution development objective, and is supposed to work completely within an existing indigenous institution. It aims to increase or speed up the institution's goal attainment by providing additional input, but without significantly affecting its operation.

The assimilation strategy also works completely within an existing indigenous institution but aims at institutionalizing new and different patterns of behaviour. This may be done through creating **structures** (division of labour and lines of authority), **systems** (procedures for transforming energy and/or information), **skills** (the aptitude with which the systems are handled), **incentives** (the range of motivations which cause persons to act) or a combination of the above. A precondition for the success of an assimilation strategy is that the purposes of the institutional innovations are seen by the actors in the recipient institution to be perfectly congruent with its existing operational objectives, and that it is not net-resource demanding. In other words: the innovations which are being institutionalized must be seen as increasing the recipient's cost-effectiveness, or more specifically, its goal attainment within given resource constraints.

The grafting strategy has ultimately the institutionalization objective as the assimilation strategy. However, it distinguishes itself from the former in that it is either net-resource demanding and/or introduces additional operational objectives to the ones already pursued by the recipient institution. The term "grafting" indicates that the purpose is to add a new branch to an existing and viable organism, and implies that this new branch first has to be developed independently of the ultimate recipient. A pre-condition for a successful grafting strategy is that it is targeted towards the recipient institution's "providers", i.e. towards those actors who control the purse strings of the institution [2]. Thus a grafting strategy will of necessity include a "demonstration phase" on the basis of which the project activities in question can be assessed. Furthermore the strategy should include a timetable for the real decision-makers about whether or not to adopt the new elements.

The by-pass strategy is similar to the grafting strategy in that the project organization is initially established outside the confines of existing institutions. But a by-pass strategy does not aim at having the project organization absorbed by such institutions. The aim is simply to dissolve the organization after it has accomplished whatever it was supposed to do. A by-pass strategy is pursued either when there are no relevant indigenous implementing institution at all, or when the cost of using them, in terms of trouble or money, is deemed too high.

6.2 Institutional Analysis and the Establishment of Capital Assets

Danida's input in Kerala to KWA's construction of new surface and groundwater schemes definitely includes the aim of sustainability in that the schemes naturally are expected to function many years after the termination of the project. However since the sustainability of these benefits will derive partly from the durability of the established assets, and partly from a not yet

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[2] In some institutional set ups, the provider, the producer and the consumer may be identical (say a farmer who excavates his own dugwell for private consumption), but in the case of provision of public goods the distinction between the three types of actors is usually crucial.

established maintenance system, it should not be discussed in detail in this chapter on institutional sustainability.

Nevertheless, since this particular component constitutes the only pure example of a catalyst strategy in the sector under review, it is worth pausing a minute to indicate one of the pitfalls of the strategy. Another case of establishment of durable capital assets in the sector is of course the handpump rejuvenation activities in Madhya Pradesh, Karnataka, Orissa and Tamil Nadu, and the supply of drilling rigs. This was handled by existing institutions (PHED and TWAD) with requisite operational objectives and technical capabilities. However, the procurement and financial transactions were not administered through these agencies but directly by Unicef or Danida. In other words, the project components supplying handpumps and drilling rigs were hybrids between catalyst and by-pass strategies. In Kerala in contrast, the funds for the construction activities flow through the indigenous administrative system according to the same procedures as national funds. The expatriate staff has been only advisory, with little administrative or accountancy duties in contrast to the T.A. components in the other projects.

KWA

The role of institutional analysis in preparation of a catalyst strategy should, at the very least, ascertain a) the congruency between the operational objectives of the implementing institution and those of the project, and b) the extent to which their resources are matched and calibrated appropriately to achieve the intended objectives.

A typical calibration problem of ministries managing public utilities in developing countries is overstaffing relative to the funding base. Channelling funds through such institutions therefore, often leads to delays in transfer and utilization due to the chronic liquidity problems caused by immediate salary obligations. One would normally expect an autonomous utility corporation like KWA to have a better short-term match between self-generated revenues and expenditures, but although it has had this status since 1984, its total revenues still cover only a fraction of its expenditures. One conspicuous problem with the speed in the earlier phases of implementation has been the non-availability of funds. The main cause for this is the budget ceiling which is being put on projects by the State Government, and the priority which other projects or issues (such as salary arrears) may get when funds are available. In other words: even when formally the objective of the project matches completely with that of the implementing institution, implementation may be slowed considerably by overlooked competing objectives and concerns.

6.3 Institutionalization of Hydrogeological Activities

Danida's support to the hydrogeological aspects of the drinking water sector has been reviewed in section 3.1. The systems and skills transferred in this connection seem to be the ones which have been most readily absorbed by the recipient institutions. Some are related to the introduction of new hydrogeological equipment, while others are more software oriented as they relate to mapping and investigation techniques. In either case, the presence of technical advisers and short-term consultants has played an important role in this.

A preliminary positive indicator of the sustainability of the systems and skills introduced in connection with new equipment is the demand expressed within the respective organizations for using this equipment outside the project areas. Such a demand for replication of use of pump

testing units has been registered in Kerala and Tamil Nadu, and in the latter State for the hydro-fracturing unit as well.

The ultimate indicator of sustainability of the use of such equipment is of course either its actual duplication or its replacement once it is worn out. Pump testing units can be built by departmental workshops, and this has in fact already happened in Tamil Nadu. In Kerala there is no such indicator as yet. In contrast to the approach in Tamil Nadu, the pump testing unit in Kerala was not originally placed under a hydrogeological section, and the testing outside of the project area has not been analyzed. Plans have, however, been made to fulfil this precondition for institutionalization.

The hydrofracturing unit comprises a high pressure pump which is probably not producible at a departmental workshop. The ultimate proof of the sustainability of hydrofracturing procedures therefore has to await the break down of the donated unit, or possibly an earlier procurement by TWAD of additional units. Meanwhile the perceived economy of the technology lends credence to the assessment that the fracturing activities are sustainable. Even if the use of a fracturing unit on a dry borewell should cost as much as drilling a whole new well, the cost effectiveness of the fracturing procedure is regarded as superior since the chances of producing water this way is perceived as significantly greater than by trying yet another hole in the same terrain. If this perception is maintained then it will be rational to sustain the hydrofracturing activities.

In contrast there is no question that the project-supplied seismic equipment is unsustainable since it has been obsolete from the start.

Inappropriate technology notwithstanding, the hydrogeological activities promoted by Danida generally appear to have greater prospects of sustainability than any other broad category of activities promoted. This has basically come about by pursuing an assimilation strategy under conditions which were appropriate: a significant number of the promoted activities were seen by the members of the recipient institutions as effective means to achieve their established institutional goals.

This seems to be particularly true in the case of TWAD in Tamil Nadu. It should give pause for thought that in this state the project's hydrogeological activities took the shape of a regular institutional programme, while elsewhere they tended to be limited by the area focus of the projects. In formal organizations the adoption of institutional changes tend to be faster and more effective when emanating from the centre rather than from some sub-division.

In Orissa, however, the project designers did not even have the option to consider a statewide hydrogeological programme rather than an area specific project. It was indeed the area specific hydrogeological problems of the coastal blocks which came to define the project area. PHED[3] does not consider any other part of the state to have hydrogeological problems of a magnitude which would warrant employment of hydrogeologists, so the Water Resource Division of the Orissa project was established in a kind of professional void without any parallel or apex organization. PHED's intention seems to be to retain a smaller version of this division under its circle organization once the project has closed down, and is accordingly in the process of having at

[3] Since summer 1990: RWSS.

least two of the project positions permanently sanctioned. Such a unit might be able to provide the necessary hydrogeological input to future siting, design of individual borewells and supervision, but it will obviously have difficulties in undertaking alone the overall exploration, investigation and mapping which was expected of the Water Resource Division. It is for example a Danish consultancy firm which is now brought in to undertake the hydrogeological investigations in the new investigation phase. If, however, the institutional landscape of Orissa had been screened at the time of project preparation one would have come across the hydrogeological cell in the Lift Irrigation Corporation (a state owned limited company). It is concerned with the same mapping and drilling challenges as those facing the project. It employs 45 hydrogeologists and has offices in all districts, including the ones where the project operates. Although this does not put it in the same league as TWAD it does seem to provide the necessary critical mass sufficient to create a job environment with a career structure and professional challenges which are necessary for an organization to be able to absorb productive innovations. So the lack of sustainability of these hydrogeological functions may be attributed to the targeting of an inappropriate recipient institution.

6.4 Institutionalization of Socio-Economic Activities

The activities of the socio-economic units of the Kerala and Orissa projects are reviewed in chapter 3. The subsequent section (6.5) will deal exclusively with the sustainability of the maintenance functions of all the handpump projects. The current section will discuss the prospects for sustaining the activities relating to 1) the Site selection functions, 2) Latrine Promotion programmes, and 3) the Health Education Programmes.

In addition the two units have conducted a range of important socio-economic studies and investigations. Basically these studies are seen as planning and monitoring tools for project management. There has been no ambition of transferring the special sociological survey skills to the respective "host" engineering outfits. The sustainability of this function thus remains a question of whether the SE personnel themselves will be absorbed by these organizations. This in turn hinges on how valuable this and the other services appear to those actors which ultimately provide the required resources.

The other socio-economic activities differ widely in purpose and methodology, but they have two things in common: 1) they all require additional and continuous resources to be sustained, and 2) they all assume an expansion of the host institution's operational objectives.

These conditions differ radically from the ones of the hydrogeological activities, but the realization of this has been lacking in project preparations. Apart from suffering from the lack of a fully fledged grafting strategy the reasons for bleak prospects for institutionalization of these activities differ from each other as discussed below.

1) Site selection functions.

Site-selection within a given locality is, in the nature of things, not a continuous exercise. The indicator therefore, of whether or not a new site selection procedure has been institutionalized in the Water Supply Agencies, is whether they apply these procedures outside the designated project areas.

By this standard there is yet little sign of institutionalization, although authorities both in Kerala and Orissa have acknowledged the importance of taking socio-economic aspects into consideration in site selection. SEUs site selection procedures have been applied for 2-3 years in the project areas in Kerala, but they have not yet been adopted in the subsequent implementation of any **regular** KWA schemes. The same holds true in Orissa. In this project the developed site selection **procedures** were not even applied within the project area in a period when project management continued the drilling programme after Danida had recommended a halt. The reasons for both these problems of institutionalization stem from the fact that the project policy with regards "coverage of beneficiaries" differ from that of the host institutions. The mechanisms differ though:

In Orissa there is full agreement between Danida and PHED about the quantitative norm for supply of handpumps to the population. On the schedules of implementation however, they differ significantly. Ultimately these differences seem to have their roots in different political constituencies.

An important pillar for Danida's constituency is humanitarian interests[4]. Assistance designed according to the mould of these interests tend to be target group oriented projects (rather than institution oriented programmes). Target group oriented projects are typically evaluated in terms of discernable impacts on designated groups. This usually implies intense and integrated project activity in limited areas, rather than extensive coverage with a diluted effect on many. The integrated nature of the project as well as the economics of scale of establishing handpumps presumes an implementation schedule of "full coverage", i.e. establishing all needed handpumps in a particular village before moving on to the next.

The PHED's constituency on the other hand is the State Assembly, which for reasons of political necessity, as discussed in chapter 1, pursue a policy of geographical equity. This implies providing at least one handpump to all villages as quickly as possible. Thus there reportedly has been in every assembly of the Orissa State Legislature in recent years, an enquiry or complaint about the speed of handpump coverage in the 20 blocks to be covered by the project.

Obviously the socio-economic mapping required for site selections according to the intensive coverage policy is significantly different from the one required by the extensive[5].

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4 For a short synopsis of the Danish aid constituency see p. 61 in "Aid to African Agriculture: Lessons from two decades of donor experience". World Bank, MADIA. Uma Lele (Ed.).

5 In fact the only site selection "method" which is needed to fulfil the national policy of prioritizing the SC/ST is asking where this population group lives in the problem village to receive its pump.

But although the resultant policies are incongruent, it is "the one who pays the piper, who calls the tune". So long as Danida is financing the project, the site selection methodology of the Socio-economic Division can be expected to be applied in the project area, and presumably to good effect, but one should not expect it to continue after the project agreement has ceased.

In Kerala, the official investment limits are making at least the replication if not the adaptation of the project's site selection procedures and activities difficult. According to information received, ARWSP, as a matter of policy, does not finance water supply schemes where the investment cost per capita exceeds a certain limit[6]. Often that makes piped water schemes an expensive technology for rural areas. Even in the special case of Kerala which has many contiguous stretches of high density population it is often impossible to design piped schemes which comply with the cost limit set by ARWSP. In order therefore not to forego this central source of funding the applications are worded such that the coverage in terms of beneficiaries may seem greater than will actually be the case, conversely implying smaller costs per capita. Seen from this funding perspective the specificity and transparency of the mapping and site location procedures promoted by the SEU will be revealing the exact coverage. This was exactly what happened in the case of the Danida supported schemes[7]. Unless therefore the ARWSP financing limit is significantly raised, these site selection procedures are unlikely to be replicated to precede applications for **regular** Government financed schemes because if they do, they are apt to document that the applications are ineligible for funding. Nevertheless, the pioneering work on site selection carried out in the Danida supported schemes has reportedly inspired steps in physical and socio-economic planning in other schemes. This may be an indicator that indeed the site selection functions can be institutionalized if the mentioned (dis-)incentive structure is changed, whether it be by raising the investment limit for GOI funds or seeking alternative financing.

The problems of replicability, and thereby the institutional sustainability, of the projects' site selection criteria does, however, not detract from the impact they may have in the specific project areas. Impacts, which, if realized, may be sustained for as long as there is water in the taps. Likewise, the demonstration of the need for better design maps, the siting of habitation on the maps and the involvement of the community has made an impact on KWA.

2) Latrine promotion programmes

In the case of these programmes the documentation is somewhat hazy even with regards to what kind of activities the project desires to institutionalize. The focus shifts from the administration of a subsidy programme to the construction of the latrines themselves.

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6 Currently the standard is said to be 300 Rs. The Indo-Dutch-Danish Mission Report of 1989 mentions the figure 250 Rs. at that time. The evaluation mission was informed that IDP has been allowed a higher limit of 400 Rs.

7 These schemes were originally prepared for ARWSP funding. The SEU surveys revealed that the actual coverage of the scheme designs averaged 48% of the population (33, 66 and 55% respectively) rather than the declared 90%.

If indeed the institutionalization of administrative activities is an objective it is noteworthy that a target institution has not yet been finally settled on. There are two candidates in the running: the Panchayat Raj Directorates (local government directorates) and the water supply agencies (in casu: KWA and PHED).

In Kerala the SEU has found that the panchayat system is the most appropriate, while in the same breath confess that sanitation and water supply activities belong together in the same agency. In Orissa the project's latrine programme is implemented under the auspices of PHED, but meanwhile PHED has deputed staff to the Panchayat Raj Directorate to run the State latrine programme[8]. There are pros and cons for either solution (ease of financial disbursement procedures and command structure versus time and place information). The reason for this "indetermination" is that the implementation of such a programme is relatively independent of the possession of special scientific (engineering) knowledge. Once a particular latrine design has been approved as a standard, it is merely a module to be amplified without location specific modifications (as opposed to, say, a bridge or a water scheme).

So almost any state wide institution can be modified to implement such a programme as long as somebody provides the additional resources necessary for the subsidization element, as well as the administration costs.

Thus, the sustainability of the subsidization programme becomes an issue of **affordability**. Who can continue the subsidies after Danida? GOI has a subsidization programme but actual allocations are meagre compared to the requirements for the whole of India. Neither PHED nor KWA are likely to be able or allowed to generate revenues for such purpose. In Kerala the KWA is administering World Bank funds for the purpose, but it will be years if not decades before it can even cover its own expenditure for supplying water. Until then it will be idle thought to saddle the institution with additional resource demanding programmes. However, for all the schemes based on government subsidies, the awkward questions raised in section 3.4.2 about the future of such subsidies remain.

A more promising approach to sustaining the latrine construction activities of the projects is institutionalizing them exclusively in the private sector. This is the expressed hope for the training of masons in building latrines. The issue of such a privatization strategy is one of **viability:** can there simultaneously be developed a demand and matching private supply for pit-latrines?

The major significant contribution the programmes have made on the supply side, apart from the training of masons, is demonstrating that the construction costs are considerably lower than expected. In Kerala some cost reduction has even been achieved by introducing the production and use of cement bricks rather than the traditional laterite slabs. This achievement was, however, not matched with an appropriate market strategy. The projects' pilot programme tends to have concentrated on the poorer and residual households in areas which already were quite well covered with latrines subsidized by other programmes. The market for the local masons was in fact already almost saturated. This may well be the hallmark of an equity oriented programme, but certainly not one which aims at social diffusion. Project documentation claims that one

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8 This deputation has subsequently been recalled in 1991-92.

project trained mason has been able to continue this acquired craft on a purely commercial basi: There may be more, but even so the results seem meagre. This does not necessarily mean thε the latrine programme will not have a greater diffusion effect when it now goes into an area wit a smaller initial coverage. It does, however, once again, draw our attention to the fact that th wish to integrate activities in area specific projects can ultimately be detrimental to the prospect of sustainability of the individual components.

3) Health education programmes

As opposed to the project activities discussed above, the various health education programmes promoted by the projects are dependent on rather specialized knowledge within the fields of health, education, or both. Institutionalization of these activities within the water supply agencies through transfer of systems and skills is therefore out of the question. This then raises the question of whether these institutions can afford structural additions in the shape of health education cells, or the like. The prospects look extremely foreboding, but even if they looked bright it would be unlikely to work. Experience shows that small isolated professional cells in an "alien" organization only work well under extraordinary incentive structures. Usually such a set-up will fail to attract and retain the necessary professional capacity.

A major concern of the SEU's health activities in Kerala is "net-working" with various agencies and NGOs engaged with health education. It is unclear to what extent these activities are meant to be institutionalized or to what extent they aim at "one-time-impact" campaigns. It is quite feasible that certain ideas, approaches and techniques developed or promoted by the project may be retained by nodes in this network. However, the basic idea of having such activities coordinated from a water supply platform will be gone with Danida, but this may be compensated for, when other institutions improve their performance.

In summary the prospects for institutional sustainability of the socio-economic activities of the ongoing water supply projects are at present not very encouraging. Project planners have undoubtedly been too optimistic. The assessment does not preclude these activities from having achieved significant impacts during the project periods and the possibility that the effect of such impacts may be sustained beyond the project period; it does, however, predict that the activities that created them will not persist. This prediction is not contradicted by evolution of the contractual status of the Socio-economic project staff. In Orissa the SED staff remains 100% project financed and is assumed "the first to go" when the project closes. In contrast the salaries of most other project employees are half financed by PHED, and are generally expected to be absorbed back into this organization. In Kerala, the SEU is still looked upon as a temporary "visitor" to be housed in the KWA during the project period although the appraisal report envisaged that the SEU would be integrated in KWA by 1990.

6.5 Institutionalization of Maintenance Activities

The conclusion of the two previous sections (6.3 & 6.4) was that the pursuit of an assimilation strategy to achieve institutional sustainability was as appropriate for the hydrogeological activities as it was inappropriate for the socio-economic ones. An obvious difference was that the socio-economic activities introduced new operational objectives to the recipient organizations while the

hydrogeological activities simply provided new means and methods of achieving established institutional goals.

In the case of maintenance activities the project designers could have some reason to believe that these activities similarly constituted support to an established institutional objective. Maintenance had for the first time been given special mention in the seventh five year plan (1985-90) and the structure which was supposed to be institutionalized for the purpose (UNICEF's 3 tier system) had already been agreed upon in 1979. A major assumption behind embarking on an assimilation strategy is that the incentive structure by and large has been taken care of. That is: that the purpose of the activities to be institutionalized has been accepted as an integral part of the recipient institutions operational objectives, and that the performance criteria of the individual actors have been adjusted accordingly. This process of integrating maintenance as an effective operational objective had however not taken place in the various States drinking water agencies. A warning indicator should have been these institutions' lack of interest in involving themselves in the caretaker training courses.

Besides not having adequate resources to fulfil their functions the PHED engineers do not see maintenance as a legitimate operational objective of their particular organization[9]. The engineers working in local government set-ups (Zilla Engineering Divisions in Karnataka, Dept. of Rural Development in T.N.) are not in doubt about their duties with regards to maintenance, but their resources are often less and their responsibilities broader than for their colleagues in the State PHEDs.

As unpaid volunteers, the caretakers' only motivation would be the satisfaction derived from seeing results of ones actions. Thus the regular multi-tiered maintenance system was posed for a quick decline after inception: weak response from the upper tiers have lead to low activity at the lowest tier, which in turn hardly gets the response from the upper etc. etc, until the system basically reverts back, i.e. from what should have been an information driven system, to one which relies on channels for political pressures.

Such political pressure for maintenance is likely to exert itself in different ways but usually after a considerable time lag. If the pressure has to be exerted through levels higher than the very lowest, location information would tend to get lost in addition.

So when the maintenance organization eventually has to react, it will have to resort to campaign style maintenance operations for lack of time and place information. Maintenance campaigning is bound to be cost ineffective, whether seen from the perspective of the consumer who will suffer long periods where alternative water sources will have to be sought (essentially ruining any health objective of the water supply programme), or from the perspective of the "maintenance producer" itself, since it will have to visit also those handpump sites which are still functional.

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[9] This perception may be illustrated with a quote from the annual plan (1991-92, p.20) of PHED, Madhya Pradesh: "The maintenance aspects in fact do <u>not</u> (underline editors!) come in the purview of Public Health Engg. Dept. works. This way new development works could not get the required attention and flow of funds, resulting hue and cry of public for not completing the [..other..] works in time." Other, more subtle, incentives also bias such engineering departments towards construction and away from maintenance, such as professional challenge and prestige, not to mention the attraction of dealing with larger cash flows.

In summary: shortly after the termination of physical and training inputs to the multi-tiered maintenance system, it can be feared that the expected performance can not be sustained.

In contrast, the maintenance system established by the Orissa project was found to function satisfactorily under the given circumstances. This system was designed around the engagement of Semi-Employed Mechanics, as described in Section 3.3.3.

The SEM system was from the beginning clearly an experiment. It is therefore, a logical and appropriate consequence of a grafting strategy, that an evaluation comparing the performance of the SEM system with that of the regular state system is scheduled for this year.

The SEM-experiment demonstrates that bringing the technical know-how down to the pumps worked, where elsewhere bringing the time & place information of repair needs to the mechanics and engineers failed.

On the issue of sustainability in the project area it should be noted that although the SEM system, in operational terms, is working satisfactorily at present, it is not, in institutional terms, standing on its own feet yet. It is strongly bolstered by the project organization with regards to selection, training, management and financing of the SEMs.

The next step towards sustainability is therefore to identify appropriate institutions for the transfer of some or all of the project managed functions. It is beyond the scope of an evaluation report to make specific suggestions for such a screening, but it is worth cautioning: it is important that the resulting constellation will not bee seen by PHED as constituting a competing system, but rather a complementary one. If competition is unavoidable then it is a must that the system not become dependent on PHEDs good will.

Even if the SEM system can be institutionalized in the project area, it is by no means given that it is replicable without modification in other parts of Orissa or the rest of India. As has been pointed out earlier, the approach taken by the project to the coverage of the population with handpumps differs from the national one in terms of intensity. The current version of the SEM system is premised on the condition that 20-25 handpumps are to be found within the radius of approximately 3 kilometres. In many parts of India it will take years before one can hope for such coverage. In other areas, men are migrant labourers and therefore not suitable candidates for SEMs. A variant based on women SEMs would need to be developed.

This does not mean that the essence of the SEM system is not replicable elsewhere. It only cautions that a number of modifications and innovations invariably will be called for depending on local contingencies, whether geological, demographical or institutional in nature.

6.6 Institutional Sustainability in Project Design

The assessment of the institutional sustainability of the major project components gave rise to a number of observations. The most pertinent ones are summed up below.

* The objective of institutionalization itself needs to be specified to a higher degree in project design. This entails a clearer distinction in appraisals between activities which need to be institutionalized and which not. This is a pre-requisite for working out adequate strategies for the purpose.

* When institutionalization cannot take place through assimilation, it is necessary that a grafting strategy be worked out in detail, including a time schedule for decision making. In comparison to a strategy of assimilation a grafting strategy has to put great emphasis on a) identification and co-option of relevant decision-makers, and b) change and development of incentive structures.

* In many, if not most, situations the geographical scope of the project is only a fraction of the geographical scope of the institutions in which project activities could be institutionalized effectively. Targeting only a geographical sub-division of a centralized institution for institutionalization is often not effective if at all feasible. Project designers may therefore be faced with a trade-off between visible short-term impacts for a narrow target group and less discernible but more sustainable results for a larger population.

* A broader and more thorough institutional screening process is warranted as part of project preparation. The attraction in terms of simplicity of dealing with one recipient institution only might be outweighed by the loss of overlooking and forgoing the full range of complementing or alternative existing indigenous institutional capabilities.

7 FINANCE AND COST CONSIDERATIONS

7.1 Cost of Project Activities

From 1980 to the end of 1990, Danida's project expenditures on the five projects have totalled DKK 370.5 mill. (Table 7.1). In addition to this amount, Danida has spent funds directly to cover the expenditures to advisers and other external consultants. Detailed project expenditures over the eleven year period are given in Annex VIII. In the earlier projects, the majority of expenditures went for hardware items such as rigs, vehicles, pumps, and other equipment. Later, Danida financed more software components, including local salaries and other operation and maintenance costs. Throughout the period, the Danish Krone appreciated against the Indian Rupee, and the Danida DKK allocations could cover prolonged implementation periods without being increased[1].

There is no consolidated account of expenditures incurred by the state governments in India, but the expenditures have been substantial for all projects. In the early projects, where Danida covered hardware supply, local governments were supposed to cover all other implementation expenditures, thus the local finance components in the appraisal budgets were much higher than Danida contributions. Also in the new projects in Orissa and Kerala does local governments contribute a significant part of the budget.

Table 7.1 - Danida Expenditures by Project (in DKK mill.)

Project	Expenditures per phase	Total
Tamil Nadu		
phase 1 (2 projects)	26.8	
phase 2	7.1	33.9
Karnataka		
phase 1 (2 projects)	41.5	
phase 2	18.9	60.4
Orissa		
rep. phase	15.5	
phase 1	57.2	
phase 2	88.1	160.8
Madhya Pradesh	36.6	36.6
Kerala	78.8	78.8
Total		**370.5**

1 For some years the practice has been that the Rupee budget and the implementation period cannot be extended without a renewed approval.

An analysis of project expenditures poses two main questions:

- Has the amount of resources used for the various project activities been reasonable in relation to the outcome?

- What will be the costs for local institutions to replicate projéct activities and to sustain benefits?

However, only limited material is readily available to answer these questions. The terms "cost-efficiency" or "cost-effectiveness" are often used in project documents and included in TORs for review missions, but are rarely defined or made operational in relation to the analysis of project activities. Only in few cases, like the 1986 Review Report from the Orissa project, are attempts made to consider the cost-effectiveness aspects of the projects.

In certain cases, some have argued that the introduction of new designs or other measures has improved the cost-effectiveness. The examples given are drilling and well design in the Orissa and Tamil Nadu projects. However, while costs may have been reduced, it is assumed that efficiency has remained the same or improved.

There is little systematic effort in any of the projects to monitor cost-effectiveness. An exception is the Orissa project, where both drilling and maintenance costs for Phase I handpumps are closely monitored. Otherwise, it is difficult from the project accounting systems to make even routine unit cost calculations. Recent changes in the Danida accounting systems have, however, improved the situation in this respect.

7.2 Unit Cost Analysis and Effectiveness

While in India, the Evaluation Team gathered information from project expenditure accounts for use in calculating unit costs. The following sections present these calculations, and discuss the relationship between the unit costs and the effectiveness of project activities. By "unit costs" is meant project expenditures in relation to a physical output or number of people covered. Looking at cost-efficiency means that costs are related to how output has been able to fulfil objectives.

Project Investment Costs for Drinking Water Schemes
For handpump installations, drilling and tubewell construction constitute principal investment costs, while pump installation and platform construction cost relative little. Therefore the investment costs varies immensely with the depth of the well.

The most detailed figures for drilling and handpump installation are available from the Orissa project. Here the wells are relatively deep and therefore also have the highest costs. Costs for handdrilling as well as drilling by rigs are shown in Table 7.2 below.

Table 7.2 - Average Expenditures on Tube Wells and Handpump Installation, 1989-90 at the Orissa Project (in Rs.)

P.H. Division	Number of handpumps	Average depth	Average cost[1]
Cuttack[2]	455	199	45,507
Bhubaneswar:			
Rig drilled	105	134	23,429
Hand drilled	169	146	37,082
Puri:			28,337
Hand drilled	251	103	

Notes:
1) Includes cost of platform (in Cuttack Rs. 1,500; in Bhubaneswar Rs. 1,000; and in Puri Rs. 1,200).
2) Apparently includes only hand drilling.

Source: DPD

The expenditure costs above include only direct material and labour costs but exclude interest on investment and depreciation. Other studies show that these items will add about 44 percent to the above costs if drilling was performed by imported rigs. The handdrilling performed by private contractors might therefore be cheaper but the two techniques are not fully substitutes.

Cost of tubewells will also vary with the design. The one used in the Danida project area seems to be 25-35 percent more expensive than PHED rates used outside the project area, even compared to a cost reducing revised design proposed by DPD.

The above figures indicate that the direct cost of investment for providing water through handpumps is between Rs. 90 and Rs. 180 per person, assuming that each handpump serves 250 people. However, a more accurate calculation of the efficiency would need to take into consideration the functioning and utilization of the handpumps. As described elsewhere in the report, problems affecting a high percentage of the handpumps have resulted in their being used infrequently or not at all. This implies that total investment costs relative to the number of people actually using the water from the installations is much higher than Rs. 90-180 per person. Taking into account the large expenditures on the technical investigations into why the programme has failed would raise these per capita costs even higher.

Available information from Tamil Nadu include budget estimates from 1989/90 which show that drilling costs in the sedimentary areas are calculated at a higher rate than in Orissa. The same estimates also show that direct costs for drilling and installation of a handpump in hard rock areas under the conditions prevailing in the western parts of Tamil Nadu are cheaper than in sedimentary areas mainly because the depth of drilling is smaller.

The project in Kerala and the three mini-water schemes in Orissa provide some information on investment cost for piped water supply. However, for Kerala it is only the latest estimates for the schemes yet to be completed.

Key investment figures for two mini-schemes in Orissa are summarized in Table 7.3.

Table 7.3 - Investment Costs for Piped Water Schemes in Orissa

Scheme	Expenditure year	Total scheme expenditures Rs. 1,000	Per capita costs in Rs.	
			Base year	Design population
Chandbali	1983/84	1,584	213 (1981)	151 (1994)
Balikuda	1988/89	1,426	386 (1986)	278 (1996)

Source: DPD Bhubaneswar.

These schemes were constructed because the technical as well as economic feasibility of alternative handpump installations was less promising. For some of the villages in the Balikuda scheme, potable water was not available within a depth of 300 meters. Per capita investment costs are therefore only a little higher than for wells with handpumps. The mini-schemes are also designed to provide more water per capita than the handpumps.

The function of the Orissa piped schemes is discussed in Section 4.1. While piped schemes in Orissa cater for a few thousand people, each of the schemes in Kerala is very large, covering from 68,000 to 249,000 people. As the schemes are not finished, only cost estimates are available and presented in Table 7.4.

Table 7.4 - Cost Estimates for Kerala Piped Water Schemes

	Kolacherry	Edappal	Cheekode, phase I
Original estimate mill. Rs. (year)	66.9	33.0 (1985)	24.6 (1985)
Latest estimate Sept. '89 of original design mill. Rs.	118.2	50.5	66.6
Estimate for 90% coverage Sept. '89 mill. Rs.	176.7	69.9	77.9
Capital investment per person with 90% coverage of target population 2011 in Rs.	710	357	899

Source: Danida Technical Adviser, Calicut.

The cost escalation of the schemes is considerable. The reason for the increases has two elements, one due to price inflation of the original design estimates, and another caused by the design changed in order to cover the 90% target population in the areas. In 1989 it was found that the original scheme designs would only cover 31% to 66% of the population. The new per capita investment estimates are now already much higher than the Rs. 300 which GOI has in its guidelines for financing similar KWA schemes. The changes in the designs have contributed to the considerable extension of the implementation period. This has led not only to an increase in costs due to inflation, but also to investments in piped mini water schemes established within the project area during the implementation period in response to popular and political pressure for water. Compared to figures from Orissa and elsewhere, unit costs for at least two large schemes in Kerala; Kolacherry and Cheekode, seem higher than for small schemes. The Edappal scheme in Kerala on the other hand, has investment costs closer to and maybe more comparable to the small schemes in Orissa. However, such comparisons are difficult to make as factors like the terrain, availability of water source, population density a.o. vary considerably, and furthermore, the Kerala schemes have yet to prove their efficiency when water starts running.

Project Investment Expenditures in Maintenance Systems

Except from Kerala, all projects have invested funds and time in maintenance systems. The training efforts have required the most time. Hardware has been supplied. Information from the projects, mainly based on the account figures, gives the unit cost figures presented in Table 7.5. The figures can only be approximate, and do not, for example, include project office overhead. Sufficient expenditure figures were not available from the terminated project in Tamil Nadu.

Table 7.5 - Unit Costs for Project Investment Expenditures in Maintenance Systems, 1989/90 in Rs.

	Madhya Pradesh	Karnataka	Orissa
Informer	27	n.a.	n.a.
Caretaker	191[1)]	134[2)]	n.a.
SEM	n.a.	n.a.	approx. 8,000[3)]
Block mechanic including tools	5,081	n.a.	n.a.
Mobile van	300,000[4)]	172,000 (1988/89)	n.a.

Notes:
1) Tools not given, exclude DPO staff wages and allowances.
2) Include DPO staff wages.
3) Investments include expenditures for training camp, wages etc. of training staff and tools to SEM's. Last item estimated to be about Rs. 4,000 per set. Exclude training materials.
4) Includes modification of van and tools.
n.a. not applicable

Source: Project accounts and reports.

Compared to the investment in the handpumps, cost for training caretakers is marginal but can be reduced further if the person functions only as an informer. The investment in SEMs is of course heavier, but at the same time it reduces investments at the levels above, e.g. exclude investment in mobile vans, and have potential savings by SEM's performing preventive maintenance.

Government of Karnataka had in its 1990-91 budget made provision for training of caretakers in the districts at a rate of Rs. 100 per caretaker. Although funds were allocated for training 44,697 caretakers, achievement by December 1990 was recorded very low.

Maintenance Costs for Handpumps and Piped Schemes

With more than 1.5 mill. public handpumps installed by the public in India, the costs of maintaining these pumps are of crucial importance for the public finances. Of equal importance are the efforts to sustain the benefits of reliable water supply. Of the five projects, only the Orissa project supports the full line of maintenance activities, and therefore has information on all costs involved.

The Training and Maintenance Division (TMD) of the Orissa project has for more than three years been responsible for the two tier maintenance system of 1650 handpumps constructed during Phase I. Based on actual expenses for the Division, costs of maintenance are shown below in Table 7.6.

Table 7.6 - Maintenance Costs in Rs. for Handpumps in the Orissa Project

	1988[1)]	1989	1990
Number of pumps	1,650	1,650	1,650
SEM contract fees	157,156	171,615	247,272
Two tier salary & allowances	85,687	180,123	111,236
Office expenses	40,066	87,572	37,588
Equipment, spares & tools	312,431	207,383	226,877
Monthly meeting expenses	6,581	677	28,441
Total expenditures	601,921	647,470	651,392
Equipment, spares & tools per pump	189	126	138
Total average cost per pump	365	392	395

Note: 1) The 1988 figures include costs for December 1987.
Source: Training and Maintenance Division, Orissa Project.

The above costs exclude project overheads e.g. advisers. The three major cost components are salary to SEMs, cost of staff at the second tier and spare parts. There are only minor transport costs involved. The project costs are otherwise close to the rates the government would have to apply. As indicated in section 3.3 it is the impression of the Evaluation Team, that the efficiency of this maintenance system is high, taking into account the preventive maintenance performed by the SEM. The value of preventive maintenance is likely to be substantial. Opportunity cost of breakdown of a India Mark II, including indirect financial cost of capital invested and opportunity cost of labour, has been calculated to be Rs. 15-16 per day[2].

In Karnataka, information on maintenance costs was collected from one division in Kolar District. Operation of the mobile van including milage, wages for non-payroll employed and spare parts for handpump maintenance only, came to an annual average of Rs. 330 per handpump. The budget allocation in 1990-91 is Rs. 275 per pump, the difference being diverted from the general provision for water supply schemes. This maintenance system with caretakers and mobile vans at Taluk level does not perform preventive maintenance beyond that done by the caretaker (see section 3.3). Karnataka as whole has about 116,000 handpumps, the number of pump repairs was about 92,000 in 1989/90. Utilising the budget figures for maintenance fully, average allocation per pump repaired is Rs. 346. In Bijapur District it had been calculated that average expenditure for one pump repair was Rs. 400-500.

2 S. Jonsson & J. Rudengren: An Economic Appraisal of a Handpump Maintenance System Using Women Mechanics, Stockholm 1990, p. 25.

A cost analysis of handpump repairs in Karnataka, made outside the project area in Mysore Taluk, estimated 1989/90 costs per pump to Rs. 347, including the same items as above: spares, labour and transportation. Of the Taluks 753 handpumps, 488 had been repaired, 288 of which more than once. There is little information available to judge the efficiency of the maintenance system in Karnataka. Pumps in Karnataka might need more frequent repairs as the installations in the project area were of lower quality than in Orissa.

The above information indicates that the direct costs of maintenance are substantial, and more than present budget allocations. On the other hand, if a pump on average is used by 250 people, annual maintenance costs seems only to be about Rs. 1.50 per person which is hardly a major budget item even for a low income household.

Such scant information can unfortunately neither say very much about the efficiency of the different maintenance systems, nor whether the SEM system with preventive maintenance pays. Comparable performance indicators are not available. The Evaluation Team, therefore, supports the plan by the Orissa project to undertake a comparative evaluation study of the two tier project maintenance system, and the three tier system performed by PHED outside the project area.

For the piped water schemes in Kerala, project documents give no information on what the maintenance cost will be for KWA. Only recently have such estimates been made for the first year of operation. These estimates include both operation and maintenance costs, and show that the per capita cost (1991) will be Rs. 21 for one scheme and close to Rs. 40 for the two others. The plans include full salaries to about 160 people plus additional wages to casual labourers. It should be underlined that these estimates have not been approved. However, the scale of operation/maintenance costs per capita is much higher than for handpumps mainly because a large system has to be operated by KWA, and not by the user as in the case of a handpump.

Figures on operation/maintenance of the piped water schemes in Orissa were only available from scheme estimates, not from actual expenditures. The estimates show annual per capita operation and maintenance costs to be about Rs. 9 to Rs. 19. Indications from other states with both piped mini water schemes and handpumps show maintenance costs to be higher for the piped schemes. Government of Karnataka allocated in the 1990-91 budget Rs. 1.600 per mini water scheme for maintenance.

Cost of Activities by Socio-Economic Units

For both the projects in Kerala and Orissa detailed figures were available on recent years' spending on socio-economic and health/sanitation activities. However, it was not possible to distribute some of the heavy overhead costs from the administration of activities. The calculated cost figures are presented in Table 7.7.

Table 7.7 - Cost of Activities by the Socio-Economic Units in Rs.

	Kerala	Orissa (1988-90)
1. Site selection per handpump/ standpost	no info. [1]	1,327[2]
2. Health education campaign per person in the area covered	0.50	179
3. Average cost per latrine constructed	approx. 1,735 [3]	1,603

Source: Project accounts and documents.

Notes:
[1] No site selection had been made since introduction of new detailed account system was introduced.
[2] Include SEU's participation in functionality studies after pump installation.

[3] Reported cost including materials and construction.

Costs for the Orissa activities include direct cost of staff and use of vehicles. They appear high if one imagines the activities to be taken over on a large scale. No doubt, some of the staff time used on the activities is due to their pilot nature.

The costs for health education activities for Orissa and Kerala can hardly be compared. Part of the population counted for in the Kerala project has only been briefly affected by the programme. While the Orissa project paid NGOs to do the field implementation, the Kerala project made use of various trainees from the cooperating official institutions without incurring costs to the project.

8 SUMMARY OF FINDINGS AND RECOMMENDATIONS

8.1 Summary of Findings

Objectives

The earlier projects had the general welfare objective to improve the supply of drinking water with specified physical implementation targets. Most of these targets have been met or are likely to be met. However, in all cases implementation has taken much longer than originally expected. In some cases, such as the Orissa and Kerala projects, the delay in implementation has political, economic, and social implications. The projects provide limited information through which the achievement of the welfare objective can be measured.

With the two projects in Kerala and Orissa, and in later planning documents from the other projects, more detailed development and immediate objectives are introduced. These concern health, reaching the weaker sections, sustainability and institution-building. Generally the arguments for how, and the strategies by which, these objectives should be met are poorly developed in the original project documents.

Hydrogeological Support

In the first phases of the projects, the hydrogeological support concentrated on the supply of field instruments. With the exception of the seismometers, the equipment supplied is generally well suited for the type of investigations required.

Valuable assistance regarding hydrogeological aspects has been provided to the implementing agencies in the four states where construction of new wells was a project component. The institutionalization of adequate hydrogeological working procedures is on its way but did in most cases not accelerate until the latest stages of the projects.

The hydrogeological support has in many cases constituted an innovative project component in respect of software as well as hardware: various geophysical field investigations, hydrofracturing, test pumping units, etc.

The possibilities of fruitful interaction with other relevant institutions have generally been given too little attention during project preparation and later stages of the projects. Alternative institutional organization regarding hydrogeological aspects have not been sufficiently investigated and procedures for exchange of relevant information have not been established.

Appropriate data storage and retrieval systems have not been established in any of the projects. In Orissa, systematic data collection and storage has taken place but convenient data retrieval facilities were not established. It may be concluded that none of the projects has benefited from a system where optimal use of the collected data could be made.

A number of Danida missions to the projects have recommended the establishment of data banks but the required resources were not allocated in time for this purpose. Apparently, the objectives of establishing data banks have not been well defined and consequently the usefulness of such systems was not fully understood by the project personnel until the latest stages of the projects.

Drilling
The supply of drilling rigs unknown in India and requiring imported spare parts has hampered the production rate of the drilling operations.

A need for adaptation of drilling technique and well design has been experienced by most of the projects. This process has generally met serious difficulties, mainly due to a lack of exact information on the functioning of the wells and due to a lack of appropriate strategy for dealing with these problems.

Particularly regarding the hand drilled wells in coastal Orissa, inappropriate well design and construction methods combined with insufficient quality control have resulted in a substantial number of failures. The seriousness of these problems are related to the complicated groundwater situation all along the coastal belt. The project itself realized the problems through the functionality studies it initiated as a follow-up. The ongoing special hydrogeological investigations can contribute to the drilling problems and be useful for activities in other coastal areas of India.

Provision of Safe Drinking Water
The physical targets for handpump installations and piped water schemes for the projects in Madhya Pradesh, Karnataka and Tamil Nadu have been met, and are likely to be met in Kerala. There is great uncertainty to when the Orissa project will reach its ambitious targets for pump installations.

The quality of platform construction and drainage was found to be the most significant variable determining sanitation around the handpump, and an important factor in handpump functioning. From the field visits these aspects were only found satisfactory in the Orissa project.

Water Quality
No adequate water quality monitoring has taken place parallel to the implementation and none of the projects providing handpumps are at present able to give detailed answers to water quality questions.

In Karnataka and Tamil Nadu, very little information at all is available on the quality of the water supplied from the wells. No proper evaluation can therefore be made regarding the projects' achievement of supplying good quality water. As the water quality has not been monitored, the projects have not been in a position to adjust drilling techniques and well design accordingly. For these projects, and also for the one in Madhya Pradesh, groundwater was most likely assumed to be safe, and the issue was not dealt with in the project formulation.

A Functionality Study in 1987 showed that 82% of the wells constructed during phase I of the Orissa project were used both for drinking and cooking. The study did not, however, show to what extent each of the wells was used.

The same study revealed that 24.5% of the wells were affected by corrosion and that this proportion was rapidly increasing. The only workable remedial action in this respect is the installation of non-corrodible pump assemblies. Tests were initiated with a view to select an appropriate design for rehabilitation of the installed pumps but by March 1991 implementation of rehabilitation has not yet commenced. This will take place under a special programme starting in April 1991.

The Functionality Study also showed the problems of Phase I wells giving saline water. A Technical Tubewell Study in 1989 estimated that 16% of the wells were affected by salinity problems and that this proportion may increase to around 20%. These wells will be rehabilitated/redrilled during the above mentioned project phase commencing in April 1991.

The forthcoming Orissa project phase is intended to investigate the hydrogeological aspects of deep as well as shallow aquifers. A total halt of project implementation apart from rehabilitation works has been imposed until the results of the forthcoming phase are available.

Maintenance

The focus of one thrust to Danida assistance on handpump maintenance was correct, because maintenance is of continuing and increasing importance in India. The country has approximately 1.5 million India Mark II deepwell handpumps. With age, and without preventative maintenance, a significant portion will break down completely. In the absence of a sustainable preventative maintenance system on an national scale, India stands to lose this tremendous investment. Danida can contribute to establishing such a system through continuing **innovative** maintenance projects on at least a district scale.

Danida made the correct decision in focusing its maintenance assistance at the lower tiers. However with hindsight, one can see that insufficient attention went to:

* spare part procurement and distribution,
* tool development,
* training of adequate quantity of block level mechanics,
* policy dialogue with water departments on hiring sufficient numbers of block level mechanics.

The caretaker training programme has been successfully implemented in that the intended number of caretakers have been well trained. The programmes most remarkable achievement has been the scale at which training was done. Other donors have implemented caretaker training, but none have succeeded in covering whole districts as the Danida supported projects did. However, caretakers have not sufficiently performed the expected roles in the maintenance system or in promoting the utilization of safe water.

The three tier maintenance system based on mobile vans has not worked for the following reasons:

* State governments do not procure vans in adequate numbers.
* The departments do not have sufficient funds for proper van maintenance.

* Vans are often diverted for other uses considered more important at the time, for instance, piped scheme maintenance and repair.
* The vans are used mainly to repair broken down handpumps, especially during a drought or just prior to the dry summer months, rather than for preventative maintenance.

Thus, the concept of preventative maintenance based on mobile vans has proved unworkable.

The SEM system has shown potential as a low cost solution to the critical problem of too few mechanics at the block level. But the system has so far only been tested under the field test conditions of heavy project financing, supervision, and control. It remains to be seen whether the system would look as promising, if run under the RWSS.

Research and Development
Implementation of the Orissa project required field research and development of handpumps in order to deal with water quality problems in the coastal saline belt. Systematic R&D did not begin early enough, nor did it adequately incorporate the experience of other projects facing similar conditions. Decisions were made too hastily on the basis of insufficient field testing. These early problems have now been overcome, and the Orissa handpump research and development component is probably the most rigorous and fruitful in India.

Site Selection
Site selection by socio-economic units improved the delivery of benefits to disadvantaged sections of the population, and in Orissa improved environmental sanitation. Whether these site selection strategies can be institutionalized within the water departments remains a moot issue.

Institutional Sustainability
The projects contain a range of institution building interventions. The ones with the best prospects of sustainability have been implemented as a assimilation strategy. The ones with the worst prospects have of necessity followed a grafting strategy. The most critical project attempt at institution development, namely a maintenance system, has only - and to various degree - taken root, although the need today is widely recognized.

Project design has been characterized as being vague on which activities are or are not meant to be institutionalized. When project designs do identify institution development as an objective, it fails to present adequate strategies to that effect.

Project Intervention and Supervision
Throughout the period, Danida assistance to the sector has been planned as project-aid, confined to a particular geographical area within a state with provisions for Danida advisers. This approach can result in comprehensive project designs, and gives the donor a good possibility to monitor project activities. However, the project approach does have its limitations:

* In a number of instances, it has proved difficult, within the project framework, to change policies which constitute major bottlenecks for the implementation and sustainability of the project.

* Utilization of equipment or know-how, when confined to a particular area like the Danida provided rigs, is questionable. In most cases the recipient has also made used of the equipment outside the project area.

* The project approach has for some project activities like training, created a distance to the recipient institution, and in general increased Danida's role in project management, and turned advisers into executives. This has particularly been the case in Madhya Pradesh and Karnataka. In Kerala, the technical adviser was more of an adviser to the local executing agency.

Besides providing advisers - which in most cases should have a strong impact on project monitoring - Danida has in recent years maintained a close supervision of the projects. In many cases this has contributed to achievement of targets and objectives. However, the supervision of projects seems to have come close to management of some project activities. There has been a risk of alienating these activities from the recipient institutions, particularly when advisers become administrators and executives.

The status of the Review Missions' recommendations seems unclear in relation to the projects. In some cases these recommendations suggest significant changes in activities and plans of operation. Review missions tend to change basic project contents and management strategies rather than lending professional support to the project implementation.

Preparation of project termination reports is a new and desirable procedure. However, the three closing projects have only very recently terminated some of their main activities, and there is no provision for follow up and monitoring to see if the assistance will have the desired effect.

Project Cost and Efficiency

Although the terms cost-efficiency or cost-effectiveness are often used in appraisal and review reports as well as other project documents, the terms are rarely defined nor made operational in relation to analysis of project activities. There is little scope in project monitoring to measure efficiency. There is no systematic effort in any of the projects to monitor cost effectiveness. Recent changes in Danida accounting systems have made it more feasible to relate costs to relevant activities.

The actual costs of making the site selections in the Orissa project may appear high and can be decreased. However, for the Orissa project - and very likely also for the project in Kerala - these costs are low compared to total investment costs.

As a new design has been applied for establishment of drilled wells in Orissa, unit costs for drilling are significantly higher compared to drilling outside the project area. With the large number of problem pumps, efficiency in establishment of wells is low.

The preliminary indications from Kerala and also from other schemes show piped water schemes, both investment- and maintenance-wise, to be more costly than provision of drinking water by handpumps. For the same amount of funds, a larger number of needy people can perhaps be catered for in other areas. Only in Orissa, do unit costs of the expensive and very deep tubewells approach the costs of piped water schemes.

While it has been possible to relate costs to appropriate activities for calculation of unit cost figures, it has proved much more difficult to measure efficiency of project outputs like amount of water produced or the health impact from health education. In cases like training of caretakers/informers in Madhya Pradesh, Karnataka and Tamil Nadu, the impact on functionality of the handpumps is not followed and the efficiency in performance of trained people is therefore unknown.

For an assessment of financial sustainability, the general impression is that costs are high as a result of the activities funded by Danida. In some cases costs include O&M for vehicles and allowances which a recipient institution will not be able to support under normal circumstances. For both implementation and maintenance activities, there are instances where project expenditures are higher than normal departmental rates. The question therefore is, how performance will be affected when recipient institutions cannot afford the higher levels for expenditures like salaries and vehicles' O&M.

8.2 Recommendations

General

1. The purpose of Danida assistance to the drinking water sector should continue to be the testing and demonstration of innovations and improvements of activities which are likely to be sustainable. Specifically, assistance should not go to current activities already adopted by the central and state governments, and which are presently pursued by the latter on their own.

2. Danida must consider from the outset how an innovation will be expanded to the district or state scale. Assistance should not go to the so-called pilot projects in a few villages or blocks which cannot be financially sustained when replicated on a larger scale depending on a concentration of a disproportionate amount of input, including advisers and consultants.

3. For certain types of aid to the sector, Danida should consider applying a programme rather than a project approach. This means, under mutual understanding of policies and objectives, to give - possibly combined - financial and technical assistance to a general strengthening of a state's institutions' or sub-institutions' capacity to implement the innovative and improving elements of its development programme. A programme approach is not to be confined to a particular geographical area within a state.

Hydrogeological Support and Water Quality

4. Water resource aspects, in terms of water quality as well as quantity should be given more attention at the project preparation stage. Appropriate means for protection of the water resource and monitoring of its development should be envisaged in the projects.

5. Data banks should be considered a management tool. An efficient data storage and retrieval system should be considered a basic project requirement which must be established in the beginning of the project. Employment of short-term consultants to ensure appropriate initiation of this activity would be relevant in many cases.

6. Further development of the performance level of the hydrogeological wing of the implementing agencies would have an important influence on the possibilities of success in future implementation of water supply. The assistance should not be water project oriented but aim at a general increase of the professional level.

Support to Drilling and Provision of Safe Drinking Water

7. Danida assistance to future projects should not include procurement of drilling rigs. But Danish assistance to innovative activities may possibly include large procurements of hardware. This was the case with procuring handpumps for rejuvenation, the latter being one means through which to encourage states to standardize on the India Mark II.

Quality, Research and Development

8. Danida must agree with the implementing agency that all input to a project will be of an assured quality. This means that Danida must insist, whenever feasible, that a third party inspects all hardware input, both that procured by Danida and that purchased by the government. Danida and the implementing agency must also agree on quality control procedures related to performance of construction works and resulting output.

9. In cases where research and development activities are required for effective project implementation, utmost care should be taken to ensure that experience form similar projects is taken into consideration. Resources for employment of short-term consultants should be available whenever research and development activities are initiated.

10. Danida should continue to support field testing and development of handpumps. Handpump development innovations in the Orissa project, such as the use of PVC riser pipe with the India Mark II, should be promoted through inclusion in the Bureau of Indian Standards (BIS) specifications.

11. New handpump developments or versions (such as the extra deepwell India Mark II) should not be procured on a large scale until thorough field testing is carried out. One should ensure that handpumps meant for particular hydrogeological conditions are used in those areas.

Maintenance

12. Handpump maintenance, particularly preventive maintenance, should continue as an objective in Danida assistance.

13. No more assistance should be given to large scale caretaker training. However, Danida should encourage and support efforts to inform communities about the handpump maintenance system, especially how and where to report breakdowns, and to give a general introduction on the reasons for using handpump water. Aspects of the Madhya Pradesh informer system and the Orissa health education campaigns could possibly be the basis for this.

14. No more assistance should be given to mobile vans, or for promoting maintenance systems based on mobile vans at the block or sub-divisional level. Any government maintenance system requires some motorized transport at the higher tiers, although in many cases this might be just a jeep[3]. Providing such transport should remain a government responsibility, with no assistance from Danida.

15. Efforts to expand and institutionalize the SEM system should receive particular attention in the future. This mainly means relaxing project supervision and control over the system, and thereby transferring these responsibilities to the state water departments and locally elected government.

16. Danida should support experiments with variations of the SEM system including those involving women in crucial areas of maintenance. Danida should study what has already been achieved in other projects, and under what conditions, and then incorporate experiments along these lines in ongoing and future projects.

17. Where Danida has found opportunities to institutionalize SEMs, support should also be given to spare parts distribution, (e.g. training of the local staff responsible for spare part procurement and distribution), and in those exceptional cases where necessary, storage facilities.

18. Wherever Danida engages in activities in support of handpump maintenance, improved platform construction and drainage should be considered as an integral part of the activity, and a pre-requisite to establish a maintenance system.

Project Cost

19. Considering the cost aspects, Danida should support rural handpump drinking water programmes rather than the more expensive rural piped water schemes in order to reach a larger number of poor and needing people.

Project Intervention and Management

20. Danida should improve its analysis of development and immediate objectives for the rural drinking water projects, and consider other development objectives besides improved health.

21. Danida should clarify the role of advisers. In general it should avoid to design projects where advisers become burdened with administrative functions instead of working as supportive professionals for the recipient institutions. In this way Danida will also be able to reduce the heavy burden at all levels in managing projects.

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[3] The particular level at which motorized transport becomes necessary depends on the geographic size of and number of handpumps in an administrative unit in the state: a sub-division in one state might be bigger and have more handpumps than a division in another.

22. For the Terms of Reference for Review Missions it should be clearly defined whether the tasks fall within or outside the project's Plan of Operation, and how they relate to problems identified from the progress reports and the projects need for professional support.

23. Danida can improve its communication to local institutions and project staff of the final status of the recommendations of a Review Mission after they have been processed by the involved parties.

24. In addition to project termination reports, Danida should consider providing short-term professional assistance to terminating projects in order to ensure that accumulated project knowledge and techniques are appropriately transferred to the recipient institution.

Institutional Sustainability

25. Project documents should distinguish clearly between the activities with an institution development objective, versus activities limited to the project period. Explicit strategies for institution development should be included in the project design, indicating **inter alia** who has to decide what and when.

26. Project preparation should include a systematic review and screening of indigenous institutional set-up.