

2 3 2 . 2  
8 4 S E

→ H. van Damme 1869/56

TRC, CWS  
The Hague  
5603

# SEMI - INDUSTRIAL PROJECTS ASSISTED BY UNICEF IN INDIA

Phase II

05	MAR	85	50356
DIR			

Milk Drying Plant, Anand  
Weaning Food Plant, Anand  
Small-scale Food Processing Unit, Dhar  
Mark II Water Handpump, Madras and Delhi  
Braille Book Printing, Dehra Dun  
Vaccine (DPT) Production, Kasauli



Assessment prepared for UNICEF by  
TATA ECONOMIC CONSULTANCY SERVICES

Regional Office for South Central Asia  
NEW DELHI  
December 1984

2322-04SE-1869

LIBRARY, INTERNATIONAL REFERENCE  
CENTRE FOR COMMUNITY WATER SUPPLY  
AND SANITATION (IRC)

P.O. Box 93190, 2509 AD The Hague

Tel. (070) 814911 ext. 141/142

rw:091603

ISBN = 1869

LO: 232.2.84SE

5585  
UNICEF  
Delhi

## MARK II WATER HANDPUMP, MADRAS AND DELHI

### CHAPTER I

#### EXECUTIVE SUMMARY

1.1 This report has been prepared by the Tata Economic Consultancy Services (TECS) for the United Nations Children's Fund (UNICEF), Delhi. In this report TECS has examined in detail, the UNICEF assisted India Mark-II handpump project.

1.2 In India, UNICEF works, in partnership with the Government, on programmes aimed at extending basic services to needy children and mothers. One of these services is the provision of safe and convenient supply of water to the needy. To fulfil this objective the handpump project was undertaken by UNICEF.

1.3 The objective of this study was to look into all aspects of the project from the point in time when it was initially mooted to its present status and to cover all aspects of the project including development, production, utilization and also the performance of the pump. In general the study is to assess the level of success, or otherwise, of the project.

#### Methodology

1.4 The study was carried out in three connected phases. During the first phase all information available at UNICEF was scanned vigorously to get an insight into the project objectives, its historical development and its present status. The second phase involved detailed discussions with knowledgeable persons directly or indirectly related to the project. These included UNICEF personnel at New Delhi, Madras and Hyderabad, some manufacturers of India Mark-II handpump, those concerned with installation and maintenance, officials of the Indian Standard Institution, etc. Two visits to Richardson and Cruddas were made to get an insight into the manufacturing, quality control and inspection aspects of the India Mark-II handpump, as the firm is the pioneer in this field.

1.5 TECS simultaneously undertook a field survey of selected handpump installations to assess the field performance of India Mark-II handpump and also evaluate the installation and maintenance practices and other related aspects.

1.6 In the third phase, the report was prepared by analysing the field survey findings and information obtained through desk research and discussions with knowledgeable persons associated with the project.

1.7 Special efforts were made during the collection of basic data to ensure its reliability. The element of bias has been minimized by balancing out the different view points presented by the respondents.

1.8 For the purpose of the field survey, an appropriate questionnaire was designed to carefully elicit responses from users and caretakers of pumps. The questionnaire was pretested in the initial contacts and then used in the field survey. A sample of the questionnaire has been presented in Annexure I.

### Background

1.9 UNICEF has been assisting the water supply programme since 1967 by providing drilling rigs for tubewells. In a survey of handpumps carried out by UNICEF in 1974, it was revealed that 75 per cent of the pumps were not functioning. UNICEF thus recognized the need for a sturdy community handpump to ensure continued availability of water. This was particularly so in the India context, as the handpump is the most economical means of water supply to small habitations spread over a geographically vast area.

### Objectives

1.10 In view of this, UNICEF initiated the handpump project.

1.11 The immediate short-term objectives of the project were to develop a sturdy community handpump and a maintenance system for it.

1.12 The long term objectives were to (a) organize commercial production of handpumps of high quality standards (b) ensure that this pump alone is installed under water supply programmes in different states and (c) ensure that an appropriate maintenance system is established in areas where these pumps are installed.

1.13 The India Mark-II handpump project falls under the broad social objective of providing the needy an improved quality of life and also improved health standards, within which the operational objectives are to ensure continuous supply of safe potable water so as to eliminate water-borne and water-related diseases and the convergence of the water supply programme with other programmes like ICDS, applied nutrition, area development, health and family welfare, etc.

### Development of Handpump

1.14 The handpump project has been a very successful scheme. Within a short period of less than two years a sturdy community handpump emerged as a result of co-operative efforts of UNICEF and other organizations like Madras Engineering Research and Development

/...

Organization (MERADO), Richardson and Cruddas (R&C) and several non-governmental organizations (NGOs) in Maharashtra. UNICEF played a pivotal role in this development work by co-ordinating and motivating the work of various organizations involved, besides participating in it. This pump was called the India Mark-II handpump.

1.15 Simultaneously efforts were made to develop for this handpump (a) Indian standards (b) special tools for installation and maintenance and (c) manual for installation and maintenance. A three-tier maintenance system for this handpump was also successfully field tested.

#### Organization of production of handpumps

1.16 Having developed the pump, large-scale production had to be organized as demand was exceeding supply and there were risks of non-standard pump or poor imitations of India Mark-II getting into the water supply programmes. On the other hand, production had to be organized carefully so that sub-standard quality pumps are neither produced nor sold.

1.17 UNICEF set about qualifying suppliers for India Mark-II handpump through a stringent screening process involving:

- (a) Shortlisting of suppliers based on information obtained through a detailed vendor questionnaire.
- (b) Detailed works inspection of suppliers' facilities by an independent inspection agency.
- (c) Trial orders and inspection of these by an independent inspection agency.

1.18 If the supplier got through the above three stages, the firm was put on UNICEF's list of qualified suppliers.

1.19 Commercial production capacity, after the above intensive screening and qualifying procedures, has risen from about 600 pumps per month from one supplier in 1977-78 to 13,000 pumps per month from 36 suppliers at present. There is at least one supplier in each of the 11 states using India Mark-II handpumps for their water supply programme.

1.20 An increase in number of suppliers has led to increased competition. This has resulted in a reduction in price of these handpumps by about 20 per cent in the last 2-3 years inspite of an inflation of about 14 per cent in the same period. Because of the competitive environment, suppliers are forced to organize the production of these handpumps in an efficient manner.

/...

### Acceptance of handpumps

1.21 Having organized large-scale production of India Mark-II handpumps UNICEF undertook steps to create an awareness of these pumps amongst its users and to ensure its use in the water supply programmes of various states.

1.22 UNICEF organized a National Conference on Deepwell Handpumps for this purpose. It also signed "Plans of Action" with various states for the water supply programme which specifies the use of India Mark-II handpumps for the programme. To expedite the process of acceptance and also to quickly eliminate the problems caused by non-standard pumps UNICEF also decided to provide India Mark-II handpumps for rejuvenation of malfunctioning tubewells. And above all, to ensure that the users procure only quality handpumps from qualified suppliers, it decided to pay for pre-delivery inspection of all handpumps procured by state government agencies for the water supply programme.

1.23 UNICEF efforts to proliferate the use of India Mark-II handpumps have paid rich dividends. About 600,000 India Mark-II handpumps have been installed so far in various states. UNICEF has supplied about 100,000 pumps for rejuvenation of old tube-wells. UNICEF has paid for pre-delivery inspection of about 450,000 pumps out of about 500,000 pumps procured directly by state government agencies.

1.24 In Tamil Nadu alone about 55,000 India Mark-II handpumps have been installed. There are still about 9,700 non-standard pumps to be replaced by India Mark-II. UNICEF has already agreed to provide 3,000 pumps out of these, for rejuvenation.

1.25 Tamil Nadu has also established a maintenance system for the handpumps. They have created posts for 366 block mechanics and for personnel for 52 mobile teams. They have also developed guidelines for selection and training of pump caretakers at the village level.

1.26 In spite of these efforts, there are instances of substandard pumps being installed in some states although such cases are few in number. UNICEF has been constantly persuading the state governments to procure only standard quality India Mark-II handpumps for their water supply programmes.

### Handpump design and performance

1.27 India Mark-II handpump has been found to be a very sturdy handpump. It has a very low frequency of breakdown compared to other pumps available in the market. Almost everybody we contacted felt that it is a very good pump. Some of the salient features in the design of India Mark-II handpump are given below. It has:

/...

- (i) a steel fabricated body, so that problems of cracking of cast parts is avoided and repairs are possible.
- (ii) only one fulcrum point with enclosed bearing to reduce wear and minimize maintenance.
- (iii) a higher mechanical advantage for ease of operation.
- (iv) a completely enclosed pumphead to avoid pilferage and damage to parts.
- (v) a concrete embedded foundation to eliminate contamination.
- (vi) a chain and quadrant system for accurate alignment of connecting rods.
- (vii) a brass lined cylinder for reduced wear of washers.

1.28 An important feature of the India Mark-II handpumps, not found in other pumps, is the standardization in its components. This makes it amenable to quick, easy and economical maintenance as a manageable inventory of spare parts can be maintained for this purpose.

1.29 India Mark-II is not only a better pump amongst those produced in the country but compares very favourably with pumps manufactured in advanced countries. Some manufacturers of these pumps have successfully exported them to a number of countries in Asia, Africa and Latin America.

#### Survey findings

1.30 Findings of our survey of 35 installations of India Mark-II handpump also indicate that the performance of the pump is very good. At the time of survey, 34 out of the 35 pumps were working although three pumps, had inadequate discharge. Of these three pumps it was indicated that two need replacement of washer and one had poor discharge because of inadequate depth of the tubewell. One pump which was not working at all seemed to have been defectively installed at a wrong location. Other than these, most of the pumps appeared to be in good working order.

1.31 Of the 34 working pumps, which had a life ranging from six months to two years, only six had broken down so far and only once each. Out of these, in five cases repairs were in the nature of change of washer, which in any case has to be carried out periodically. Only in one pump the chain had broken and had to be replaced.

1.32 It would be important to note that most of the pumps surveyed catered to more than 250 persons (as should be the practice) and that there were no caretakers at any installation to look after the pumps and service them on a routine basis.

1.33 The installation of pumps seemed to have been carried out properly although greater care is necessary to provide proper slope while constructing the platform. In eleven cases, stagnation of water was noticed on the platform.

1.34 The maintenance system does not seem to be fully functioning. There were no caretakers at the sites surveyed nor was there any formal procedure to communicate breakdowns to the block mechanic or mobile team. There were considerable delays in attending to repairs by the block mechanic. In four out of the six cases of breakdown the pump repairs carried out by the block mechanic took as many as 15 to 30 days. In two cases, repairs carried out by a private mechanic were completed within four days.

1.35 There is no preventive maintenance of pumps nor is any routine analysis of water carried out. There is no question of training of caretakers as none had yet been selected. Although there were some installations where villagers were told how to use the pump, this practice did not appear to be uniformly carried out at all the installations.

1.36 At most installations the people find the pump water quite good. Those who have had some experience with other pumps, felt that India Mark-II was better in all respects. Almost all villagers were very happy to have the pump and at as many as 20 installations they desired to have another pump.

1.37 There did not seem to be convergence of other programmes at most locations. Health services at as many as 28 installations were not available and only four habitations were covered by immunization programme.

1.38 The India Mark-II handpump is no doubt a very sturdy pump and has definitely proved very beneficial. It has enabled a convenient and safe supply of water to be provided on a reasonably continuous basis to far-flung habitations in the country. The benefits of a convenient source of supply of water, and the reliability and continuity of supply, are immense, although difficult to quantify.

1.39 Thus, even though India Mark-II is costlier than other non-standard pumps by 50-60 per cent, this should not, and does not, deter the use of these pumps in the water supply programme. It should be remembered that, in any case, the handpump contributes only about 10 per cent to the cost of a complete installation and the use of a cheaper pump would not reduce the cost of the



installation drastically. Further, as India Mark-II has a maintenance cost (Rs 300-400) which is considerably lower than that of non-standard pumps (over Rs 1,000), the additional costs at the time of its installation are offset by just a year's saving in maintenance costs.

1.40 On the whole, we feel that the handpump project is a very successful one. UNICEF has succeeded in developing a very sturdy community handpump which also proves to be economical in the long run. UNICEF has also done well to organize large-scale commercial production of the handpump and has, by and large, succeeded in ensuring use of these pumps in the water supply programmes of various states. There has, however, been limited success in establishing a maintenance system for the pumps. This would require closer monitoring by UNICEF than it has been able to do so far.

#### Report structure

1.41 The assessment has been carried out and presented in the following five chapters. In Chapter II we have covered the genesis of the project and its objectives, which are used as the basis/frame of reference for evaluation of the project. In Chapter III we have discussed the development of India Mark-II handpump. In Chapter IV we have reviewed the efforts made for the commercial production of the handpump. Chapter V deals with efforts made for acceptance of India Mark-II by the users. Chapter VI evaluates the performance of the handpump and also the installation and maintenance practices and other related aspects.

CHAPTER IIGENESIS OF THE PROJECT AND ITS OBJECTIVES

2.1 A vast number of people in India, living in small villages and habitations, do not have reasonable access to safe and convenient source of water. Water-borne and water-related diseases are leading killers of infants and children in India. Inadequate access to sufficient quantities of water, unhygienic personal habits and poor environmental sanitation are also important contributors to prevailing high rates of infant mortality.

2.2 The provision of potable water has therefore been recognized as an essential pre-requisite to the achievement of any long-term improvement in community health standards.

2.3 It is also realized that the provision of safe drinking water to the villages in scarcity areas will, in itself, not become a turning point in the lives of the beneficiaries unless it is accompanied by other essential programmes such as immunization, supplementary feeding and other similar measures. It is for this reason that convergence of various programmes is one of the basic objectives in UNICEF assistance.

2.4 UNICEF assistance to the water supply programme had, since its inception in 1967, been provided mostly in the form of down-the-hole hammer air percussion drill rigs predominantly to the hard-rock states which make up approximately 70 per cent of the country.

2.5 In 1974, UNICEF projected five years of assistance, in the form of a single integrated country programme, closely linked to the country's Fifth Five Year Plan (1974-79). The overall goal of the programme was to improve the physical, social and psychological development of the most vulnerable and the most needy groups of children, their mothers, and potential mothers as well. The objective of the programme was to provide to these children the services adequate for assuring a minimum in terms of the overall quality of life.

2.6 Water Supply and Environmental Sanitation formed an important component of the above programme, along with Integrated Child Development Services, Applied Nutrition, Health and Family Planning, Pre-school and Primary Education, etc.

2.7 Thus within the broad social objective of providing a better quality of life to the needy and achieving long-term improvement in health standards, supply of potable water to the scarcity areas was one of the operational objectives.

/...

2.8 In a geographically vast country like India, wherein a large per cent of the population is dispersed in far-flung rural areas and wherein there exists a large number of habitations with a small population, exploitation of ground water resources through drilled tube-wells fitted with handpumps has been found to be the most economical and appropriate solution for the supply of water. Experience has shown that piped water supply schemes, originally designed for the urban situation but scaled down for village applications, are too expensive to construct, operate and maintain on a nation-wide basis.

2.9 In a survey of handpumps carried out by UNICEF in 1974, it was revealed that 75 per cent of the pumps were not functioning. This meant that even when efforts were made to provide water to the scarcity areas, this objective was not being achieved due to breakdown of handpumps.

2.10 It was thus recognized that handpumps of a suitable design and adequate quality were not available to ensure continued availability of water. Further, the variety of pumps being used, and the deficiencies therein, made it difficult to establish an effective maintenance system also.

2.11 This therefore marked the beginning of the India Mark-II handpump project.

2.12 The immediate objectives of the project were to design and develop a sturdy, community handpump and to demonstrate the connection between improved handpump designs and an effective maintenance system. The long-term objectives were to organize large-scale production of the improved handpumps, to ensure use of these handpumps both for new installations and for rejuvenation of an effective maintenance system wherever these pumps were installed.

2.13 The linkages between the project objectives and the broad social objectives are quite clear. An improved handpump would ensure continued supply of water and would require less maintenance, resulting in reduced recurring costs. Continued supply of potable water in sufficient quantities for drinking, personal hygiene and other domestic purposes would reduce the incidence of water-borne diseases. This, together with other programmes such as ICDS, Applied Nutrition, Area Development, Health and Family Welfare, etc. would result in improved health standards and improved quality of life of the needy.

#### Master Plan of Operations

2.14 The India Mark-II project, involving in the initial stages development of a sturdy community handpump, was part of the programme for 'Water Supply and Environmental Sanitation' component of the 'Master Plan of Operations (1974-79)' signed between UNICEF and the Government of India.

/...

2.15 In the context of the water supply programme, the general objectives were (a) to reduce the incidence of water-borne diseases through the provision of potable water in sufficient quantities for drinking, personal hygiene and other domestic purposes, (b) to augment the Central Public Health and Environmental Engineering Organization (CPHEEO) in order to ensure adequate implementation, expansion and follow-up of the programme and (c) to demonstrate to local bodies, and to the population at large, the advantages of a comprehensive rural water supply and environmental sanitation programme and to educate them in the relationships between water supply, environmental sanitation and health.

2.16 The specific objectives of the programme were (a) to develop projects within the Minimum Needs Programme and Master Plan of Operations (MPO) to ensure continued availability of water, (b) to derive the maximum synergistic benefits from coordinated services for children within the minimum needs package with geographical concentration, wherever possible on other UNICEF-assisted programmes and (c) to investigate and study the technical and financial aspects of extensive water supply and environmental sanitation programmes in disadvantaged rural areas of the country by securing, recording and utilizing the relevant hydro-geological, engineering, economic and administrative data required for national execution of an overall comprehensive development plan.

2.17 UNICEF assistance to the programme included:

- (a) drilling equipment, air compressors and related major components;
- (b) groundwater survey equipment and potable water laboratory kits;
- (c) equipment for training;
- (d) stipends for participants in training courses.

2.18 The total value of UNICEF assistance was estimated at US\$9.25 million. In addition, UNICEF was to make efforts to obtain special contributions through 'noting' to the extent of US\$4.5 million.

2.19 The commitments of the Government were in terms of provision of necessary personnel, materials, supplies, equipment, vehicles and local expenses required by the programme, except as provided by UNICEF and WHO. Provision for rural water supply in the Fifth Plan under the Minimum Needs Programme was Rs 5,430 million.

2.20 The addendum to the Master Plan of Operations (1974-79) for a programme of services (1978-80) had almost the same objectives as in the MPO (1974-79). However, it specifically stated that the input of handpump for deepwells will be the India Mark-II or its developed version, coupled to a supporting maintenance structure. It added that the CPHEEO will use its authority to see that states will accept appropriate plans of action to this effect and that only by this expedient, the desired end-result would be achieved. Also, the three-tier maintenance system as was introduced in Tamil Nadu will be extended to the rest of the ten hard rock states.

2.21 The Master Plan of Operations (1981-83) describes the activities related to handpump development, production, installation and maintenance as below:

"19. The deep-well handpump can provide protected and perennial water to small villages in many regions of the country. The India Mark-II handpump, made to ISI specifications, at present offers the best available design for a deep-well handpump. Further improvements in the India Mark-II design are possible and efforts will be supported. As the construction of a rigid base with a concrete platform and drainage will ensure the longevity of the pump and help prevent contamination, installation of these handpumps in accordance with the India Mark-II installation and Maintenance Manual will be required of all states participating in this programme."

"20. The production of quality India Mark-II handpumps, made to ISI specifications, needs to be increased in order to meet the decade's demand. All states involved must develop quality control procedures for the pre-delivery inspection of a quality control agent in order to ensure that sub-standard handpumps are not procured."

"21. The need for quality control was clearly stated in the following recommendation (No. 14) adopted at the National Conference on Deep-well Handpumps (1979):"

"Quality control in the procurement of handpumps is essential. There should be two stages in ensuring quality control:"

"(i) Pre-qualification of suppliers to ensure that they have the necessary machinery, metallurgical expertise, jigs and quality control procedures so that they are capable of turning out quality pumps in the required time."

"(ii) Selection of a supplier out of the pre-qualified listed suppliers, after the normal tender procedure and ensuring, by pre-delivery inspection, that the supplier, in fact, delivers quality handpumps."

- "22. To avoid frequent breakdowns due to over-use, not more than 250 persons will normally be served by one handpump. In locations where a school or health facility exists, an additional handpump will be provided as close as possible. In order to reduce the number of handpump breakdowns and ensure constant availability of safe drinking water, appropriate maintenance systems, using village caretakers, will be required by all states, as stated in the following recommendation (No.19) adopted by the National Conference on Deep-well Handpumps:"

"It is resolved that there should be adequate technical personnel at the Block and District levels to undertake maintenance of handpumps. The communication time lag between the villager and the technical repair personnel, should be kept to a minimum, if the maintenance is to be effective. One of the ways of bridging this gap is through adoption of the "Caretaker Programme", as obtaining in Tamil Nadu. All states should provide such means of communication adopting the Tamil Nadu pattern, or any other pattern, as considered feasible in their states. The personnel used for such communication need training in all aspects of the handpump-failure

reporting if they are to be of real help. It is resolved that such training may be started in all states with the assistance of UNICEF. While the communication link between the village and the officials should be preferably voluntary, provision of an incentive may be considered wherever found necessary."

"23. UNICEF will co-operate with the states in the supply of India Mark-II handpumps, vehicles, tools and training for all categories of personnel involved in the implementation of the three-tier maintenance system. The states will be required to purchase only quality India Mark-II handpumps from qualified suppliers. UNICEF may assist in quality control for any orders placed by state governments to ensure that only quality pumps are fitted to new and rejuvenated tube-wells."

2.22 In the MPO (1981-83) it is also stated that, "for each state receiving drilling rigs, India Mark-II handpumps, supporting vehicles and accessories, a Plan of Action will be drawn up between state governments, CPHEEO and UNICEF. State governments will ensure that only quality India Mark-II handpumps from qualified manufacturers are fitted to the tube-wells drilled. UNICEF will provide the state governments with a list of qualified manufacturers who have passed work inspections by third-party quality control. Assistance may also be given for pre-delivery inspections. UNICEF inputs of India Mark-II handpumps for rejuvenation of old tube-wells, vehicles for District Mobile Maintenance and Installation Teams, installation and workshop tools and training, will also be covered in the State Plans of Action."

2.23 It can be seen from the above statements in the MPOs for 1974-79, 1978-80 and 1981-83 that UNICEF had progressively the following objectives for its handpump programme:

- 1) In 1974 when it realized that a sturdy community handpump was not available, its immediate objective was to support development of such a product.
- 2) Once a sufficiently sturdy pump was developed (notwithstanding continued efforts for further improvements), its aim was to organise large-scale production of handpumps of high quality standards, ensure its use across the country both for rejuvenation of old tubewells and also for new installations and establish a supporting maintenance structure wherever these pumps were installed.

/...

CHAPTER IIIDEVELOPMENT OF INDIA MARK-II HANDPUMP

3.1 Prior to 1975 a number of handpumps with different designs were available in the country. These were Mahasagar (cast iron), Sholapur, and Jalna-type handpumps. Most of these pumps had short lives. The designs were not sturdy enough for community use and none were standardised, and the quality of manufacture often poor. The components used were also not interchangeable.

3.2 Various surveys of handpumps carried out around that time revealed that as much as 75 per cent of the pumps installed had broken down. This high rate of failure of handpumps was very discouraging as immense amount of efforts and resources invested in water supply programmes were not yielding necessary benefits to the people, because of the failures of these handpumps.

3.3 UNICEF, which was actively involved in the water supply programme in India thus took upon itself to assist in the design and development of a sturdy community handpump.

3.4 In June 1975, a workshop on deep-well handpumps was organized at Bangalore to consider the following:

- (i) The status of handpump design/technology
- (ii) Standards of handpump manufacture
- (iii) Identify the problems with the existing pumps

3.5 The workshop was sponsored by WHO, UNICEF, the Government of India and the Government of Karnataka. The invitees to the workshop included Richardson and Cruddas, Madras, and the chief engineers of Public Health Engineering Departments of various states.

3.6 The participants of the workshop unanimously resolved that:

1. the handpumps available were not good in design;
2. standards of manufacture were very low;
3. the spare parts were not interchangeable due to variations in design, resulting in very high inventory costs;
4. a new pump should be designed keeping in view the various problems encountered with the existing pumps;
5. Standards of manufacture should be set.

/...



3.7 This marked the beginning of a joint effort by UNICEF, Mechanical Engineering Research and Development Organization (MERADO) and Richardson and Cruddas to develop a sturdy community deep-well handpump, which was later called the India Mark-II handpump.

Prior to this, as early as 1967, several volunteer organizations in Maharashtra state, which were involved in drilling projects, had begun handpump development and production work. The pumps developed by them were the Jalna and Sholapur handpumps.

3.8 The work on the new handpump was started around July 1975. The original design criteria set by the designers were:

- (i) Trouble free operation for at least a year. It must be capable of drawing water from a static water level (SWL) of 150 feet depth (average installation serves 500 people from a SWL of 60-70 feet).
- (ii) The pump, complete with rising main, should cost less than US \$ 200.
- (iii) Design must be suited to local manufacture and not require any imported components or materials.
- (iv) An adult must be able to operate the pump without undue effort at a SWL of 150 feet; if villagers are to be discouraged from using unprotected water sources.
- (v) The design must permit maintenance by people with a minimum of engineering skill.
- (vi) The above-the-ground mechanism should be hygienic. The mounting of pump on the platform must prevent pollution entering the tube-well from the surface.

3.9 The Sholapur pump was taken as the basis for development of the new pump. After several discussions amongst representatives of UNICEF, MERADO and Richardson and Cruddas, wherein the pump designs developed were scrutinized and modified as per suggestions of these people, the final design evolved. Ten prototype pumps of this design were sent to the Coimbatore area for field trials conducted under the joint supervision of UNICEF and the Tamil Nadu Water Supply and Drainage Board. The field trials were very encouraging and revealed that these pumps had a very low breakdown factor and were easy to operate, compared to pumps of old designs.

3.10 Encouraged by the results of field trials of ten prototype pumps, UNICEF decided to put another 1,000 of these pumps on field trials in various states. These 1,000 pumps were supplied by Richardson and Cruddas by December 1977.

/...

3.11 The development efforts so far on the new pump were restricted mainly to the pump head. The below-the-ground mechanism (viz. pump cylinder) used was the Sholapur brass cylinder. All the pumps supplied for field trials as mentioned above, were initially fitted with these Sholapur brass cylinders.

3.12 The Sholapur cylinder had brass cast body with cast iron caps. During the field trials it was found that while the above-the-ground mechanism was performing well, the performance of these cylinders brought out many weak points which necessitated development of a new cylinder design.

3.13 The development work on cylinder was then taken up. The basis for design of the cylinder was the cylinder used in the Dempster pump of Dempster Industries Inc., Nebraska, U.S.A. The cylinder so developed basically consists of a cast iron casing fitted with solid drawn brass tube. This cylinder was then supplied along with the newly developed head. The reports from the field were very encouraging and it appeared that the efforts of the designers had finally succeeded and a new sturdy handpump had emerged. The pump can be described in brief as below.

3.14 The pumphead is a welded steel fabrication from steel sections and plate and is bolted together. Additional lock-nuts are used to improve secured fastening. A chain and quadrant system is used to provide pump rod alignment during pumping, sealed ball bearings being used for the main pivot. Pump rod of diameter 12 mm and 32 mm drop pipe (both galvanized) are used to operate the 63.5 mm diameter cylinder. The handle is heavy and designed to counter-balance the pump rod weight at a depth of about 25 meters. An important feature in the design is that the pedestal has to be concreted into the well apron instead of being bolted down to the casing pipe.

3.15 Some of the features of India Mark-II handpump which deserve mention are as follows:

1. The cast iron body of conventional pumps is replaced by welded steel fabrication which is stronger and which does not crack unlike iron body.
2. The number of fulcrum points has been reduced to one, which rotates in a sealed ball bearing with a life of several years. Thus there are no points requiring oiling or greasing.
3. The handle is a solid mild steel bar with an 8:1 mechanical advantage. Besides providing ease of operation it is sturdy and does not break as do handles made of hollow pipe.

4. The pump is not attached to the well casing, it is embedded independently in concrete. This avoids chances of base plate nuts coming loose and eliminates possibility of contaminated water finding its way into the well.
5. The pumphead is completely enclosed except where the handle enters it. This ensures that pumphead parts are not damaged.
6. The pump attachment to the concrete platform is strengthened by three iron legs set at an angle to the pedestal.

3.16 The effort and care that has gone into the design of India Mark-II pump can be observed from some of the details given below.

1. The spout points downwards at an angle of  $96^{\circ}$  unlike the horizontal or vertical spout. This provides for ease of flow into vessels.
2. Lock nuts and washers are provided for all bolt fixings.
3. Even when the handle moves in a small arc, a chain and quadrant system is provided for accurate alignment of the connecting rod.
4. The legs welded to the pedestal are of angle section, which has to be provided with suitable radius so that it sits closely to the pedestal pipe at the time of welding.

3.17 It would also be important to mention that the development work on the handpump has not yet stopped. Constant improvements based on feed-back from the field and tests and evaluations carried out have been incorporated on a continuous basis. Some of the important improvements effected over the years are mentioned below.

1. In the original design, the water chamber was sand blasted and painted with epoxy paint. As epoxy paint constantly exposed to water and air could not prevent rusting, hot dip galvanizing was resorted to. Similarly, the conversion head assembly and pedestal which were originally to be painted are now galvanized.
2. The material of the handle axle has been changed from EN 8 to stainless steel, as field reports indicated rusting of handle axle causing damage to bearings and creating maintenance problems.

/...

3. The plate gussets provided to support the top and bottom stoppers of the bracket are replaced by solid gussets as there were reports of cracks.
4. The single side shielded bearings which were packed with grease before installation on handle, have now been replaced by pre-packed double side shielded bearings, to avoid use of inappropriate grease by manufacturers and maintenance crews.
5. The position of the rear legs on the pedestal has been changed from  $120^{\circ}$  to  $80^{\circ}$  so as to have an improved support for impact loading.
6. Spout diameter has been changed from 32 mm to 40 mm to more quickly empty the water chamber and thereby avoid wetting the chain.
7. Connecting rods and plunger rods have been produced with hexagonal couplers instead of lock-nuts to avoid loosening of these rods.

3.18 The initial design efforts and the constant design improvements speak a lot for the men behind the handpump development programme.

3.19 Even though the pump, after all the improvements, is giving a good performance, there are new improvements and developments under consideration.

3.20 In the present form, for maintenance of India Mark-II handpump, the cylinder has to be lifted along with the rising main for replacement of washers. This requires special tools and also the services of skilled fitters. The washers in any pump have to be frequently replaced as they wear out on continued usage. The life of the washer would be about six to 18 months depending on the usage of the pump. The need for skilled fitters and special tools for repair on the cylinders or for replacement of washers, results in delays in repairs and maintenance whenever there is a breakdown in below-the-ground mechanism.

3.21 It would definitely be useful if the underground mechanism is modified to enable easy maintenance of the same. Efforts are being made to redesign these components so that the maintenance work may be carried out by two persons without use of special tools and tackles. Basically, the modification to be incorporated should enable drawing out the piston without removing the riser main.

### Indian Standards

3.22 An important aspect of the India Mark-II handpump development programme was that while, on the one hand, the design and development of the pump were undertaken, on the other, there were efforts to develop (a) Indian Standards for the pump, (b) an installation and maintenance manual and (c) special tools required for installation and maintenance.

3.23 The need for Indian Standards was felt to ensure:

- (a) production of standard handpumps of proven design and
- (b) interchangeability of components for ease of maintenance.

3.24 As a result of combined efforts made in this direction by PHE Departments of State Governments, MERADO, UNICEF, and reputed manufacturers such as Richardson and Cruddas and Indian Standard Institution (ISI), a standard on deep-well handpumps was first issued in 1979.

3.25 Normally ISI specified in its standards only matching dimensions and performance characteristics of products so as to give freedom to designers and manufacturers. However, in the case of this handpump, since considerable effort had gone into the design and development and since the product had proven itself quite well, a very detailed Indian Standard (No. 9301) was brought out. This standard was more like a manufacturer's manual, with detailed drawings and specifications of all components.

3.26 The standard has since its introduction been revised in 1982 to incorporate changes as per the improvements made in the design of the pump. Important modifications incorporated in the revision were:

1. the requirement of galvanizing have been incorporated so that the pumps are free of rust for a longer period.
2. the "performance test" of the original standard has been designated as the "type test" in the revised standard and a new clause on "routine test" has been included.

3.27 The standards are further undergoing revision. The revisions are again as per the design modifications carried out on the pump. The following changes are proposed in the second revision.

- (a) Some of the dimensions have been changed to new tolerances.
- (b) Stainless steel has been specified as the manufacturing material for axle.
- (c) Solid triangular gussets have been specified at the top and bottom handle brackets provided.

/...

- (d) Connecting rod and plunger rod have been provided with hexagonal couplers in place of nuts.
- (e) 40 mm tank spout has been specified in place of 32 mm in order that the tank is immediately cleaned of water and there is no undue splash.
- (f) Rear two pedestal legs at 80° has been specified in place of 120° in order to increase the stability of pump.
- (g) Painting has been deleted as an alternative anti-corrosive treatment.

#### Installation and Maintenance Manual

3.28 The benefits of a proven design of a handpump can accrue if it is properly installed and maintained. Since such installation and maintenance work, by the very nature of the product, has to be carried out by a large number of people spread far and wide, it was considered essential to develop a manual which could guide these workers/mechanics and their engineers-incharge in this work.

3.29 The installation and maintenance manual so developed is a comprehensive document giving in detail, with the help of sketches and drawings, step-by-step procedure for installation of the handpump. It also gives (a) step-by-step procedure for dismantling of the pump for overhauling and repair work, (b) monthly and annual maintenance schedules, (c) a list of troubles often encountered, their causes and remedies, (d) a list of standard and special tools required for installation and maintenance, and (e) a list of spares for two-year normal maintenance.

3.30 This installation and maintenance manual is not only useful for erecting and maintaining the pumps but can become an effective teaching aid for the men involved in this work. With the help of this manual even a layman should be in a position to perform the task. This manual was the result of a joint effort of UNICEF, R & C and other reputed manufacturers of handpumps and is supplied with handpumps to the consumers.

3.31 The installation and maintenance practices need to be standardized based on time-tested procedures to ensure maximum benefits from all pump installations. In an effort to do so, ISI has already initiated steps to bring out Indian Standards on "Code of Practice for Installation and Maintenance of Deepwell Handpumps", on the lines of the manual described above.

/...

### Special tools

3.32 Another area where good foresight has been shown by the persons involved in the development of India Mark-II handpumps is the development of special tools to enable easy installation and maintenance of these handpumps. These tools can enable installation and maintenance of handpumps with fewer persons, more easily and faster. The special tools developed are:

1. Tank pipe lifter
2. Self locking clamp
3. Coupling spanner
4. Connecting rod lifter
5. Handle axle punch
6. Lifting spanner
7. Chain coupler supporting tool
8. Connecting rod vice.
9. Crank spanner.

3.33 The standard on installation and maintenance of handpumps, which is likely to be brought out soon, lists these special tools and also indicates their use at various stages of installation and dismantling.

3.34 The development process for India Mark-II handpump has come a long way - from the time when the need for a sturdy community handpump was felt to the stage when a proven, successful product is available. The roles of various organizations, involved at various stages of this development process and their inputs in terms of monetary assistance, technical and support personnel, manufacturing and testing infrastructure, are not clear from the limited information available to us. In any case, the excellent co-operative effort put in by them stands out in testimony of the excellent product, although their individual roles are hard to delineate.

3.35 For the same reasons, it would be difficult to describe the role played by UNICEF in its entirety. However, in case of UNICEF, while it may have provided technical and financial inputs for the handpump development, its role as a pivotal agency and a catalytic agent in the development process is recognized by various parties.

3.36 It was UNICEF which highlighted the need for developing a sturdy community handpump and the necessity to tackle this problem on a nation-wide basis instead of the hitherto piecemeal efforts of some organizations in some pockets of the country. It was UNICEF which evinced the interest of nodal central and state government organizations like CPHEEO and state PHEDs. It was UNICEF which brought together and coordinated the efforts of organizations like MERADO, R&C, the NGOs, and ISI for design and development of the pump, manufacture of prototypes, field trials and development of Indian Standards, special tools and installation and maintenance manuals.

3.37 Without the initial seeding of the idea and the subsequent nurturing of the same by UNICEF on a continual basis, it is unlikely that a pump like India Mark-II would have been developed at all. It is our conclusion that the support from UNICEF in terms of close co-ordination and monitoring of the programme was much more valuable to its success, than any financial assistance provided by it, although valuable in itself.



CHAPTER IVORGANIZATION OF MANUFACTURING FACILITIES  
FOR INDIA MARK-II

4.1 The initial production of India Mark-II handpumps was taken up by Richardson and Cruddas, who were also associated at the development stage of the pump. The production at Richardson and Cruddas was of a very high quality both because it was done under the watchful eye of UNICEF and also because the company was committed to quality production.

4.2 With the increase in demand for India Mark-II handpumps it was observed that some companies began to copy the design and produced cheaper models which tended to have poor welds, used reconditioned bearings and several other faults. To prevent the India Mark-II from getting a bad reputation because of these sub-standard pumps and also realizing that one single supplier will not be in a position to meet the demand, UNICEF decided to prepare a list of approved pump manufacturers.

4.3 UNICEF went about this task very scientifically and methodically. It had realized that quality control in the procurement of handpumps is essential for the success of the programme. It also realized that while pre-delivery inspections may ensure good quality, the costs for the same would be prohibitive if the manufacturers' capabilities are not ensured and there are more rejected pumps. Further, to keep a control over a large number of manufacturers would be administratively difficult.

4.4 To ensure that the pumps procured by user agencies/state government departments are of requisite quality standards, it decided to have quality control at the following two stages:

1. Qualification of suppliers.
2. Pre-delivery inspection of pumps.

4.5 For qualification of suppliers it established the following procedure:

1. A detailed vendor questionnaire was sent to each prospective supplier to get relevant information on the firm's legal status, financial soundness and technical capability in terms of machinery, metallurgical expertise, jigs and fixtures, quality control procedures, etc.

2. Based on the information received in the vendor questionnaire, it was determined whether the firm is prima-facie capable of manufacturing high quality standard handpumps. UNICEF did not stop at this. Once a firm was so short-listed, a work inspection was carried out by an independent inspection agency - the Crown Agents. The works inspection involved a thorough check of the technical capabilities of the firm.
- 4.6 Based on the report of the inspection agency, a decision is taken, whether to pre-qualify a supplier or not. It may be mentioned that this stringent procedure for the screening of suppliers resulted in identifying a large number of prospective suppliers not coming up to the desired standards.
- 4.7 After a supplier is pre-qualified in the above manner, a trial order is placed on him by UNICEF to be executed within a specified time. The handpumps manufactured by the supplier undergo pre-delivery inspection by Crown Agents. Only after these pumps are found to be of desired quality standards is the supplier finally put on the list of qualified suppliers.
- 4.8 It may be important to mention here that the role of Crown Agents is not limited to inspection alone. They often go back to the manufacturing process to identify the source of defects and suggest ways and means to put them right.
- 4.9 The success of India Mark-II handpump had encouraged a large number of manufacturers to get into its production. UNICEF has, in the last 5-6 years, developed as many as 36 qualified suppliers. If the stringent qualification procedures were not adopted, there would have been, perhaps, many unqualified suppliers.
- 4.10 As water supply is a State subject, the government insisted that there should be at least one qualified supplier in each state undertaking installation of India Mark-II handpumps. UNICEF has ensured this. The up-to-date list of qualified suppliers is presented in Annexure II.
- 4.11 The combined production capacity of these qualified suppliers is over 13,000 handpumps per month. While all these manufacturers are capable of producing India Mark-II handpumps of high quality standards, their production capacities vary widely. The capacity ranges between 5000 handpumps per month for INALSA to a few hundred handpumps per month for some of the smaller companies.

4.12 The organization of production facilities by different suppliers also differ considerably. For example, Richardson & Cruddas has a large number of sub-contractors who carry out production of various components of the handpump under its strict quality control procedures. The final assembly of the pump is done by the company itself. On the other hand, some other companies manufacture a larger number of components themselves. A profile on manufacturing activities of Richardson & Cruddas for handpumps is presented in Annexure III.

4.13 It is interesting to note that the production of handpumps in India has reached such an advanced stage that some of the suppliers have successfully exported these pumps to a number of other developing countries.

4.14 To ensure that the handpumps finally installed are of high quality, all India Mark-II handpumps procured by UNICEF are inspected by independent quality control agency before delivery. UNICEF also pays for pre-delivery inspection of pumps against state government orders placed on the above qualified suppliers.

4.15 The pre-delivery inspection carried by Crown Agents or SGS (Societe Generale de Surveillance of France) is quite comprehensive. The inspectors ensure among other things, quality of finish and workmanship, dimensional accuracy, adherence to specified raw materials, satisfactory welding, proper alignment, true and easy function of assemblies. They also check performance characteristics on a few randomly selected pumps.

4.16 UNICEF has invested considerable time and resources in developing suppliers for India Mark-II handpump and has also been spending considerable sums of money for pre-delivery inspection of pumps procured by it and also by state government agencies. It is realized now that UNICEF cannot with its limited resources continue to support the above activities. Further, as a good foundation is already laid, the purchasers of handpumps should take the initiative to set up systems for ensuring high quality standards of handpumps procured by them.

4.17 To enable this, UNICEF persuaded the Indian Standard Institution to set up procedures for certification of suppliers. In order to ensure that the quality of the pumps manufactured by the suppliers does not deteriorate, it was decided that for a supplier to use the ISI mark, every lot produced by it will be subjected to inspection by ISI inspectors. This is a deviation from the usual practice of periodic inspections undertaken by ISI for certification.

4.18 To obtain ISI certification, a supplier has to go through similar stringent works inspection by ISI as was necessary to get qualified by UNICEF. Further, ISI specifies a scheme of testing and inspection which manufacturers have to accept during normal production and for which they have to maintain records for perusal by ISI inspectors.

4.19 Each supplier has to pay a lumpsum fee for certification as well as a fee for each pump marked to the ISI. The certification licence is valid for a year and the supplier's past performance is reviewed for issuing licence for another year.

4.20 So far, 15 suppliers have been certified (granted licences) by ISI. Other suppliers are in the process of obtaining ISI certification.

4.21 There has been continued co-operation between UNICEF and ISI in this process of certification of suppliers and it is felt that over time the task of ensuring supply of India Mark-II handpumps of high quality standards could entirely be handled without UNICEF assistance.

#### Efficiency in Production of India Mark-II Handpumps

4.22 Handpump forms an important component of the water supply programme in India. It is therefore natural that efficiency in production of these handpumps and the resultant low cost of production, quality remaining high, becomes important from the point of overall benefit to the economy.

4.23 It is difficult to assess minimum cost of production for the handpump without a detailed study of every component of its cost, viz., raw materials, manufacturing costs, labour costs, etc., and a comparative evaluation of various alternative processes. This is in any case not within the purview of this study.

4.24 As an alternative, we considered studying the costs of production of one supplier, viz., Richardson and Cruddas, the pioneer in the industry, and identifying any areas where cost reductions are possible. However, this exercise was not possible as the company is involved in the manufacture of a number of products and separate costs for handpumps were not available. Further, since Richardson and Cruddas is a commercial organization operating in a very competitive environment, it was not willing to provide details on costs of production.

4.25 Although a detailed study of the cost of production of handpumps could not be carried out, we can be reasonably sure that the costs cannot be unreasonably high, otherwise they would go out of business. The reason for our reaching this conclusion stems from the fact that there are a large number of suppliers of handpumps who are operating in a highly competitive market and have to necessarily produce efficiently if they have to survive in the market.

4.26 In any case it is worth noting that the prices have fallen due to competition in the last 2-3 years by about 20 per cent, inspite of an overall inflation in the relevant industry of about 14 per cent. The price of India Mark-II handpumps over the years is given below:

<u>Year</u>	<u>Domestic Price</u>	<u>Export Price</u>
1979-80	\$ 168.45	\$ 194.08
1981-82	\$ 194.30	\$ 222.90
1983-84	\$ 159.00	\$ 183.00

CHAPTER VEFFORTS FOR ACCEPTANCE OF INDIA MARK II HANDPUMP

5.1 The process of development of a sturdy community handpump and organising large-scale production of the same have been explained in the earlier chapters. Having completed the above process successfully the next task faced by UNICEF was to ensure that these pumps alone are installed in future, under water supply programmes in various states and a suitable maintenance system is introduced in areas where these pumps are installed.

5.2 Since around 1977-78, UNICEF began providing India Mark-II Handpumps for rejuvenation of existing tube-wells with broken down or malfunctioning cast iron Jalna and Sholapur-type handpumps. Various state governments too started switching over to India Mark-II for new installations.

5.3 Simultaneously UNICEF in co-operation with the Tamil Nadu state and district officials, experimented with a three-tier district level maintenance system. UNICEF deliberately encouraged conversion of all old-style handpumps as the above maintenance system could not be effective with a mixture of different kinds of handpumps.

5.4 In order to create awareness regarding (a) the advantages of India Mark-II handpump and (b) the viability of the three-tier maintenance system, UNICEF in co-operation with the Government of India, sponsored a "National Conference on Deepwell Handpumps" in 1979. The conference was attended by representatives from state governments as well as delegates and observers from neighbouring countries.

5.5 In this conference a broader and more effective framework for the successful implementation of the handpump programme was evolved. It also highlighted, amongst other things, the need for:

- (a) data regarding the status of rural water supply in various states,
- (b) strengthening of the Public Health Engineering Organisations of the state and central governments,
- (c) increased financial resources for an effective and speedy implementation of the programme,
- (d) adoption of India Mark-II deepwell handpump by all states both for rejuvenation of old tubewells as well as for new installations, to be procured from qualified suppliers after pre-delivery inspection of all pumps,

/...

- (e) introduction of an effective maintenance system for handpumps, which would include an effective communication link between village and repair personnel,
- (f) proper selection and training of persons at village level, i.e. the caretakers,
- (g) continuous monitoring and feedback on water supply programme.

5.6 The conference thus served the purpose of creating an awareness among the users viz. Public Health Engineering departments of the states regarding the advantages of India Mark-II handpump and the need and viability of a maintenance system for these handpumps.

5.7 To further ensure that the states adopt the India Mark-II handpump and procure only pumps of standard quality, UNICEF decided to provide for pre-delivery inspection of handpumps by agencies viz. Crown Agents and SGS, against state government orders on suppliers qualified by it.

5.8 It also decided to assist state governments in training of personnel at all levels for inspection, installation and maintenance of India Mark-II handpumps.

5.9 To further ensure that the drilling, installation and maintenance of deepwell handpumps is carried out effectively UNICEF signed a 'Plan of Action' with various state governments and the Government of India. An illustrative plan of action is presented in Annexure IV.

5.10 As can be seen from the plan of action, it highlights the general and specific objectives of the programme, the framework for implementation of the programme and the inputs and commitments of UNICEF and state government.

5.11 UNICEF inputs with regard to handpump programme, besides those for drilling of tubewells, include provision of handpumps for rejuvenation, vehicles and tools for mobile installation and maintenance teams and training programmes for installation and maintenance personnel.

5.12 State government inputs include all personnel, premises, vehicles, supplies and funds to support UNICEF inputs viz. district mobile maintenance team for every 500 pumps, all necessary operational and consumable goods such as casing pipe, cement, fuel oil and India Mark-II pumps for new installation, etc.

5.13 It can be seen from various points highlighted above that UNICEF has taken several steps to popularise the use of India Mark-II handpumps and also encourage establishing an appropriate maintenance system for them.

#### Achievements

5.14 It is estimated that more than 600,000 India Mark-II handpumps have been installed in various states both for new tube-wells as well as for rejuvenation. UNICEF has directly provided about 100,000 handpumps whereas about 500,000 pumps have been procured directly by the state governments. As many as 450,000 pumps procured directly by state governments have undergone pre-delivery inspection which has been provided for by UNICEF.

5.15 There are 11 states with hard rock areas, where UNICEF assistance for deepwell handpumps has been planned. These states are Tamil Nadu, Karnataka, Andhra Pradesh, Orissa, Maharashtra, Madhya Pradesh, West Bengal, Bihar, Uttar Pradesh, Rajasthan and Gujarat. All these states have extensively installed India Mark-II handpumps both on new tubewells and for rejuvenation.

5.16 Some other states which have also used the India Mark-II handpump are Kerala, Jammu and Kashmir, Assam, Meghalaya, Manipur and Himachal Pradesh.

#### The Case of Tamil Nadu

5.17 With specific reference to Tamil Nadu, one of the pioneering states to introduce India Mark-II handpumps and also the three-tier maintenance system, the water supply programme seems to have progressed quite well. In order to have an insight into the efforts made by a state, we have studied Tamil Nadu to some extent.

5.18 The habitations in Tamil Nadu have been divided into six categories in order to set priorities for supply of water. The six categories listed in Exhibit 5.1 are in order of most needy habitations to less needy with respect to water supply.

5.19 It was indicated by Tamil Nadu Water Supply and Drainage Board officials that a large number of habitations have already been covered by installation of India Mark-II handpumps. According to them the pumps installed by them are all India Mark-II handpumps manufactured by suppliers qualified by UNICEF. The two suppliers from which they procure all their supplies of handpumps are M/s Richardson and Cruddas and M/s Tamil Nadu Small Industries Corporation both of whom are located in Tamil Nadu.

5.20 The number of India Mark-II pumps installed and the number of non-standard pumps still to be replaced by India Mark-II pumps in various districts of Tamil Nadu are presented in Exhibit 5.2.

/...



5.21 It can be observed from the Exhibit that around 58,000 India Mark-II handpumps have already been installed in Tamil Nadu. There are still about 9,700 non-standard pumps to be replaced by India Mark-II handpump. Out of these, replacement programme for about 3,000 pumps is already underway. UNICEF has already agreed to supply these 3,000 India Mark-II pumps for this purpose.

5.22 From the above statistics and from discussions with various officials of the Tamil Nadu Water Supply and Drainage Board it becomes clear that at least the agencies involved with water supply programmes in Tamil Nadu are committed to use India Mark-II handpump of desired quality. Needless to say their commitment is a result of the good experience they have had in the past with India Mark-II and their complete confidence in the performance of the pump.

5.23 Tamil Nadu has also introduced the three-tier maintenance system in all districts, where India Mark-II handpumps are installed. The three-tier maintenance system provides for staff at the village, block and district level.

5.24 At the village level there has to be a voluntary caretaker selected from among the users of the handpump. At the block level there is the mechanic-cum-fitter and at the district level there is the mobile maintenance team consisting of a Junior Engineer, a fitter, a helper and a driver.

5.25 In Tamil Nadu, 366 posts have been created for block mechanics to attend to the maintenance of handpumps in the blocks. Similarly, 52 mobile teams have been established for maintenance of handpumps and power-pumps. The mobile teams are under the control of the Divisional Development Officers.

5.26 Besides creation of the above posts for maintenance personnel, a cell at the District level, to assist the District Collectors, and to co-ordinate, monitor and speed-up the maintenance work in the entire district, has been created. The cell consists of an Assistant Executive Engineer and supporting staff viz. typist, junior assistant and peon.

5.27 To ensure supply of spare parts, procedures for purchase by TWAD Board and stocking at district level have been laid down. In emergencies, purchase of spare parts at block level are also authorised. The government also provides some subsidy for expenditure incurred by blocks towards maintenance of handpumps. The total amount sanctioned for this purpose for the year 1983-84 is Rs.2,070,000.

5.28 Guidelines for selection and training of village handpump caretakers are also laid out.

5.29 From the above, it can be seen that the Government of Tamil Nadu has taken all the necessary steps to establish a three-tier maintenance system for the handpumps. It is however not clear whether the maintenance system has started operating effectively. It has to be understood that the effectiveness of the system depends considerably on the motivation and dedication of the persons at various levels. An assessment of this would be made on the basis of a survey of some installations of handpumps in the state. However, it is gratifying to note that the concerned government agencies in the state have accepted the merits of this maintenance system and have taken necessary steps to establish it.

5.30 It is clear from the above that UNICEF has taken several steps to popularise the India Mark-II handpumps and also the maintenance system. It has succeeded to a large extent in this endeavour. However, there are instances of sub-standard India Mark-II handpumps being installed in some states, although only a few. UNICEF has no direct control over the working of the concerned departments, and is therefore not in a position to stop the above practice. Nevertheless, UNICEF has been persuading the concerned agencies into using only standard India Mark-II handpumps.

EXHIBIT 5.1CLASSIFICATION OF HABITATIONS IN TAMIL NADU

Classification	Definition	No. of habitations
1.	Habitations with no source within habitations.	2,866
2.	Habitations where the source yields only non-potable water.	1,144
3.	Habitations where water is potable but source is not perennial.	6,487
4.	Habitations where water is potable and perennial but the source is privately owned or unprotected.	4,953
5.	Habitations where there is no good source within the habitations but an alternative good source is available with 1 km.	1,107
6.	Habitations where there is good source available.	<u>38,450</u>
	Total:	55,007 -----

EXHIBIT 5.2NUMBER OF HANDPUMPS IN TAMIL NADUAS ON 31 DECEMBER 1983

Sl.No.	District	No. of non standard handpumps	No. of India Mark-II hand pumps
1.	North Arcot	526*	5,232
2.	Dharmapur	546*	3,573
3.	South Arcot	-	6,528
4.	Salem	-	6,440
5.	Chengelpet	261	4,520
6.	Thanjavur	319*	4,616
7.	Padukkottai	569*	2,019
8.	Ramnathapuram	1,112*	3,431
9.	Tiruchinapalli	1,176	3,859
10.	Madurai	1,964	7,216
11.	Tirunelveli	1,795	4,374
12.	Periyar	519	2,713
13.	Coimbatore	393	2,503
14.	Kanyakumari	531	995
Total:		9,710	58,019

\*These non-standard handpumps will be replaced under UNICEF supplies of 3,000 India Mark-II pumps already sanctioned.



non-standard pump. The agency responsible for maintenance of handpumps in Tamil Nadu state indicated an average cost of maintenance for India Mark-II pumps of only Rs.243 per pump. Thus the additional cost of India Mark-II handpump is more than offset by just a year's savings in maintenance cost, not counting the value of continuous supply of water.

6.7 From the above, it can be surmised that India Mark-II handpump is not only a sturdy pump but is also economical to instal and to operate in the long run.

6.8 India Mark-II pump is not only found to be a better pump amongst those manufactured in India but also amongst the pumps manufactured the world over.

6.9 A comparative evaluation of handpumps was carried out in 1980 by Consumers' Association Testing and Research, Harpenden, U.K., a laboratory specialising in the comparative testing of consumer products. In all, twelve pumps, ten of which were from developed countries like U.K., France, Sweden, Canada, Holland and U.S.A. and two from developing countries, including the India Mark-II, were tested. India Mark-II proved to be a very good pump. This is best indicated by the following excerpts from the evaluation report "In conclusion we think that a suitably designed conventional pump could easily fulfil the majority of the needs for drinking water wells in developing countries. None of the pumps tested fully met all the requirements we think necessary, but Codes L and M came nearest". Code L represents India Mark-II handpump.

6.10 Ratings as per the evaluation of these pumps on a five point scale for important parameters like ease of manufacture, installation and use, breakdown frequency, performance, etc. have been reproduced in Exhibit 6.2. It can be seen from the exhibit that Code L (India Mark-II) pump has a fairly good rating for all the parameters. Only one parameter each has a rating of 2 and 3. Corrosion resistance for India Mark-II was given a rating of 2. However, this has been improved on the pumps being manufactured now by switching to hot dip galvanising of all components.

6.11 While there have been good reports regarding India Mark-II handpump performance from all quarters, we considered it fit to look at some installations of these handpumps ourselves to get first-hand information on not only the pump's performance but also on other aspects like installation and maintenance practices, acceptance by the users, etc.

6.12 In all, 35 installations of India Mark-II handpump were visited in Chengelpet district of Tamil Nadu state. For the purpose of this field survey, a questionnaire was prepared to carefully elicit responses from users and caretakers. A sample of the questionnaire has been presented in Annexure I.

6.13 The salient findings of the survey are discussed below:

Age of pumps surveyed

6.14 Out of the 35 pumps surveyed, 20 pumps were more than six months old, six more than one year old and nine more than one-and-a-half year old.

Population served

6.15 The extent of population served by different pumps is summarised below:

<u>Population served by a pump</u>	<u>No. of pumps</u>
Less than 250	6
250 to 300	7
300 to 350	7
350 to 400	9
400 to 500	3
More than 500	<u>3</u>
Total:	<u>35</u>

6.16 It can be seen from the above, that as many as 29 pumps cater to a population of more than 250 persons. Ideally, one pump is sufficient for 250 persons only.

Source of water

6.17 Normally, habitations where there is no good, safe and perennial source of water are given priority for installation of deep-well handpumps. The habitations (with India Mark-II pumps) surveyed by us fall into the following category with respect to sources of water.

<u>Source of water</u>	<u>No of habitations</u>
1. Only the pump	20
2. Pump and public open well	10
3. Pump and private open wells	<u>5</u>
Total:	<u>35</u>

6.18 It can be observed from the above that at as many as 20 habitations people are solely dependent on India Mark-II handpump. At 10 habitations there are open wells which are not a safe source of drinking water supply and often dry up in summer months.

/...

6.19 It is obvious from the above that the habitations where these pumps are installed are mostly dependent on the pump for supply of water. The people in these habitations are put to great hardship and/or resort to using unsafe supply sources in case the pump breaks down.

#### Pump location

6.20 The pump location seemed to be appropriate in all cases except one from the point of view of water availability. At 32 pump installations, the villagers also found the location convenient from the point of view of use. The pumps also seemed to be rightly located to enable easy drainage of water.

#### Pump caretaker

6.21 Not a single installation had a pump caretaker. It was indicated that no caretaker was selected nor was any person trained for this purpose. Normally, the persons staying close to the pump or those who command influence over the habitants looked after the pump. However, their attention was restricted to avoiding misuse of the pump and did not cover servicing of the pumphead. There was no formal system for reporting breakdown of pumps to the block mechanic or district mobile team; however, any person going to the block office carries this information.

#### Condition and performance of pumps

6.22 All pumps, except one, were working although three pumps had poor discharge. The pump which was not working seemed to have problems right at the time of installation and had never worked. Apparently the tube-well was not at an appropriate location.

6.23 Reasons given by the villagers for poor discharge of three pumps were, inadequate depth of tube-well in one case and the need for change of washer in the other two cases. The villagers at each of the 34 installations indicated that the pumps gave water perennially, although at eight installations they complained of inadequate discharge in summer months.

6.24 A majority of pumps (above-the-ground mechanism) were in good condition. In all the pumps, the nuts and bolts were in position and tightly fastened. There was no damage to any of the parts at any of the pump installations. However, four pumps had some corrosion and the handle was not operating smoothly in three cases.

6.25 The pumps had a good record as far as breakdown is concerned. Out of the 34 working pumps, 28 had never broken down or required any repairs. The remaining six pumps required repair only once each. Even in these six pumps, five pumps required repairs which were in the nature of replacement of washer in the cylinder (below-the-ground-mechanism).



6.26 Only in one pump there was breakdown in the pumphead. In this case, the chain had broken down and had to be replaced.

6.27 It is important to note that there is a low incidence of breakdown in pumpheads even in a situation when there are no caretakers at any of the installations to carry out routine maintenance of these pumpheads.

6.28 We can surmise from the above findings that the pumphead (above-the-ground mechanism) of India Mark-II pump is really sturdy and seldom breaks down.

6.29 The conclusions for cylinder assembly (below-the-ground mechanism) are also not any different. The washers in the cylinder of such type of pumps do wear out on use over long periods and need to be replaced periodically. Normally these washers have a rated life of six months to one year, depending on the usage of the pump. As many as 15 of the 34 working pumps have been installed, more than a year ago, nine of which more than one-and-a-half years ago. It is natural that the washers of these pumps would need replacement. The fact that only five pumps required change in washers so far and another two may need them to be changed soon, indicates that most washers outlive their rated life.

6.30 The above performance of India Mark-II handpump compares very favourably with that of non-standard pumps. Surveys carried out in 1974-75 indicate that more than 75 per cent of the non-standard pumps surveyed were not working.

#### Installation and maintenance

6.31 The foundation of 31 of the 35 installations was good. In the other four cases, although the pedestal was not loose, there were cracks in the platform.

6.32 The construction of platform in 24 cases was good. However, eleven platforms had poor drainage resulting in stagnation of water in the platform.

6.33 Installation of the pumps otherwise seemed to have been carried out properly. There is an instance of only one pump not working since installation. There is scope for improvement in the construction of concrete/masonry platform.

6.34 Although all the pumps were located at a higher level to enable easy drainage of water, there seemed to be no efforts made to direct the water, for instance, to gardens. As a result, the water often formed a pool a few yards from the pump.

6.35 As indicated earlier, there are no caretakers at any of the installations. There were only six instances of breakdown with the pumps surveyed by us and our inferences are drawn from these only.

6.36 The repairs in four cases were carried out by the block mechanic and it took as many as 15 to 30 days for the pumps to be repaired after they broke down. This implies that there are considerable delays in attending to repairs by the block mechanic.

6.37 In two cases, repairs were carried out by private mechanics. These pumps were repaired within four days of breaking down. However, repair costs for these had to be borne by the villagers.

6.38 It was indicated at all the installations that no routine maintenance was carried out by anybody. Routine analysis of water was also not carried out at any of the installations. Thus, the maintenance system for the pumps surveyed is not very satisfactory.

#### Observations regarding use of pumps

6.39 There seems to be lack of understanding amongst the villagers regarding cleanliness around the pump. At as many as 18 installations, it was found that the area surrounding the pump was slushy. Some reasons given by persons for the area becoming slushy are (i) bathing of cattle and persons, (ii) washing of clothes and utensils, (iii) spillage while carrying water. There seems to be a need for educating the people regarding the necessity of keeping the area clean and controlling misuse of the platform. As mentioned earlier, there is hardly any caretaker and a good caretaker can educate the users.

6.40 There did not seem to be any caste/communal feelings regarding the use of the pump. All the people in the village were allowed to use the pump at every installation. This surely is an indication of social advancement, if one considers the situation in rural areas.

6.41 Pump water was liked by villagers at as many as 30 installations. Even where options of other sources were available, they preferred to use pump water and seemed to understand the benefits of using pump water. At four installations, the people did not like pump water. At three out of these four installations, the villagers still used pump water for lack of options. At one installation, the people used well water particularly for drinking purposes as they did not like pump water.

6.42 At most installations, the villagers indicated that they operate the pump with long strokes. At 20 installations, they said that they were told how to use the pump and how to take care of it from outside.

6.43 At 14 installations, some villagers had experience of other pumps and indicated that they find India Mark-II much better in comparison. At others, the villagers had no experience with any other pumps.

6.44 At almost all the installations, the villagers were very happy to have an India Mark-II handpump and at as many as 20 installations, they indicated the desire to have another handpump.

6.45 It was observed that health services in as many as 28 installations were not available and villagers had either to go to a distant place for medical help or to rely on private practitioners. Most of the installations were not covered by the immunization programme. Only at four installations, immunization had been carried out.

6.46 An overall assessment of the situation based on the findings of the survey reveals that the India Mark-II handpump is a sturdy pump and has a very low frequency of breakdown. It is also very popular with the villagers. The installation of the pump is all right although greater care is necessary in constructing the platforms. The maintenance system is not yet fully operating as desired. The selection and training of caretakers has not been done everywhere resulting in lack of routine care, including hygiene of the surrounding area, and servicing of the pump and absence of a formal system of communication of pump breakdowns. The block mechanics also seem to take a long time to attend to repairs. There is need for streamlining the maintenance system.

EXHIBIT 6.1  
COST OF HANDPUMP INSTALLATION

Cost components	Cost (Rs.)
1. Borewell (60 M deep)	12,000
2. Casing pipe (20 M)	3,000
3. Platform construction	500
4. Handpump (IM-II)	2,000
5. Rising Main (24 M)	720
6. Erection of pump	100
Total A:	18,320
7. Overheads and supervision costs	
@15% of A	2,750
Total B:	21,070

Source: As indicated by TWAD Board.

EXHIBIT 6.2RATING OF DIFFERENT HANDPUMPS

Property	Code											
	A	B	C	D	E	F	G	H	J	K	L	M
Ease of manufacture	4	2	3	2	1	1	3	2	3	4	4	4
Ease of installation	3	5	3	3	1	1	3	3	3	3	3	3
Frequency of maintenance	4	3	1	5	5	5	4	2	3	4	4	5
Performance*	3	3	5	1	5	4	4	4	4	1	4	4
Ease of use	3	4	4	3	5	3	5	4	3	1	5	3
Frequency of breakdown	3	4	1	5	4	5	3	4	3	1	5	5
Resistance to abuse and neglect	2	4	1	4	3	3	2	1	2	5	4	4
Overall design	2	4	2	4	4	4	2	2	2	2	4	5
User acceptability	3	4	4	1	5	2	4	3	3	1	4	3
Adequacy of well head seal	3	4	4	4	3	3	1	4	4	3	5	4
Corrosion resistance	4	5	2	2	2	2	2	2	2	3	2	5
Safety	5	5	5	5	2	5	5	2	5	4	5	5

Notes: 1.\* Performance ratings are based on mechanical volumetric efficiency measurements only.

2. Ratings are on a 1-5 scale: 5 = very good  
1 = poor

3. Code L represents India Mark-II handpump.

ANNEXURE ISURVEY OF INDIA MARK-II PUMP INSTALLATION

Name of Caretaker : \_\_\_\_\_

Address of Handpump: \_\_\_\_\_  
\_\_\_\_\_

Installation : \_\_\_\_\_

A. Information based on observation:

1. Condition of Platform and pump foundation
2. Condition of platform drainage
3. Cleanliness in surrounding area of pump
4. Condition of pump head parts -
  - Paint/corrosion
  - Nuts and Bolts in position
  - Handle operation smooth
  - Damage to any parts
5. Pump working or not and whether discharge is good.
6. If pump is not working - why?

B. Information from caretaker on India Mark-II

1. What is the approximate population of the village?
2. What are the sources of supply of water?
3. If other supply sources exist, what percentage of village population use the pump?
4. Are some persons not allowed to use the pump? If so why?

5. Are there any problems amongst the villagers on the use of the pump?
6. Is the pump conveniently located from the point of view of use, drainage etc.?
7. When was India Mark-II pump installed? (Month/Year)
8. New Installation or replacement.
9. If replacement - new borewell or old borewell.
10. Installed by government departmentally or contractor.
11. Breakdown record (since installation or for last year).

Sl. No.	Nature of breakdown	Days lost in repair	Parts replaced	Repairs carried out by
1.				
2.				
3.				
4.				
5.				
6.				
7.				

12. How is request for repair communicated?
13. Does the pump give water throughout the year? And is the discharge inadequate in summer months?
14. If not, what is the source of water when the pump is dry or when it breaks down?

15. Routine maintenance carried out by the caretaker/mechanic/mobile team.
16. Is routine analysis of water carried out by government agency?
17. Training given to caretaker.
18. Any specific problems/suggestions on India Mark-II.

C. Information on old pump (if Q.7 indicates replacement)

1. What type of pump was installed and when?
2. Why was it replaced by India Mark-II pump?
3. How often did it break down and what were the nature of breakdowns? Also give days lost per year due to breakdown.
4. Who carried out the repairs of the old pump?
5. When did it stop functioning and why?

D. Survey of users

	Users				
	1	2	3	4	5

Name of user

1. If other source of supply of water than pump - which do they prefer and why?
2. Is water from the pump liked?
3. Is Mark-II pump better than old pump from point of view of
  - i) discharge?
  - ii) continuous supply?
  - iii) breakdown frequency?
  - iv) promptness of repair?



4. Is the pump location convenient?
5. Is one pump sufficient?
6. How do they use the pump - short strokes or long strokes?
7. Were they told how to use the pump?
8. Is immunization programme operating?
9. Are health services adequate?

ANNEXURE IIQUALIFIED SUPPLIERS OF INDIA MARK-II  
HANDPUMPS AND SPARE PARTS

1. Richardson and Cruddas (1972) Ltd.  
(A Government of India Undertaking)  
Rajaji Salai, P.O. Box 1276  
Madras 600 001, Tamil Nadu
2. INALSA Private Limited  
19 Kasturba Gandhi Marg  
New Delhi 110 001
3. Central India Engineering Co./Meera Industries  
7846 Hill Street, Raniguri  
Secunderabad, Andhra Pradesh
4. Richardson and Cruddas (1972) Ltd.  
(A Government of India Undertaking)  
48A Govindpura Industrial Estate  
Bhopal 462 023, Madhya Pradesh
5. Balaji Industrial & Agricultural Castings/  
PSR Engineering  
4-3-140 Hill Street, Ghasmandi  
Secunderabad 500 003, Andhra Pradesh
6. Balaji Industries & Engineering Corp./  
Varalakshmi Engineering Works  
4-3-74 Hill Street, Ghasmandi  
Secunderabad 500 003, Andhra Pradesh
7. Greysham (International) Pvt. Ltd./  
Greysham & Co.  
7249 Roop Nagar, Delhi 110 007  
B-15, Industrial Estate, Meerut Road,  
Ghaziabad, U.P.

8. Achieve Engineering Works  
C-294, Peenya Industrial Estate  
Bangalore 560 068, Karnataka
9. Tamil Nadu Small Industries Corporation (TANSI)  
(A Government of Tamil Nadu Undertaking)  
1, Whites Road, Madras 600 014, Tamil Nadu
10. Prakash Engineering Enterprises  
A-193 Peenya Industrial Estate  
Bangalore 560 058, Karnataka
11. Varun Enterprises  
17-18-19 Parvati Nagar, Tonk Fatak  
Jaipur 302 004, Rajasthan
12. Adroit Industries  
19-B Industrial Area, Richhai  
Jabalpur, Madhya Pradesh
13. M.M. & Co. (Engineers)  
B-30 Industrial Estate  
Cuttack 763 010, Orissa.
14. Shree S.K. Industries  
Gola Road, Dinapore Cantonment  
Patna 800 503, Bihar
15. Janata Industrial Corporation  
8-3-224 Yousufguda Road  
Hyderabad 500 873, Andhra Pradesh
16. Rajasthan State Agro Industries Corp. Ltd.  
(A Government of Rajasthan Undertaking)  
0-1 Subhash Nagar  
Jaipur 302 016, Rajasthan
17. Soham Engineering Corp./Gurudev Engineering Co.  
1-7-1054 Industrial Area, Azambad  
Hyderabad 500 020, Andhra Pradesh.
18. Surya Bharat Industries  
58 Craftsmen Guild, Mallepally  
Hyderabad 500 047, Andhra Pradesh.

19. Varun Enterprises  
27-28-29 MPLUN Sheds, Govindpura Industrial Estate  
Bhopal, Madhya Pradesh
20. Electro Fabric  
S-5 Industrial Area Richhai, Post-Vehicle Factory  
Jabalpur 482 009, Madhya Pradesh.
21. Stanley Engineering Industries  
Cooperative Industrial Estate Extension  
Balanagar, Hyderabad 500 037, Andhra Pradesh.
22. Uma Engineering Works  
B-11 Technocraft Industrial Estate  
Balanagar, Hyderabad 500 037, Andhra Pradesh.
23. Premier Deep-well Handpumps (P) Limited  
A-6, Cooperative Industrial Estate  
Balanagar, Hyderabad 500 037, Andhra Pradesh
24. Orissa Aluminium Products Limited  
B-34 Industrial Estate  
Cuttack 753 010, Orissa.
25. Ajay Industrial Corporation  
20/11 Site No. 4, Sahibabad Industrial Area  
Sahibabad, Uttar Pradesh.
26. INALSA Private Limited  
57 Anand Industrial Estate  
Mohan Nagar, Ghaziabad, Uttar Pradesh.
27. Janata Industries  
187-3 & 4/10 1st Floor, Karbala Maidan  
M.G. Road, Secunderabad 500 003, Andhra Pradesh
28. Submersible Pumps Pvt. Limited  
Plot No. G-25, Sector XI, NOIDA 201 301  
District Ghaziabad, Uttar Pradesh
29. Orissa Pump & Engineering Company Ltd.  
(A Government of Orissa Undertaking)  
B-9 Industrial Estate, Jagatpur (New) 754 021  
Orissa

30. M.A. Tool Room  
4-3-54/80 Old Bhoiguda, Ghasmandi Road  
Secunderabad 500 003, Andhra Pradesh.
31. Bhagirathi Jute & Holdings Pvt. Limited  
Baryana House, 57E, Ballygunge Circular Road  
Calcutta 700 019, West Bengal
32. Koshala Udyog  
B-23 Industrial Estate  
Rourkela 796 004, Orissa
33. Engineer's Associates  
Bolangir, Orissa.
34. Steelman Industries/Industrial House  
Kankar Bagh Road (Near Tiwari Beachers)  
Patna, Bihar.
35. Indira Engineering Corporation  
5/18 Veerakeralam  
Coimbatore 641 007, Tamil Nadu.
36. Murti Enterprises  
A-125, Group Industrial Area  
Wazirpur, Delhi 110 052.

ANNEXURE IIIA PROFILE ON RICHARDSON & CRUDDAS' MANUFACTURING  
ACTIVITIES FOR INDIA MARK-II HANDPUMPS

Richardson & Cruddas (A Government of India undertaking) is the pioneering unit for manufacture of India Mark-II handpumps. Not only this, they were also involved in the design, development and prototype manufacture of the pump.

Capacity

RICHARDSON & Cruddas started with a modest capacity of about 600 pumps per month, which is now augmented to about 2,000 pumps per month.

Manufacturing facilities

In view of the directive from the Government of India for development of Small Scale Industries for manufacture of components and sub-assemblies, Richardson & Cruddas decided to organise production of India Mark-II handpump with the active participation of several such small units.

The organisation of manufacturers in this manner posed several problems in the initial stages due to the inexperience of several small units, on the one hand, and the stringent quality requirements for the product, on the other. However, it overcame all these problems with careful selection of these units, provision of training and guidance to the workers and supervisors of these units, provision of jigs and fixtures, necessary tooling, and vigilant and extensive quality control/ inspection procedures.

The selection of sub-contractors was done after considering (a) the facilities available with them in terms of land, buildings, machinery, etc., (b) the level of skill of the workmen employed by it, (c) their financial status, (d) registration with appropriate authorities, and (e) their past performance with other clients.

In view of the risk involved in controlling the quality of raw materials at the sub-contractors end and also the lack of financial resources with these small units, Richardson & Cruddas decided to keep procurement of all raw materials with itself. The raw materials procured, undergo inspection before they are supplied to the sub-contractors.

The components/sub-assemblies manufactured by the subcontractors are thoroughly inspected before they are accepted by Richardson & Cruddas. Richardson & Cruddas inspectors also

/...

supervise production at these units, if necessary, and also carry out spot checks to ensure that the established manufacturing practices are being followed.

The total number of sub-contractors manufacturing components/sub-assemblies of India Mark-II for Richardson & Cruddas are about 80. A number of them carry out work exclusively for Richardson & Cruddas and are therefore solely dependent on its orders. The total workmen employed by these sub-contractors are over 500.

The assembly of the pumps is done entirely within Richardson & Cruddas itself. This acts as another check on the quality of components supplied by the sub-contractors.

Richardson & Cruddas has a team of highly trained workmen for assembly of handpumps. It is felt that the productivity of the personnel at Richardson & Cruddas is quite high, Richardson & Cruddas has also not faced any substantial turnover of its workers.

#### Quality control

An effective quality control system is one of the main strengths of Richardson & Cruddas. The quality control department is headed by a senior officer with over 23 years of inspection experience. He is supported by a team of 20 inspectors in various categories.

The department is independent in the matter of giving verdict about the product. This has been particularly possible because the quality control department reports go directly to the General Manager, with no interference from the production department.

Richardson & Cruddas is legitimately proud of the quality of pumps it is manufacturing. It seems that not a single pump offered for inspection to the independent inspection agencies viz. Crown Agents/SGS has been rejected so far by them.

#### Production

Richardson & Cruddas has, since the inception of pump manufacture, produced about 85,000 pumps. The production over the years is as follows:

<u>Year</u>	<u>Production of pumps ('000)</u>
1977-78	7.0
1978-79	7.7
1979-80	11.0
1980-81	12.0
1981-82	13.0
1982-83	16.5
1983-84	19.0

/...

There has been a steady rise in production in addition to a steady improvement in quality.

### Sales

The major customers of Richardson & Cruddas are UNICEF, DANIDA, TWAD Board and Public Health Engineering Departments of Madhya Pradesh, Maharashtra, Rajasthan, Gujarat, Orissa, West Bengal, Karnataka, etc.

Richardson & Cruddas has also exported pumps in small quantities to Sri Lanka, Burma, Thailand, Afghanistan, Sudan, Nigeria, Ethiopia, Ivory Coast, Kampuchea, Gabon, and Niger.

The market share of Richardson & Cruddas for these pumps in India is around 20 per cent. It is heartening to note that the popularity of its pump is spread far and wide.

Although production of handpumps at Richardson & Cruddas appears to be efficiently organised, there seems to be scope for reduction in costs. Lately, Richardson & Cruddas has been finding it difficult to match the prices of its competitors. It feels that the prices quoted by its competitors are unrealistic and can only be possible if sub-standard material and components are used. However, this is unlikely as pumps manufactured by its competitors also undergo inspection by independent agencies viz. Crown Agents/SGS.

It would in any case become necessary for Richardson & Cruddas to reduce its prices, if it wishes to continue to remain in the market. It has already undertaken steps to reduce its costs by rationalising work rates of its subcontractors.

In conclusion, we may note that Richardson & Cruddas has been able to (a) produce high quality handpumps, with the active support and guidance given by UNICEF, MERADO and other agencies, (b) develop a large number of small-scale units, thus conferring benefits to many people, (c) adopt strict quality control, (d) promote improvement in quality through Richardson & Cruddas, and (e) sell even in markets abroad amidst fierce competition. It has now to do everything to reduce costs if it wants to continue to serve in this manner.



ANNEXURE IV

PLAN OF ACTION  
FOR DRILLING AND INSTALLATION AND  
MAINTENANCE OF DEEPWELL HANDPUMPS FOR  
DOMESTIC WATER SUPPLY  
1981-1983

Introduction

1. The purpose of this plan of action is to record the agreement now made between the Government of India through CPHEEO, the Government of the State of Orissa through its Rural Water Supply Agency Public Health Engineering Organisation and UNICEF regarding drilling and providing deep well handpump installations in the districts of Sundargarh, Phulbani, Mayurbanj, Koraput, Kalahandi, Keonjhar, Sambalpur and Ganjam districts which have been selected for UNICEF-assisted project. If successful, this project will pave the way for further UNICEF assistance to the State.

General objective

2. The general objective of the project is to reduce the incidence of water-borne diseases through the provision of potable water in sufficient quantities and at convenient locations for drinking, personal hygiene and domestic purposes, thereby contributing a decline in infant and child mortality and morbidity.

Specific objectives

3.1 To assure continuous availability of a minimum of 40 litres of potable water per person per day.

3.2 To install one tube-well with dependable handpump for every 250 people.

3.3 To install a second tube-well and handpump where the population exceeds 250, or a school or health facility exists.

3.4 To give priority in the provision of drinking water to areas where Government of India and UNICEF cooperate in providing other basic services for children, for example, ICDS blocks, rural development areas and area development projects.

3.5 Wherever potable water is provided to promote complementary hygiene and health education and improved methods of excreta and refuse disposal.

3.6 To develop maintenance systems involving community participation in order to ensure constant availability of water and drainage and the safe operation of excreta and refuse disposal system.

3.7 To provide continuous monitoring and evaluation to enable timely adjustments and corrections in water and sanitation systems.

Plan of Action

4. In accordance with the provisions laid down in the Master Plan of Operations, and in addition to the conditions set forth therein, the following conditions have been formulated and agreed upon.

5. For proper utilisation of the drilling rigs provided by UNICEF, the State Government must furnish the following information for selecting and equipping the drilling rigs, which depends upon the local conditions.

- 5.1 The names of the problem villages, by block and district, together with the district maps indicating the location and population of the villages. (see annexures).
- 5.2 Estimates of the number of wells to be drilled in each village together with a map indicating the tentative borehole locations. (see annexures).
- 5.3 Expected depth of boreholes. The boreholes will be drilled deep enough, depending upon the local hydrogeological conditions, for a minimum sustained supply of about 400 to 500 gallons per hour required for the satisfactory operation of the handpump, even during peak summer and drought periods. In consolidated formations, drilling will normally continue for three to four metres below the aquifer. It is particularly important to drill deep enough in the post monsoon season when the ground water table may be temporarily higher than normal.
- 5.4 An indication of the thickness of the alluvial or semi-consolidated overburden, together with the district map showing the geological formations.
- 5.5 The present status and deployment, by district, of rigs, make-wise and support vehicles already supplied by UNICEF to the State. (see annexures).

6. For proper utilisation of the India Mark-II deepwell handpumps and installation/maintenance vehicles provided by UNICEF for the rejuvenation of old tube-wells which have malfunctioning cast iron or other sub-standard handpumps, the State Government must furnish the following information:

- 6.1 Total number of District Mobile Maintenance Teams already formed and provided with a UNICEF or department vehicle and in which districts they are assigned. (see annexures).
- 6.2 The name and location of villages, by block, in the selected districts which have cast iron or other substandard deepwell handpump which need to be replaced with India Mark-II Handpumps. (see annexures).
7. The annual drilling targets will be in the range of 150 to 200 wells per year per new rig depending upon depth of aquifer, amount of casing required, etc.
8. In order to avoid overlapping of responsibilities of the operational staff, the State Government will define the duties of the drilling crew, maintenance personnel and supervisory staff (if necessary in consultation with UNICEF) for the satisfactory operation of the rigs. Any change in the staff of the rig recommended by UNICEF shall be considered favourably by the State.
9. Every effort will be made by the State to maintain the same crew members who were originally trained with a new rig.
10. The State Government will arrange that all UNICEF-supplied rigs are given a "UNICEF Number" which will be painted on the chassis and the compressor of the rig. The UNICEF Decal provided will be displayed at all times. In addition, each rig and its equipment will have a running/maintenance log book.
11. The State Government shall ensure that all wells drilled with UNICEF rigs have proper surface seals, with bentonite, as per UNICEF recommendation, in order to prevent contamination. This includes casing through the overburden and at least one metre into the consolidated formation.
12. The State Government will appoint an Assistant Engineer (Rig Maintenance) with three trained mechanics for every three rigs for looking after the maintenance of the rigs and equipment supplied.
13. The State Government will be responsible for the installation of quality India Mark-II handpumps, made to I.S.I. specifications for qualified suppliers, for all newly drilled wells and for all old tube-wells which have malfunctioning cast iron or other sub-standard handpumps. Installation includes the construction or renovation of a concrete platform, together with adequate drainage, along the lines recommended in the India Mark-II Handpump Installation instructions.
14. The State Government will ensure that no later than one month after completion of a successful tube-well, a quality India Mark-II handpump is installed with a proper platform and drainage.

15. The State Government shall be responsible for the maintenance of all deepwell handpump installations throughout the districts mentioned above.

16. In order to carry out the installation and maintenance of India Mark-II handpumps, District Mobile Installation/ Maintenance Teams, under the authority of the State Rural Water Supply Agency, will be formed and fully equipped to carry out all contingencies of repair and installation of India Mark-II handpumps. A team will consist of one full-time Sub-Engineer Incharge, one mechanic, one mason, two helpers and one driver.

17. To support the District Mobile Maintenance Teams, a system of reporting pump failures and effecting minor repairs will be established at the Block and Village Levels. Together, these three levels will constitute a three-tier maintenance system as follows:

17.1 Village Caretaker (one handpump user per pump).

17.2 Block Mechanic-cum-Inspector (responsible for a maximum of 50 handpumps).

17.3 District Mobile Maintenance Teams (responsible for a maximum of 500 handpumps).

18. In the blocks selected for operation, all drilling of new wells and conversion of cast iron and other sub-standard handpumps to India Mark-II pumps will be carried out in a systematic manner. This will require that all drilling and conversions in one block are completed before moving on to a new block.

19. The State Government will ensure that the rig deployed in a particular village/block/district will complete the required number of wells in that area before moving out to the next village/block/district so as to avoid unproductive movement of the machine.

20. In order to monitor the progress of the project, monthly reports will be submitted to UNICEF indicating the number of wells drilled and handpumps installed. For handpump rejuvenations, quarterly reports will be submitted. Standardised forms will be provided by UNICEF.

#### UNICEF Inputs

21. Six (6) drilling rigs and necessary imported spare parts.

22. Six (6) Rig Support Trucks for rigs provided.

23. Workshop equipment for repair and maintenance of rigs, if deemed necessary.

24. Geophysical and water quality testing equipment may be provided, if deemed necessary.
25. One thousand (1,000) India Mark-II Handpumps for rejuvenation of old tube-wells with malfunctioning cast iron and other sub-standard handpumps.
26. Five (5) Vehicles for District Mobile Installation/Maintenance Teams.
27. Five (5) tool sets for District Mobile Installation/Maintenance Teams.
28. Tools for District Level Workshops for handpump repairs.
29. Training programmes for drilling, maintenance and supervisory personnel.
30. Training programmes for District Mobile Installation/Maintenance Teams, Block Mechanics-cum-Inspectors and Village Caretakers.

#### State Government Inputs

31. The State Government will provide all personnel, premises, vehicles, supplies and funds necessary to fully support the UNICEF inputs to the project. Some of these are detailed below.
32. Each air rotary drilling rig will require the following personnel for a two short operation, in addition to supervisory staff, one driller in charge, two assistant drillers, one mechanic, one welder, six technical helpers, two drivers, one cleaner and two chowkidars.
33. For each drilling rig provided, one District Mobile Installation/Maintenance Team will be constituted. The team will come in with each new rig and take care of installation and maintenance work. When 500 installations are completed, the team will stay back and attend to repair and maintenance of handpumps in that geographical area. Another teams will consist of one full-time Sub-Engineer in charge, one mechanic, one mason, two helpers and one driver.
35. For every three Air Rotary Rigs, an Assistant Engineer (Rig Maintenance) plus three trained mechanics will be appointed.
36. A full-time Project Coordinator will be appointed by the Public Health Engineering Department to ensure that Handpump Caretakers at the Village Level are properly selected and trained.

(The syllabus for handpump caretaker training will include material on hygiene and health aspects of safe drinking water and environmental sanitation. Efforts will be made to link the drilling and pump installation activities with ongoing health education and environmental sanitation projects in the area.)

37. The State Government will provide all necessary operational/consumable goods such as casing pipe, drilling bits, bentonite, G.I. Pipe, handpumps, cement, fuel, oil and lubricants. The Government will provide India Mark-II Handpumps from qualified suppliers and have them installed on new tube-wells as well as provide platforms and drainage. For rejuvenation of existing tube-wells, the State Government will have platforms and drainage constructed and UNICEF provided handpumps installed as per the India Mark-II installation instructions.

38. The State Government will provide adequate storage and workshop facilities with experienced staff for servicing drilling rigs, vehicles and handpumps and for store keeping and accounting.

39. All inland freight and delivery charges will be paid by the State Government. Four per cent ad valorem charges for imported equipment will also be paid by the State Government, as necessary.

#### UNICEF Financial Commitment

40. The estimated expenditure for the UNICEF input is US Dollars three million.

#### State Government Financial Commitment

41. The estimated annual recurring expenditure for the State Government is Rs.83.5 lakhs.

41.1 Rs.350/- per year each quality India Mark-II Handpump. This figure includes salaries of the District Mobile Installation/Maintenance Team and allowances, depreciation of the vehicle over five years, diesel, fuel, oil, lubricants, maintenance of the vehicle and spare parts for the handpumps.

41.2 Rs.20/- to 30/- lakhs per year per air rotary rig depending on the number of wells drilled, amount and type of casing used, number of handpumps installed, etc. These figures include salaries and allowances, diesel, fuel, oil, lubricants, rig maintenance, casing pipe, locally manufactured spare parts, geophysical surveys, water quality testing, handpumps, cement, etc.

Time Frame

42. This plan of action and any addenda will remain in effect from the date it is signed until 31 December 1983. UNICEF inputs will reach the State in a phased manner in accordance with the rate of implementation.

Additional Inputs

43. As and when additional funds become available, UNICEF may allocate further inputs which will be matched by the State on the same basis as described above. These inputs, and the inclusion of additional districts can be agreed upon by an exchange of letters and will then constitute an addendum to this plan of action.

Signed on behalf of  
Government of Orissa.

Dated

Signed on behalf of  
UNICEF.

Dated

Signed on behalf of  
Government of India.

Dated

5127T

/...