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MID-TERM REVIEW

WATER & SANITATION
(1991-1995)

**Government of India
in cooperation with
The United Nations Children's Fund**

18 May, 1993

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THE 1993 MID TERM REVIEW

The objectives of the 1993 Mid-Term Review for the Water and Sanitation Programme are to :-

- Provide the Government of India and UNICEF with an assessment of achievements at the mid point of the 1991-95 GOI/UNICEF programme of Cooperation with especial reference to the Global Goals for the year 2000.
- Determine whether the Water & Sanitation Programme as envisaged in the 1991-1995 Plan of Operation is appropriate and relevant in the light of current economic, political and social conditions in the country or whether it needs to be modified.
- Provide an opportunity to address policy, strategy, technical or operational issues of special concern.

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ACRONYMS

AIHH&PH	All India Institute of Hygiene and Public Health
ARWSP	Accelerated Rural Water Supply Programme
ATR	All Terrain Rig
BIS	Bureau of Indian Standards
CAPART	Council for Advancement of People's Action for Rural Technology
CDD	Control of Diarrhoeal Disease
CDRT	Centre for Development of Rural Technology
CRSP	Centrally Sponsored Rural Sanitation Programme
CSM	Communication & Social Mobilization
DDS	Decision Support System
DWCRA	Development of Women & Children in Rural Areas
GOI	Government of India
HRD	Human Resource Development
ICDS	Integrated Child Development Services
IEC	Information, Education, Communication
IERT	Institute of Engineering & Rural Technology
ITI	Industrial Training Institute
ITN	International Training Network
KAP	Knowledge, Attitude and Practice
LPCD	Litres per capita per day
MHRD	Ministry of Human Resources Development
MIS	Management Information System
MNP	Minimum Needs Programme
NGO	Non-Government Organization
NPA	National Plan of Action
ORS	Oral Rehydration Salts
ORT	Oral Rehydration Therapy
PHED	Public Health Engineering Department
POA	Plan of Action
R&D	Research & Development
RGNDWM	Rajiv Gandhi National Drinking Water Mission
RKM	Rama Krishna Mission
RMS	Rig Monitoring System
RSM	Rural Sanitary Mart
RSP	Rural Sanitation Programme
RWSP	Rural Water Supply Programme
SC	Schedule Caste
ST	Schedule Tribe
SPMS	Spare Parts Management System
SWACH	Sanitation Water & Community Health
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UP	Uttar Pradesh
VCD	Village Contact Drive
VLOM	Village Level Operation & Maintenance
WATSAN	Water Supply & Environmental Sanitation Programme

EXECUTIVE SUMMARY

MID TERM REVIEW: 1993

WATER AND SANITATION

KEY BACKGROUND INFORMATION	
PRINCIPAL OBJECTIVES :	<ul style="list-style-type: none">- Increase access to safe water- Increase access to sanitary means of excreta disposal- Eradicate Guineaworm Disease by 1995
MID DECADE OBJECTIVE :	<ul style="list-style-type: none">- Narrowing the gap for Rural Water Supply by 1/4 and for Sanitation by 1/10- Eradication of Guineaworm disease by 1995
GOVT. SECTOR ALLOCATION AS PERCENTAGE OF EIGHTH PLAN (1992 - 1997)	: 3.84 %
UNICEF SECTOR ALLOCATION AS PERCENTAGE OF PLAN OF OPERATIONS (1991 - 1995)	: 16.77 %
ESTIMATED UNICEF CONTRIBUTION AS PERCENTAGE OF GOVT WATSAN PROGRAMME (1991-92)	: 2.3 %

- KEY PROGRAMME COMPONENTS:**
- Water Supply
 - Environmental Sanitation
 - Guineaworm Eradication
 - Communication and Social Mobilization
 - Management Information System

PROGRAMME OVERVIEW

STRATEGY:

A two pronged approach with interventions at the National Level advocating for accelerated coverage against Global Goals through policy development, capacity building, communication and social mobilization (CSM), low cost technology and Management Information System (MIS); at the District Level, increasing service levels and WATSAN convergence with women and child related activities for overall improvement of quality of life in which community involvement is an integral component.

TREND:

A shift from supply and technology input to a more balanced hardware/software combination in which the social dimensions of the WATSAN programme are emphasized. A stronger sanitation component, stress on reaching the unreached, community based maintenance systems, cost sharing, focus on safe water consumption and sustaining service coverage are highlighted.

SUCCESS:

78 % of rural population provided with safe water (existing norms). Reducing the incidence of guineaworm disease to achieve eradication by 1995. 11 % families provided with latrines (8 % from private initiative) and an 11 fold increase RSP allocation between Seventh and Eighth Plan. Innovative, cost effective WATSAN technologies including, alternative latrine designs and delivery systems; drilling in unserved areas, hydrofracturing for well rehabilitation, rainwater harvesting and household water protection.

OPPORTUNITY:

Reducing the gaps between available resources and needs. Sustaining service delivery with low cost technology through continuous R & D and accelerating coverage against Global Goals. Achieving a more equitable balance in resource allocation between Water Supply and Sanitation. Strengthening the CSM link between hardware and communities to create awareness and thence demand. Advocating technology that is protective of the environment. Recognizing the difference between safe water supply and safe water consumption. Using CDD/WATSAN as a learning opportunity for more extensive convergence of services. Consolidating MIS initiatives for strengthening the WATSAN data base. Multi-level capacity building, at National, State, District and Community.

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MID-TERM REVIEW : 1993

WATER AND SANITATION

1. THE PRESENT SITUATION

1.1 Introduction

The overall goal of securing health and well being of children and women is advanced through the provision of safe drinking water in sufficient quantities at convenient locations, the installation of sanitary facilities and the promotion of their use. Drinking water is a priority for all rural communities. It therefore serves as an entry point around which social and developmental activities can be organized. Linking community involvement and optimal service levels lead to the better utilization of clean water and sanitary facilities which, in turn, impacts on the reduction of diarrhoea incidence and malnutrition.

The guiding principles of GOI-UNICEF cooperation in the Water Supply and Environmental Sanitation Programme therefore are :

- The protection of children from diarrhoea and other diseases related to unsafe water and insanitary conditions and
- The reduction of drudgery for women and young girls in carrying water over long distances.

India's Rural Water Supply Programme (RWSP) is regarded as one of the largest and most successful programmes in the world with an estimated 78 % of the population provided with a safe water source and the Global Goal of universal access by 2000 within reach. UNICEF support to rural water supply in India dates back to the 1950s with a major GOI/UNICEF thrust to address the rural water supply problem during the Fourth Plan Period (1969-1974).

By comparison, GOI/UNICEF cooperation in the field of environmental sanitation only commenced in 1983, gaining further momentum when the centrally sponsored Rural Sanitation Programme (CRSP) was launched in 1986 and rural sanitation was included in the Government of India's 20-Point Programme. Consequently, population coverage with sanitary means of excreta disposal is estimated at only 11% (1989) with the Global Goal of universal access still remaining a major challenge.

GOI/UNICEF cooperation for the eradication of guineaworm was initiated in 1984. However, impressive gains have been made in eight years and it is anticipated that India will be free of the disease by 1995, thereby achieving this Global Goal.

1.2. 1991-95 Plan Of Operations

The major programme components supported by UNICEF are grouped under the following five broad headings. The latter two are cross cutting :-

- Water Supply
- Environmental Sanitation
- Guineaworm Eradication
- Communication & Social Mobilization
- Management Information System

1.2.1 Objectives

The objective of UNICEF cooperation in the Water & Environmental Sanitation (WATSAN) sector is to support the National Programme in the following areas :

- Increased availability of safe drinking water to reach a national norm of one point source for every 150 rural population in selected districts.
- Improved sanitation coverage to meet a national target of providing facilities for safe disposal of human excreta to 15% of households in selected districts.
- Elimination of guineaworm disease through extensive health education, provision of safe water and improved environmental sanitation and surveillance.
- Increased awareness and behavioral change, particularly among children and women on improved environmental sanitation and personal hygiene.
- Enhanced role of community members, particularly women in the planning, implementation, operation and maintenance of WATSAN facilities.
- Encourage partial or complete cost sharing for operation and maintenance of drinking water systems and for the construction of sanitation facilities.
- Effective programme convergence between Water, Environmental Sanitation and Health interventions, especially for the Control of Diarrhoeal Disease (CDD).
- Development and propagation of low-cost appropriate technologies in water supply and environmental sanitation through research and development.
- Human resource development (HRD) as an integral component of institutional development and capacity building.
- Monitoring and evaluation of the programme through an effective Management Information System (MIS) leading to an improvement in cost effectiveness and efficiency of delivery systems.
- Coordination and cooperation with other UN agencies, bi-laterals and NGOs to attain complementarity and mutually reinforce individual agency effort.
- Focus on reduction of adverse environmental impact of water and sanitation interventions.

1.2.2 Strategy and Focus

The operational strategy stated in the Plan of Operations reflects a two pronged approach with interventions at the national level and in selected districts. (Annexure I) This combination is intended to achieve a more coordinated and cohesive programme implementation. Thus : -

National level strategy - Policy development for the national programme addressing Global Goals, infrastructure and capacity building, communication and social mobilization activities, promotion of low cost technology transfer, development of MIS, evaluation and selected research and development activities. The National level strategy is intended to reinforce activities on the ground and accelerate the pace of implementation.

District level strategy - Through a participatory process between the National and State Governments, District Administration and UNICEF, cooperation in selected focus districts is envisaged with the intention of increasing service levels for safe drinking water supply and improved sanitation practices based on the national norms. This is achieved in convergence with women and child related activities leading to an overall improvement in the quality of life for women and children. Community involvement is an integral part of the district focus approach.

The Plan of Operations reflects for the first time, a shift from the predominantly 'hardware' approach (supply & technology inputs) to a more balanced combination of supply and technology with Communication and Social Mobilization (CSM) activities. The social dimensions of the WATSAN programme including increase in public awareness, community management & participatory planning are thereby emphasized.

Consequently, the Plan of Operations envisages the institutionalization of CSM activities within Public Health Engineering Departments (PHEDs) through the establishment of Information Education Communication (IEC) Cells, as also through training and orientation of PHED functionaries on developmental issues related to water and sanitation.

1.3 Accomplishments

The Water and Sanitation Programme has made important gains against planned objectives during the period under review, keeping in mind the Global Goals which include : (i) universal access to safe drinking water, (ii) universal access to sanitary means of excreta disposal and (iii) eradication of guineaworm disease.

Water Supply : Access to safe drinking water is defined in terms of providing a handpump/standpost for 250 population; the consumption and distance norms being 40 lpcd (total water requirements) and 70 litres in desert areas (for humans and cattle), within 1.6 kms horizontal distance or 100 m vertical distance in hilly areas. The population and distance criteria are relaxed for difficult areas and hamlets including those of scheduled castes and scheduled tribes. Viewed in this perspective, 489 million of India's 627 million rural population or 78 % is estimated to have been provided with a safe drinking water source by 1992 leaving 138 million or 22 % population without access. Although the Eighth Five Year Plan envisages universal access to safe drinking water by March, 1997 with the existing norm, thereby achieving the Global Goal, revising the norm to one handpump/ standpost for 150 population as envisaged in the 1991-95 Plan of Operations and the National Plan of Action (NPA) will meet with severe logistical and resource constraints. (Fig 1 & Fig 2)

Environmental Sanitation : While the RWSP is oriented towards a community-based approach, the RSP is primarily household-oriented and therefore dependent upon the attitude of a household and the behavioral pattern of its members. In addition, sanitation has received low priority compared to water supply. Consequently, by the end of the Seventh Five Year Plan (March 1990), the percentage of households provided with sanitary latrines through the Government sponsored programme was estimated at less than 3%, on the assumption that the number of households having their own latrines outside the government programme might be negligible. However, this was not the case as evidenced by the 44th Round of National Sample Survey (1988-89) from which 1 out of 9 rural households in India were found to have latrines of various types, with the North-Eastern States showing a higher trend than the 11% country coverage (Fig 3). Results of a base-line survey carried out in 15 districts in 15 states show that during 1992 the percentage of households having access to latrines was more than 11 % which

compared favourably with the 15 % target envisaged in the 1991-95 Plan of Operations and as per NPA goal of 10% by 1997, but is far behind the Global Goal of providing universal access to sanitary means of excreta disposal. Reaching the planned coverage level of 25 % by 2000 may prove overly ambitious. (Fig 4). However, recent adoption of revised subsidy norm (80% only for the families below poverty line) and mandatory fund allocation for IEC component (10% of the RSP allocation) would provide potential for accelerating coverage.

Guineaworm Eradication : The 1991-95 Plan of Operations as well as the National Plan of Action envisages the eradication of guineaworm by 1995. Due to an effective case containment strategy adopted by the Ministry of Health as well as the drinking water supply programme launched by the Ministry of Rural Development, India has made impressive progress towards this Global Goal which is likely to be achieved by 1995. Through this strategy there was a dramatic decline in guineaworm cases from 39,792 in 1984 to 1,081 in 1992. During the same period, the number of endemic villages reduced from 12,840 to 249. Two of the six guineaworm-affected states in the country are now reporting zero cases. (Fig 5).

1.4 Financial Inputs to the Programme (1991-92)

Government and State : The expenditure incurred by the Central and State Governments on Rural Water Supply and Sanitation can be seen in Table 1. For the sake of comparison, expenditure figures for the Seventh Five Year Plan (1985-1990) and outlay figures for the Eighth Five Year Plan (1992-1997) have been provided. The likely expenditure during the first two years of the present Plan of Operations (expenditure for 1991-92 and allocation for 1992-93) will be more than Rs. 25,641 million, or over 56 % of the total expenditure during the Seventh Plan period. Similarly, the proposed outlay for the Eighth Five Year Plan is Rs.107,287 million or over twice the expenditure incurred during the Seventh Plan in this sector.

A significant feature of the investment pattern of the Government in recent years has been a higher outlay for rural sanitation for which the likely expenditure during the first 2 years of the present Plan of Operations will be over Rs.1000 million, which is more than 150% of the amount spent during the entire Seventh Plan period. Similarly, the outlay proposed for sanitation in the Eighth Five Year Plan (Rs.6,740 million) is more than 11 times the expenditure incurred during the Seventh Plan. The share of rural sanitation in the WATSAN sector has increased from less than 2% during 1985-90 to a proposed 6% of the National outlay during 1992-97. While these figures indicate greater attention now being given to environmental sanitation by the Government, the level of investment is still minimal in relation to needs for attaining the Global Goal. (Fig 4)

UNICEF : UNICEF contributed US\$ 27.5 million during 1991 & 1992 or 2.3% of the total expenditure likely to have been incurred by Central and State Governments during 1991-92 and 1992-93 (9 % for sanitation). (Table 2)

2. ASSESSMENT OF THE APPROACHES AND STRATEGIES

Although UNICEF's financial contribution to the National WATSAN programme in India is estimated at only 2.3%, the interventions supported have been critical. Several approaches and strategies were jointly developed with financial and technical support from UNICEF, having policy implications for the programme at the country level. A critical analysis of these approaches and strategies and the experience gained during the first two years of the current Plan of Operations, highlights areas of success, scope for consolidation and opportunities for accelerating coverage against Global Goals in a sustainable manner.

2.1 Sustaining Cost Effective Service Delivery

Water Supply : With population growth estimated at 2 % (1991 census) India's rural population will increase by 110 million to 750 million by 2000. For population growth alone therefore an investment of \$ 506 million will be needed to provide one handpump/borehole for 250 population (present norm). Assuming 10 % of all handpumps/boreholes become defunct annually an investment of \$ 1610 million will also be required by 2000. Consequently, alternative cost effective technologies are needed to reduce the burden of sustaining and increasing coverage. In this context, several alternative technologies and approaches have been explored .(Fig 6)

The handpump/borehole represents the major technological approach and continues to reflect a cost effective option at \$ 5 - 6 per capita (250 population at 25 lpcd). However, the use of geophysical equipment for source funding to reduce the failure rate of drilled wells (a 1 % reduction in the annual number of dry wells achieves a \$1.25 million cost saving Fig 7) the wide scale adoption of enhanced well quality standards and the deployment of hydrofracturing equipment for rehabilitating dry or low yielding bore wells are proven approaches necessary for mass replication as cost saving measures and to sustain previous investments.

"Environment friendly" hydraulic drill rigs (small diameter bores, low fuel consumption), the deployment of All Terrain Rigs (ATR) to facilitate drilling in difficult unserved areas and simultaneous drilling/casing systems for heavy overburden and boulder formations have made significant contributions to water resources development.

With a proven success rate of 75%, hydrofracturing of boreholes in hardrock areas has been the latest addition in the transfer of technology, the average cost of which is estimated at US \$400 per bore as against an estimated cost of US \$ 1150 for a new bore. With the failure rate from drilled wells approximately 14% or 21,000 out of a total of 150,000 bores drilled per year, the amount that could be saved by using this technology on a wide scale is \$ 24 million (Fig 8).

Efforts to improve the maintainability of the India Mark II Handpump have resulted in the development of the India Mark III (VLOM) deepwell handpump. The reduced maintenance cost of this handpump offsets the initial capital costs, which is 30% higher than the India Mark II Handpump, over a 3 year period. The simplified technology has been shown to provide user communities with a functional pump for almost twice the number of days annually compared to the India Mark II.

The Direct Action Handpump for low and medium lifts at \$ 80 a unit, offers potential for rural populations in alluvial areas of North India and the North Eastern states. The all plastic pump is a simple device that requires minimum skills for maintenance and is well within the means of individual households. It is compatible with the local low cost hand-boring techniques. The per capita costs of a new installation (40 m depth) for a population of 150 is \$ 2. The pump has a very high discharge rate (1 litre per stroke) and consequently can easily serve a population of 250 persons. The benefits of this low cost technology are presently being demonstrated in 9 States.

Open dug-wells have long been considered an unsafe source of domestic water supply. However, there is a growing interest in improving and protecting open dug wells and other traditional sources with very low cost interventions. The investment required for improving open dug wells on a cost sharing basis averages US \$ 300. Of this amount 40% can be generated through communities contribution. Two such projects are at present underway, in West Bengal & Uttar Pradesh.

Bamboo reinforced and ferro-cement technology for construction of rain-water collection household units is developed to provide protected water supply in the poor water quality areas of coastal Tamil Nadu and in the hills of Assam. The investment per litre of water stored is estimated at Rs. 1.50. Average storage period is 100 days. User contribution to the extent of 30% has been collected by user groups, with Government and UNICEF providing the balance.

The development and introduction of low cost household filters (\$ 5 per set) is a cost effective means of providing/storing drinking water and preventing the transmission of disease from polluted water sources. This intervention on a cost sharing basis is expected to yield good results in the rural households.

Technology transfer and the development of local industry represent major spin off benefits that have been reaped by the Water and Sanitation Programme during 25 years of GOI/UNICEF cooperation. India's strong industrial and technological base has also contributed to the development of Water and Sanitation Programmes in many countries cooperating with UNICEF, particularly in Africa where handpumps and drill rigs amongst other equipment, have been widely used.

Environmental Sanitation : Several activities have been initiated for the development of alternate delivery systems and transfer of low-cost technology. Alternate designs, use of local materials, promotion of local production capacity and the training of masons all contribute to a reduction in construction costs. Thus, in Medinipur, the Rama Krishna Mission (RKM) offers ten different models of sanitary latrines to accommodate various income groups. Unit costs range from Rs.250 for a single pit water seal latrine to Rs. 3000 for a dual pit pour flush type with an improved superstructure. The Institute of Engineering and Rural Technology (IERT) Allahabad is engaged in trying out alternate superstructures using local materials. A Low-cost sewer system is being experimented within a group of villages in Hoogly district in West Bengal by the All India Institute of Hygiene and Public Health (AIHH&PH). Attempts are being made to involve the Centres for Development of Rural Technology (CDRT) and the Community Polytechnics Experiment with alternate strategies and technology transfer. Areas for further interventions include, development and adoption of suitable designs for water logged, rocky, hilly and arid areas; R&D on cost-effective superstructure; and use of ferro-cement technology.

Management Information System (MIS) : Perceiving the need for MIS and its use as a monitoring tool at various levels of operation, a comprehensive MIS package was developed to address the requirements at Central, State and District levels. At the District level a Decision Support System (DSS) module has been developed with UNICEF cooperation as part of a comprehensive MIS package. GOI has also completed an all India hamlet survey. Data from this survey will accurately indicate water sources availability throughout the country. Through data analysis, it will be possible to develop strategies for the most appropriate, cost effective and sustainable sources of water supply. It will also prove valuable for decision makers in planning and implementing Rural Water Supply and Sanitation schemes. To further support the State Governments in using available resources optimally, a computerized Spare Parts Management System (SPMS) has been developed and implemented in most of the states. A Rig Monitoring System (RMS) providing qualitative and quantitative analysis has also been institutionalized. For new technology such as hydrofracturing, a monitoring system is under development for introduction end 1993. Support to State Governments for handpump maintenance and inventory control has continued through advocacy, training, supply and installation of a "Kardex" system.

2.2 Serving The Unserved As A Social Commitment

UNICEF has assisted the GOI in its efforts to provide drinking water and sanitary facilities to those living in difficult access areas as well as those belonging to the lower socio-economic strata. While an increasing number of villages are being covered under the rural drinking water supply programme, a large number still remain to be served either partially or fully. These include some of the hard core problem villages, as well as habitations within a village. Supply of geophysical equipment, all-terrain rigs and simultaneous casing systems for difficult drilling conditions have all contributed to Government efforts in source finding and drilling in water deficient underserved rural areas. Similarly, the use of alternate technologies such as rainwater harvesting and gravity feed systems have provided water to areas where drilling bore holes is difficult and costly. In the case of sanitation, providing a range of options has enabled people in the lower socio-economic strata to have their own latrine. Thus, in Medinipur, the majority of the 20,000 households covered by the RKM belong to the weaker sections of society. Similar experiences have been reported from Allahabad, Kanyakumari, Krishna and Ranchi districts where sanitation projects are promoted by reputed local NGOs in selected places. However, more effort is needed to draw in many more NGOs with extensive 'grass root' water and sanitation experience, so that a visible impact can be achieved within a short period.

2.3 Community Based And District Focus Approach For Replicable Models

The period 1991-92 witnessed implementation of several projects in the WATSAN sector with a district focus.

Area specific strategies have been developed by motivated NGOs and district administrations for implementation of community based handpump maintenance projects in 17 districts of which 9 are in hard rock areas and 8 in the alluvial belt.

As a result of intensive communication and social mobilization activities undertaken as integral components of all strategies, WATSAN committees have been formed as organs of the Village Panchayats. Local communities contributed towards installation, repair and maintenance of handpumps as also towards payment to women handpump mechanics identified from the communities. While there has been in general, an increased involvement of women in the planning and implementation stages of these projects, the women in the WATSAN committees, in particular, have proved to be good channels for promotion of personal hygiene, environmental sanitation, immunization, nutrition and primary education.

A salient feature of the community based maintenance projects is the transfer of accountability and skills for maintenance and management of handpumps from the PHEDs to the Village Panchayats and through them to the community. This process of decentralization, strengthened through the Village Contact Drive (VCD), creation of WATSAN committees, training and orientation of committee members as also user representatives has helped in the social acceptance of women as mechanics.

In the sanitation projects, several community based approaches promise replicability. In Alwar, communities have been motivated to adopt sanitation as a package of health related facilities ; in Periyar the concept of 'cleanliness' has been promoted and in Medinipur self-financed rural sanitation has taken root through Youth Clubs. A three pronged approach to subsidizing household sanitary facilities including establishment of sanitary marts, subsidizing as per government norms and offering normal subsidy to motivated households, has been initiated in Allahabad. While the Alwar strategy has been replicated in five more districts of Rajasthan, the Government of Assam has adopted the Medinipur model in Kamrup district and the concept

of sanitary marts has been extended to several districts of Uttar Pradesh, Rajasthan, Orissa and Delhi. Considering the low sanitation coverage in the country, experiences gained from these approaches need to be rapidly disseminated in order to create an impact at the National level.

2.4 The Critical Link - Communication and Social Mobilization for improved Community Participation

UNICEF played a key role in advocating for government policy on IEC and social mobilization, supporting a number of interventions at national, state and district levels. At the request of the Rajiv Gandhi National Drinking Water Mission (RGNDWM), UNICEF commissioned a professional communication agency to develop an innovative media strategy based on the results of a 1989 KAP study on water use and sanitary practices in rural areas. The agency developed a prototype media package to illustrate to state governments how to net work different types of local media for promoting awareness of hygiene, safe water and health. The media package has been handed over to the state governments of Hindi speaking regions to use as basic material for awareness activities in their states.

To strengthen the capacity of the PHED to take up communication and social mobilization activities more effectively, GOI agreed to establish IEC cells at state level with UNICEF providing initial financial and technical support. The organizational structure of these cells and the scope of their work was based on a series of in-depth studies undertaken by two professional agencies in eight states. Seven State PHEDs have now submitted IEC proposals to the GOI for approval and clearance has been given to four states to establish IEC cells. However, there still remain obstacles including non-sanction of posts. In the interim, efforts are being made to provide institutional support on an ad-hoc basis from NGOs such as the National Institute of Design. One significant development in this regard has been the Government's decision to earmark 10 % of CRSP funds for IEC activities. All the district level Plans of Action (POAs) for WATSAN interventions now have an IEC component which takes into account local requirements. The component has a strong element of Human Resource Development (HRD) at the grass root levels and lays stress on training and orientation of functionaries of different on-going government programmes as also NGOs on aspects related to promotion of safe water and sanitation. Proposals have been made to introduce an innovative IEC strategy for WATSAN as a part of the overall village development in the 55 mini-mission districts of the RGNDWM. Several IEC materials including TV spots have been developed and all possible channels of communication, including print, electronic and folk media, have been used to convey various messages on WATSAN. Availability and development of communication skills represents a major challenge in the promotion of IEC activities in the WATSAN sector and a critical link between community and technology.

2.5 Cost Sharing For Sustainability

Advocacy for cost sharing from a beneficiary household or community, aims to create a sense of ownership and allows limited funds to rotate for an increased coverage. Supply of drinking water hinges primarily on government support, although there are examples of communities providing contributions in isolated areas. Thus, in Medinipur, the community contributes half a rupee per family per month for the maintenance of TARA handpumps with some making a token contribution of Rs. 500 per pump towards installation costs. Similarly, the rural sanitation programme now has a built-in cost sharing element. The 1991 CRSP guidelines required beneficiary contributions even from the SC and ST families and those below the poverty level, for construction of household latrines. This has since been revised, with no subsidy to

those above poverty level; irrespective of caste considerations. This means that households above the poverty line must now pay total latrine costs, while those below the poverty line are expected to contribute 20 % of the total cost. This is seen as a significant development.

GOI/UNICEF advocates for cost-sharing from beneficiary households and explores alternate approaches. In Medinipur, the beneficiaries contribute full cost irrespective of their socio-economic status. In order that a facility is extended to reach otherwise unserved groups, a revolving fund is in operation which provides loans to the poorer groups, to be recovered in easy installments. During 1991-92, over 18,000 households were provided with latrines with full cost recovery. This approach has now been adopted in Hoogly district of West Bengal and Kamrup district of Assam.

The concept of zero subsidy is also promoted through the Rural Sanitary Marts (RSM) and several other projects are now in operation where the subsidy provided to a household is lower than the government norm including Allahabad (UP), Ranchi (Bihar), Kanyakumari (Tamil Nadu), Mysore (Karnataka), Krishna (Andhra Pradesh) and Najafgarh (Delhi). The recent decision of the Government to withdraw subsidy for those above the poverty level will necessitate developing alternate marketing strategies to facilitate those who want to have a latrine independently. This is essential since the materials needed for construction of latrines in rural areas are not always available. Development of local production capacity and marketing capability will require special attention.

2.6 Responsive Delivery & Market Mechanism For Greater Spread Effect.

The growing demand for materials associated with drilling and handpumps, have encouraged private enterprise to manufacture and trade. At present, India has 47 approved manufacturers of India Mark-II handpumps meeting national demand and exporting to over 40 countries. Self sufficiency has been achieved in the manufacture of previously imported hydraulically operated small drill rigs, while accessories for hydrofracturing units and simultaneous casing systems are now locally available. While this positive development indicates a sensitive and demand driven market for water supply equipment, the same cannot be said of sanitation with only 10 under-utilized production units in the country engaged in manufacturing pans & traps according to UNDP specifications for pour flush water seal latrines. Initial support for developing a suitable market mechanism was therefore, necessary to promote sanitation. Towards this end UNICEF collaborated with the Uttar Pradesh government in 1991 to introduce the concept of the Rural Sanitary Marts (RSM). The RSM is a retail outlet offering a "Sanitation Package". It deals with the materials required for the construction of latrines and other sanitary facilities and acts as a counselling centre for those interested to have latrines and other sanitary facilities. The RSM also maintains a panel of trained local masons and thus acts as a service centre. While ORS packets are already stocked and marketed, the RSM offers potential for the sale of essential handpump spare parts in areas where community based handpump maintenance is active. Based on the initial success at 12 locations, the Government of Uttar Pradesh has promoted more RSMs in the state while the production centres of Medinipur are now being converted to serve as RSMs. Marts have also opened in Rajasthan. Several other States have shown interest in RSMs while the Government of India has accepted the concept. RSMs are a step towards commercializing the supply of sanitary materials for RSP and are intended to promote private initiative over a period of time. Close monitoring of this initiative and assessing its potential for mass replication is now required.

2.7 The CDD-WATSAN Strategy For An Effective WATSAN-Health Linkage

The need for an integrated control of diarrhoeal disease, and water and sanitation (CDD-WATSAN) strategy emerges from the inherent association between the two. Thus, diarrhoea which has a direct link with water and sanitation should not be looked at as merely a medical problem. A reduction in the diarrhoeal incidence can be a generic indicator of an improved water supply situation and better personal hygiene. The recently announced Government of India Policy on Management of Diarrhoeal Disease amongst children under five through promotion of ORT has called for undertaking preventive measures in terms of providing safe drinking water and promoting improved sanitation and better personal hygiene practices together with correct case management for reducing morbidity and mortality from diarrhoeal disease. The CDD-WATSAN strategy which is being experimented with, in 15 districts of India aims to :-

- Reduce the incidence of diarrhoeal cases among children under 5 years by 25% by 1995
- Provide universal access to safe drinking water and improved sanitation coverage by 1995 with major activities completed by 1994.

In order to achieve these objectives, three broad strategies have been envisaged. These are : i) Improving access to drinking water supply to the 40 lpcd optimal level, sanitation and diarrhoea management services, ii) Promoting key practices for prevention of diarrhoea and iii) Promoting key practices for management of diarrhoea.

Convergence of water, sanitation and the relevant health inputs together with empowering mothers on prevention and management of diarrhoea at village level represents a major challenge. Benchmarks have already been created through a household survey so that the impact of this strategy can be assessed in 1995. Based on the lessons learnt, the strategy can be extended to other districts to facilitate achieving the "Health for All" goals by 2000 AD.

2.8 Focus On HRD & Capacity Building

HRD continued to receive priority during the period under review with a focus on institutionalization through identification of suitable agencies and their networking. Attempts were made to streamline the working of the International Training Network (ITN) with more active participation of other institutions in the country. A National level workshop was held involving the state governments to work out a strategy for development of human resources for the WATSAN sector. Workshop recommendations are under active Government consideration. A large number of UNICEF supported training programmes involving state governments and NGOs were simultaneously conducted. Core trainer groups have been formed in focus districts. Several teaching aids including tutorial films on low cost sanitary facilities and installation of handpumps have been developed and used. Inclusion of low-cost sanitation as a part of the basic training of different village level functionaries such as teachers, anganwadi workers, and group organisers as well as the academics of Industrial Training Institutes (ITI), engineering schools/polytechnics and engineering colleges may prove decisive.

From 1981 to 1985 State Government departments relied heavily on service engineers from equipment manufacturers. With training inputs continuing to upgrade the skills of **Government engineers, capacity building has been well demonstrated through increased self reliance on operation, maintenance and repairs of drill rigs and hydrofracturing units within Government departments.**

Training materials have been developed through an action research project to train neo-literate women on repair and maintenance of handpumps. Similar efforts were made for development of video films for the implementors' groups for community based maintenance projects on topics such as Handpump installation, maintenance, manufacture and quality control of Handpumps. A comprehensive manual on quality control was developed for use by inspection agencies, PHEDs, manufacturers and NGOs. Efforts are now on to prepare materials for the TARA Direct Action Handpump in different languages so that community level action and mobilization as well as technical training can be imparted to user groups.

2.9 Inter-sectoral Coordination

WATSAN cannot be treated in isolation from other social sectors. While its association with health is inherent, efforts are required to integrate WATSAN with Education, Nutrition, ICDS and DWCRA. In the CDD-WATSAN districts a mechanism has been created to achieve convergence in a systematic way. In Medinipur and Howrah districts of West Bengal there is a very strong linkage of Water Supply, Sanitation and ICDS. In Medinipur, Anganwadi workers have been trained to carry out water quality surveillance using water quality field kits developed locally.

In Banda district in UP the Mahila Samakhya, a voluntary group working on literacy/adult education are involved in training mechanics and are actively involved in using adult education structures for vocational training of women handpump mechanics. A similar experience exists in a few rural areas of Delhi. Promoting sanitation in schools is one prospective opportunity. In Mysore and Medinipur water and sanitation education has already formed a part of the Total Literacy Campaign. Periyar has adopted a School Sanitation Programme on an extensive scale with the involvement of students, parents and teachers. This is linked with promoting sanitation in the community which includes provision for sanitary facilities at household level. Anganwadi Workers will play a key role as motivator-cum-ORS stockists in the CDD-WATSAN districts and a crucial role in empowering mothers on the prevention and management of diarrhoea. These linkages will be more easily achieved at the district level where convergence can more easily take place under the guidance of the district administration.

A significant development has been the active collaboration of Ministry of Rural Development with Ministries of Information and Human Resource Development at the National level to promote the concept of sanitation. As a result, awareness campaigns are being conducted by Ministry of Information in selected districts to promote low cost options in sanitation and MHRD is seriously considering ways to involve Community Polytechnics throughout the country in the sanitation programme.

2.10 Sharing The SWACH Experience For Guineaworm Eradication

Major efforts to eradicate guineaworm continued country wide as well as in the SWACH projects located in the Banswara, Dungarpur and Udaipur districts of Rajasthan. Based on the successful experience of these projects, Plans of Action were developed for sixteen guineaworm affected districts of Madhya Pradesh and nine in Rajasthan. Simultaneously, further innovations in the planning and implementation of activities in the SWACH project areas were introduced. For example the case containment strategy under which guineaworm incidence is detected early for prevention of further transmission. During 1992, 86 % of patients were detected and treated by the SWACH project before the infective stage. The case reporting system was further strengthened by introducing a new "guineaworm scouts" scheme under which youths were trained

in the early detection and reporting of guineaworm, supported through SWACH mobile medical teams. As a part of the case containment strategy, SWACH supported the surgical extraction technique developed by its ayurvedic doctors - the traditional medical practitioners and guineaworm extractors - to reduce the period of suffering among patients. The experience was shared with Nigeria and Ghana where demonstrations were held by the SWACH project staff on how to undertake surgical extraction of the guineaworm. It is understood that the government of Ghana has now taken a decision to adopt this technique. Surgical extraction has been one of several interventions which contributed to a significant decline of guineaworm cases in the SWACH project areas.

3. LOOKING TOWARDS THE FUTURE

3.1 WATSAN Overview :

The first two years of the current Plan of Operations witnessed several innovations as well as the consolidation of technologies and successful strategies developed since the Fourth Five Year Plan (1969-1974). Universal access to safe drinking water and the eradication of guineaworm disease before 2000 are within reach. Universal access to sanitation however, will take many more years to achieve.

The Water Challenge : In 1991, 120 million rural people did not have access to safe drinking water. At a population growth rate of 2% (1991 census), 75 million more people will be added to India's rural population by the end of the Eighth Plan or 110 million by 2000. Consequently, the target group for safe water supply is 200 million by 1997 or 230 million by 2000. Based on the existing Government norm of one spot source per 250 population, the number of handpump/boreholes to be provided during the Eighth Plan is 800,000 for an investment of Rs. 24,000 million (\$762 million).

Furthermore, at an estimated handpump/borehole replacement rate of 10 % per annum, an additional 200,000 handpump/boreholes will be required each year, or 1 million during the remainder of the Eighth Plan for a total of 1.8 million. By 2000 approximately 2.3 million handpump/boreholes will be needed for an investment of \$ 2645 million.

India currently produces over 100,000 handpumps a year for the domestic market and exports 25,000. Present installed manufacturing capacity is 300,000 handpumps. The gap between demand and capacity therefore needs to be addressed. Considering these factors alone, a reduction of the population norm to 150 may be feasible only in selected areas.

The Sanitation Challenge : As regards providing sanitary facilities in terms of household latrines, the number of rural households, at present, is estimated at 113 million. As per the 1988-89 National Sample Survey, 12.4 million households possessed their own latrines. Since then, the number of sanitary latrines provided through various programmes is estimated at 0.7 million. Thus, by 1992, it was estimated that 13 million households in India had latrine facilities of various types leaving 100 million households in India without access.

The Eighth Plan envisages a total outlay of Rs. 6,740 million for the Rural Sanitation Programme. Of this, roughly Rs. 6000 million (\$ 200 million) is expected to be available for providing sanitary latrines for those below the poverty level, 80% subsidy (Rs. 2,000 per unit) has been envisaged for this purpose. Of the 100 million households without latrine facilities, 30% (30 million) fall within this category. At the present rate of subsidy, an outlay of Rs. 60,000 million will be required to achieve full coverage of the households below poverty level.

Thus, with the proposed outlay envisaged for the Eighth Five Year Plan, it will be possible to provide latrines to only 10% of these households. At the national level this may add another 3% to obtain an overall coverage of 14%. Although this does not take into account any addition through private initiative, insufficient financial resources will be a major constraint to increased sanitation coverage. It remains to be seen whether a subsidy of Rs. 2000 is really needed to provide a sanitary latrine to a household or whether this could be further reduced by offering a range of options to a household with a differential subsidy. The Medinipur experience, where even with full cost recovery a large number of households with low-incomes have opted for a single pit water-seal sanitary latrine indicates the potential with the cost of single pit latrine at Rs.250 using local materials for a temporary superstructure. There are also examples of NGOs motivating households below the poverty level adopting a dual-pit with subsidy of less than Rs. 500 by using locally available materials for the superstructure. The possibility of their replication has to be explored to facilitate increased coverage within the same level of investment.

For those above the poverty level, alternate delivery systems must be introduced on a wider scale. For this purpose, the required financial support must be provided. While excluding this group from subsidy, it is assumed that ownership of latrines by households with a low-economic profile would bring a certain amount of social pressure on those belonging to the wealthier strata of society. It is also expected that by confining the subsidy only to a certain segment of the population it will be possible to achieve a wider geographical coverage. This in turn may encourage a large segment of the relatively better-off groups into the sanitation fold. In order that these assumptions are realized, it is necessary to devise an appropriate strategy to promote private initiative for an increased sanitation coverage. Besides expanding the network of RSMs' the concept of revolving funds might be introduced through reliable NGOs. The Council for Advancement of Peoples' Action for Rural Technology (CAPART) might be persuaded to initiate this as a priority, rather than making its support purely subsidy-oriented.

3.2 WATSAN in the Eighth Five Year Plan (1992-1997)

The Eighth Five Year Plan has provided new direction and opportunity to the WATSAN Programme taking into account the New Delhi Declaration of the Global Consultation on WATSAN which was adopted by the UN General Assembly in December 1990. a) Protection of the environment and safeguarding health through an integrated management of water resources as well as liquid and solid wastes. b) Organizational reforms, promoting an integrated approach and including changes in procedures, attitudes and behavior and the full participation of women at all levels. c) Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water and sanitation programmes. d) Sound financial practices, achieved through better management of existing assets and extensive use of appropriate technologies.

The Plan perceives WATSAN as a key component of a "Total Programme" for rural development. The Constitution (Seventy-second Amendment Bill, 1991) included WATSAN in the 11th schedule thereby facilitating the involvement of the Panchayati Raj System and through it the community in the planning and implementation of the rural development programme in a more effective way. The recommendations of the National Seminar on Rural Sanitation, when ratified by the Government of India, will have a far reaching impact on the sanitation programme.

3.3 Future WATSAN Strategy

The major thrust in GOI-UNICEF cooperation from 1993 will be to :

1. Bridge the gap between the needs and resources. Cost effective methods such as rehabilitating defunct or poor yielding borewells offer good potential for sustaining the existing safe water sources. Converting traditional water sources such as open wells to sanitary wells, rain water harvesting and mini piped water schemes are possible alternative modes of safe water supply
2. Provide emphasis on sanitation promotion in order to achieve the sectoral impact on health status by reducing the present gap between the coverage levels of Rural Water Supply & Rural sanitation
3. Accelerate coverage in a sustainable manner to achieve the Summit Goals pertaining to safe drinking water and facilitate increased sanitation coverage with private initiative playing a major role. The priority for providing drinking water facilities will be given to the no source village, hamlets and partially covered villages, in that order.
4. Secure additional financial resources from the Government and non-government sectors as well as external support agencies for the remaining years of the current plan as well as for the next plan and evolve suitable criteria for the distribution of planned funds among water, sanitation, IEC and MIS. Create additional incentive for the State Governments to provide resources for the sanitation programme such as raising the present matching share between MNP and CRSP.
5. Undertake water quality monitoring and surveillance by establishing water testing laboratories at district level and introducing a system of water quality testing and surveillance at the community level by developing cost effective water quality test kits. Introduce the concept of water 'Security' at the household level through the introduction of simple, low cost filters.
6. Pay special attention to areas with high fluoride content in water as well as arsenic and iron and address the problem of bacteriological contamination of ground water through improved environmental sanitation around water sources, particularly the handpumps.
7. Identify areas showing depletion of ground water resources through a programme of monitoring and investigate alternate technologies and approaches to tackle this and other environmental issues.
8. Shift the management of handpumps and other drinking water sources to the community through the gram panchayats and other local bodies and create a local maintenance network system in the non-government sector.
9. Transfer responsibility pertaining to quality control of handpumps and spare parts from UNICEF to BIS and strengthen the latter to take up this responsibility in a phased manner. Transfer the responsibility of consignee end inspection to the state governments.
10. Explore the possibility of installing direct action (TARA) and suction handpumps in the alluvial and coastal tracts on a large scale and adopt India Mark III (VL0M) as a user friendly pump in hard rock areas in a phased manner.

11. Develop alternate delivery system and a responsive market mechanism for promoting rural sanitation. This will call for extending the concept of the Rural Sanitary Mart to areas with potentially high demand for sanitary facilities and other strategies such as creating revolving funds, linking the programme at household level with bank credit and involving large industrial houses to take up specific projects.
12. Develop alternate designs for sanitary facilities to suit different geohydrological situations and varying socio-economic population segments.
13. Strengthen the IEC support at central, state and district level and use the existing infrastructure of other agencies for providing messages on WATSAN. This will involve preparation of a general IEC strategy at the centre, a more focussed strategy at the state level and location specific interventions at the district level.
14. Extend the integrated Drinking Water & Sanitation programme to the 55 mini mission districts with the help of NGOs and village panchayats. The programme envisages social mobilization for resource mapping with regard to availability of water, its quality, related land use and assets, environmental problems related to water as also awareness creation about safe water and personal hygiene. Emphasis will be placed on mobilizing communities to adopt available low- cost options, such as sanitary marts, in an effort to bridge the gap between the demand created and service delivery with regard to sanitation facilities.
15. Link WATSAN with other programmes such as ICDS, DW CRA and, Education (including total literacy mission) and evolve a strong sanitation hygiene education programme for schools.
16. Institutionalize the process of training pertaining to the WATSAN sector. Explore the possibility of including low-cost WATSAN as a part of the basic training of the village level functionaries and also in the academics of the technical institutes such as ITI, Polytechnics and Engineering schools. Create a net work of training institutions at country, region, state and district level.
17. Examine the efforts already made in evolving an effective monitoring system and use the National Informatic Centre to create a data base for planning WATSAN programmes and monitoring programme implementation.
18. Create and strengthen the network of NGOs for social mobilization and implementation of the WATSAN programme involving the community. A closer rapport with CAPART will be required for this purpose.
19. Study the environmental aspects of WATSAN interventions and evolve appropriate strategies for sustainable development through the adoption of technologies that are protective of the environment.
20. Develop drought preparedness and response strategies for WATSAN, recognizing the vulnerable population living within a fragile environmental balance.

ANNEXURE I

UNICEF SUPPORT AT STATE AND DISTRICT LEVEL

National level

- Advocacy and support for development of policy guidelines on water, environmental sanitation, guineaworm eradication and communication/social mobilization, including the enhanced role of women.
- Development and protection of communication and social mobilization (CSM) materials and use of mass media for CSM activities.
- Strengthening of state level infrastructure and institutionalizing the training of personnel.
- Development and promotion of cost effective technologies on water and environmental sanitation with focus on difficult areas and technology transfer for guineaworm eradication.
- Support for the national drilling programme, monitoring of ground water fluctuations and management of ground water resources through area specific projects.
- R&D on India Mark II/III handpumps, direct action and suction type (shallow) handpumps and support for their standardization and quality control.
- Development of local production capacities and delivery systems.
- Expanded use of non-government organizations (NGOs) in the overall planning and implementation.
- Support for development and implementation of MIS for specific WATSAN interventions.

District Level

- Establishment/strengthening of district/block infrastructure and training of personnel including government functionaries, community motivators, anganwadi workers and women's groups.
- Development of communication and social mobilization capacity and building of area-specific communication resource net work through NGOs and other resource groups.
- Formation of Village Water & Sanitation committees and community mobilization through interpersonal and other communication channels.
- Development and production of local communication materials on water and sanitation activities.

- Support to geophysical investigations for source finding and installation of handpump to achieve a target of one source for 150 people.
- Developing and operationalising a viable community-based handpump maintenance system with user responsibility and contribution
- Improvement of traditional drinking water sources particularly open dug wells and support to gravity feed piped water systems and rainwater harvesting structures.
- Development and demonstration of appropriate cost-effective technologies for providing safe water in areas with high fluoride content, arsenic and iron.
- Support for promotion of sanitation as a total package with emphasis on behavioral change.
- Encouraging construction of environmental sanitation facilities on a cost sharing basis.
- Linkage between WATSAN and other social/health inputs, particularly CDD.
- Expanded use of non-governmental organizations in planning and implementation.
- Field trials of pilot projects on development of ecologically balanced approaches for water supply and sanitation for the improvement of health, hygiene and environment of the community mainly in the selected districts.

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TABLE - 1

**WATER AND SANITATION
CENTRE/STATE EXPENDITURE UNDER EIGHTH PLAN**

(Rupees in Millions)

YEAR	CENTRAL SECTOR			STATE SECTOR			TOTAL		
	WATER (ARVSP)**	SAN (CRSP)	TOTAL	WATER (MNP)	SAN (MNP)	TOTAL	WATER	SAN	TOTAL
7th Plan 1985-90	18989	166	19155	25715	492	26207	44704	658	45362
1990-91	3886	28	3914	5958	329	6287	9844	357	10201
1991-92	5045	34	5079	6900	134	7034	11945	168	12113
1992-93*	4590	376	4966	8048	515	8563	12638	890	13528
8th Plan 1992-97	51000	3800	54800	49545	2942	52487	100545	6742	107287

* Allocation

** Includes National Drinking Water Mission

TABLE - 2

WATER AND SANITATION

UNICEF EXPENDITURE FOR 1991 & 1992 AND PLANNED FOR 1993

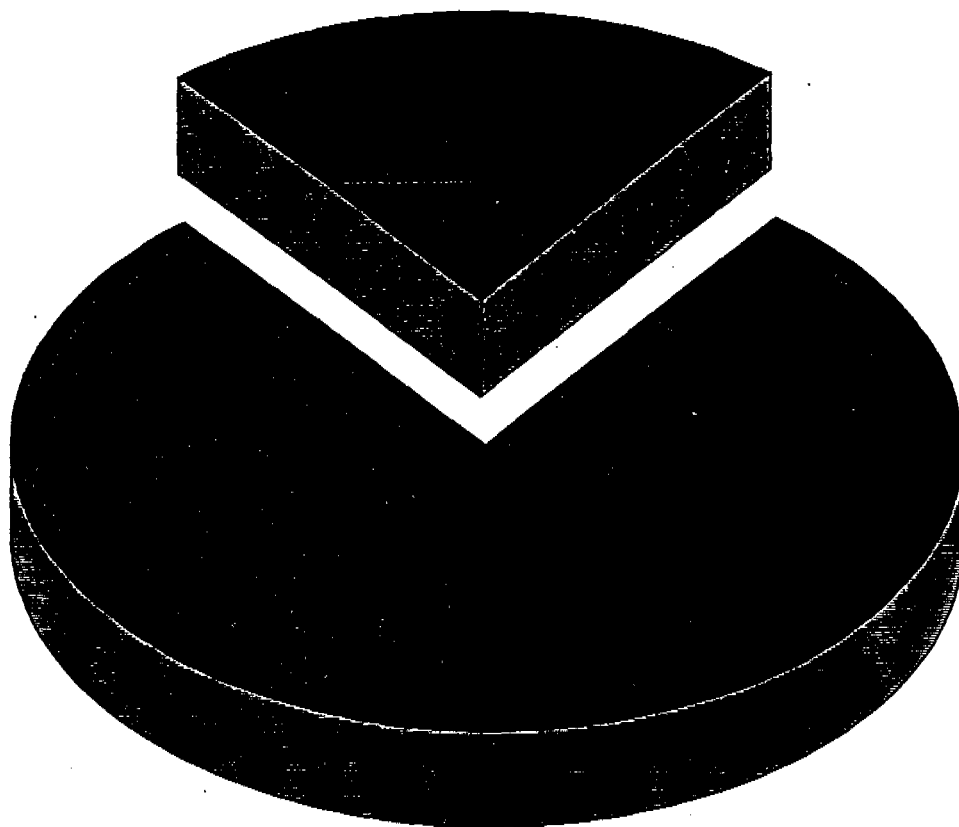
(in 000s of US\$)

FUNDS	1991 EXPENDITURE	1992 EXPENDITURE	1993 PLANNED
GENERAL RESOURCES	2,816.80	3,165.60	2,770.00
SUPPLEMENTARY	7,903.00	13,669.00	19,192.40
TOTAL OF GR & SF	10,719.80	16,834.60	21,962.40

ACCESS TO SAFE WATER FOR RURAL POPULATION IN INDIA IN 1992

BASED ON 1 HANDPUMP FOR
250 POPULATION

**21.5% POPULATION HAS
NO ACCESS TO SAFE WATER**

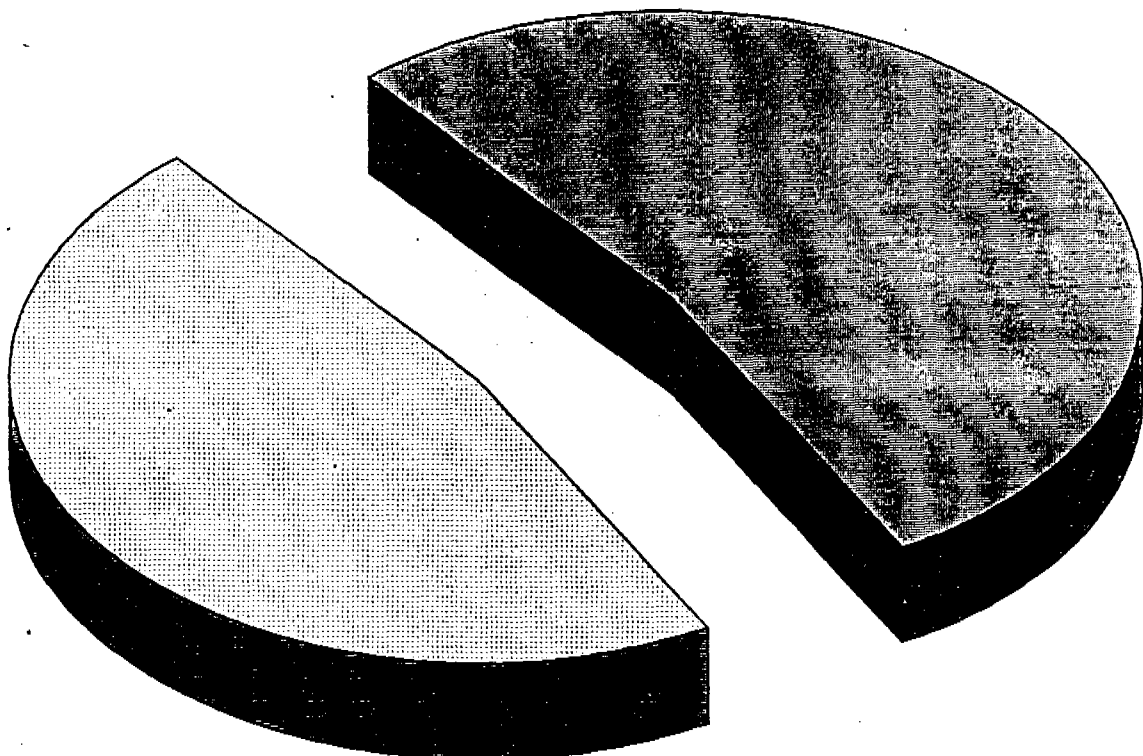


**78.5 % POPULATION HAS
ACCESS TO SAFE WATER**

ACCESS TO SAFE WATER FOR RURAL POPULATION IN INDIA IN 1992

BASED ON 1 HANDPUMP FOR
150 POPULATION

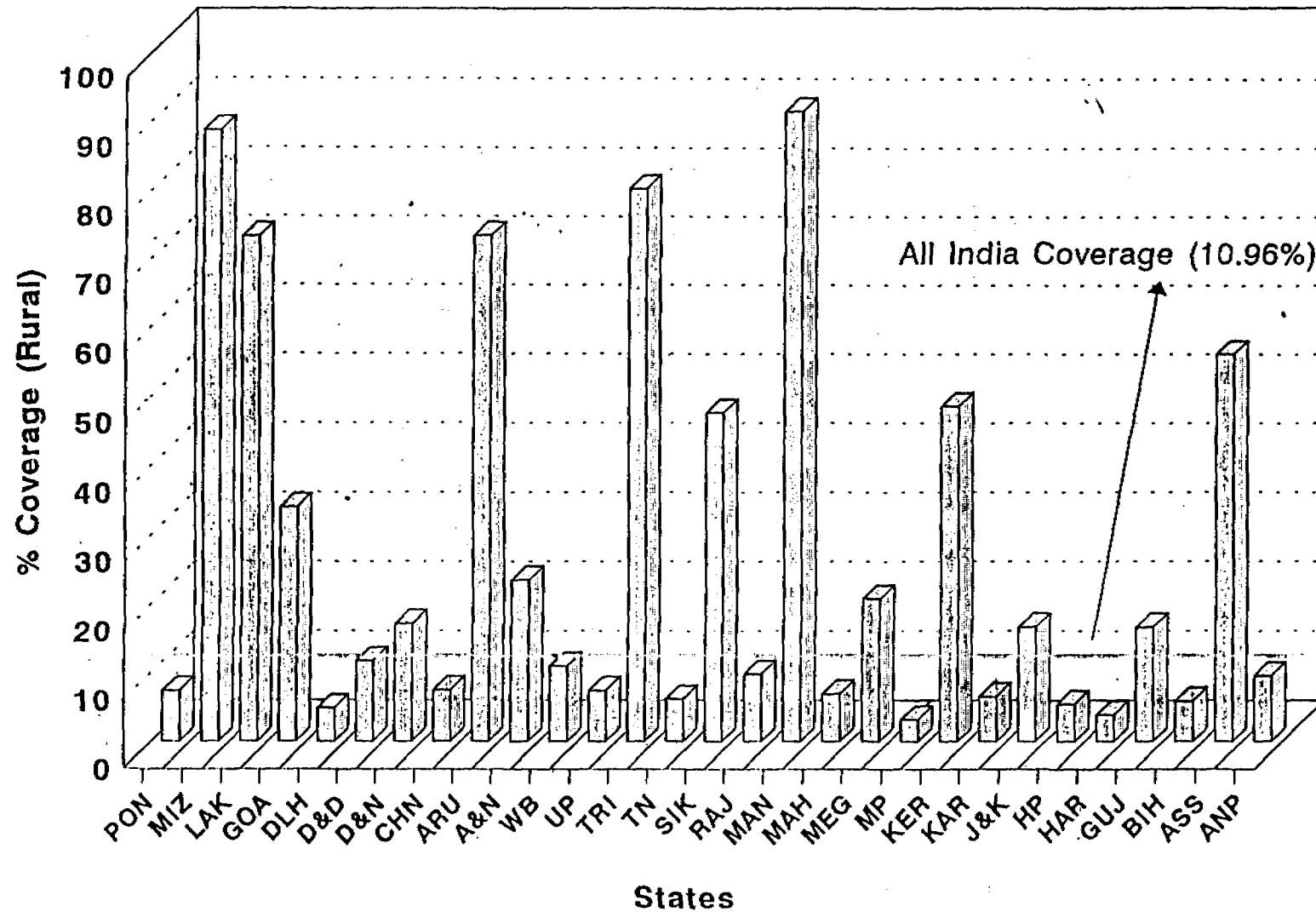
**53 % POPULATION WILL HAVE
ACCESS TO SAFE WATER**



**47 % POPULATION WILL NOT
HAVE ACCESS TO SAFE WATER**

Latrine Coverage (All India & States)

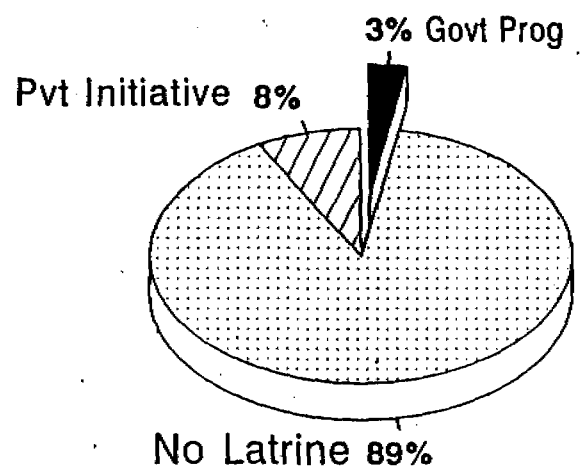
Fig 3



RURAL SANITATION

GLOBAL GOAL: Universal Access to Sanitary Means of Excreta Disposal by 2000.

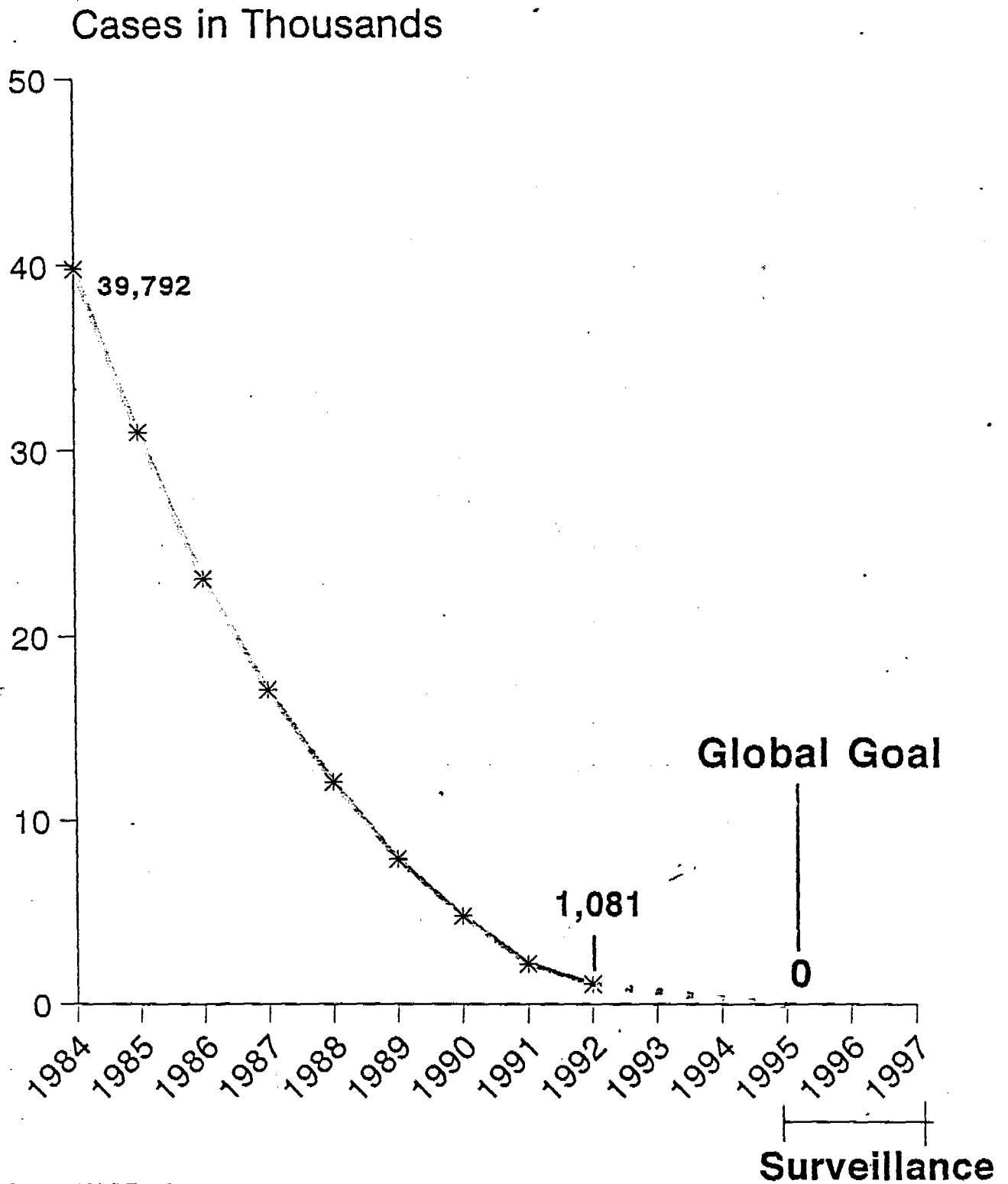
LATRINE COVERAGE (1990)



CHALLENGE AHEAD

100 MILLION FAMILIES
300 BILLION RUPEES
(10 BILLION US \$)

GUINEAWORM ERADICATION IN INDIA

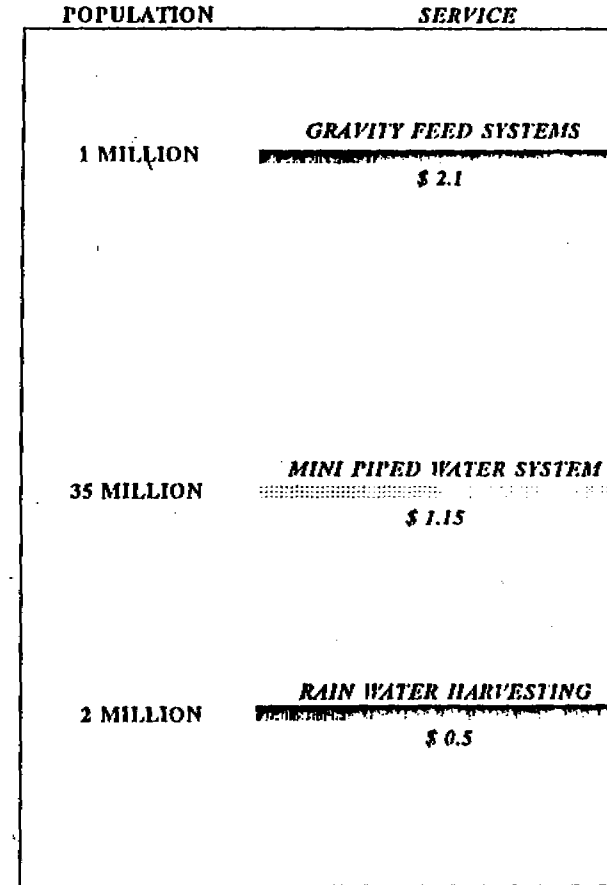
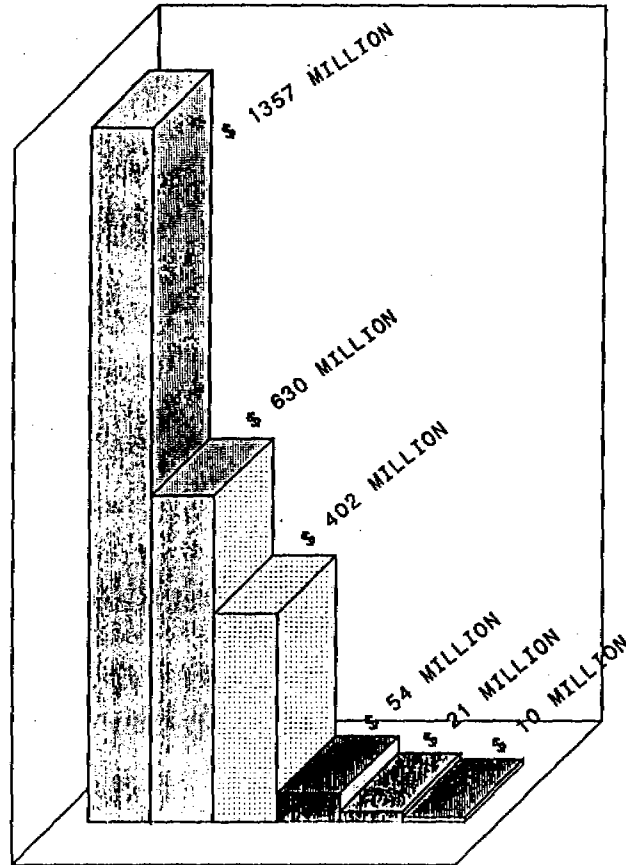
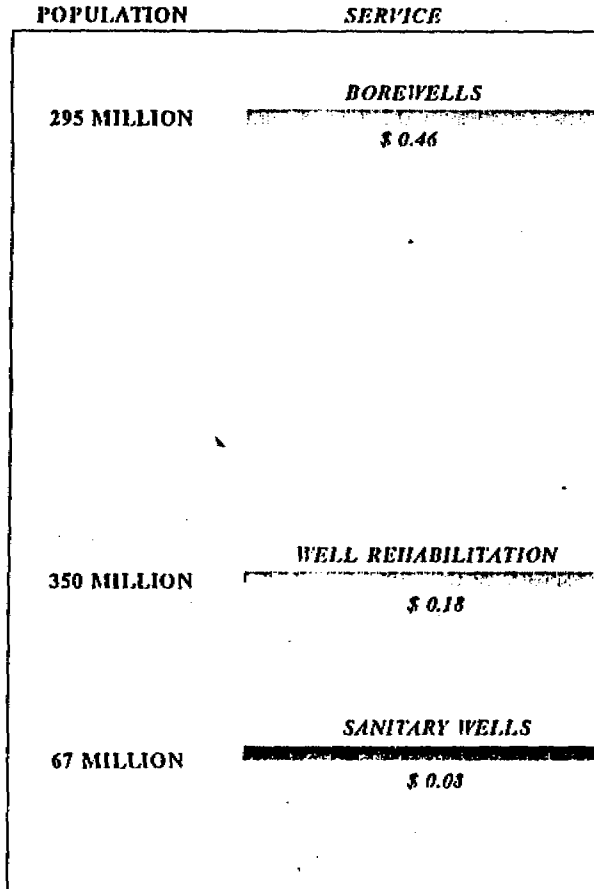


Based on NICD data.

SAFE WATER 2000 TECHNOLOGY CHOICE

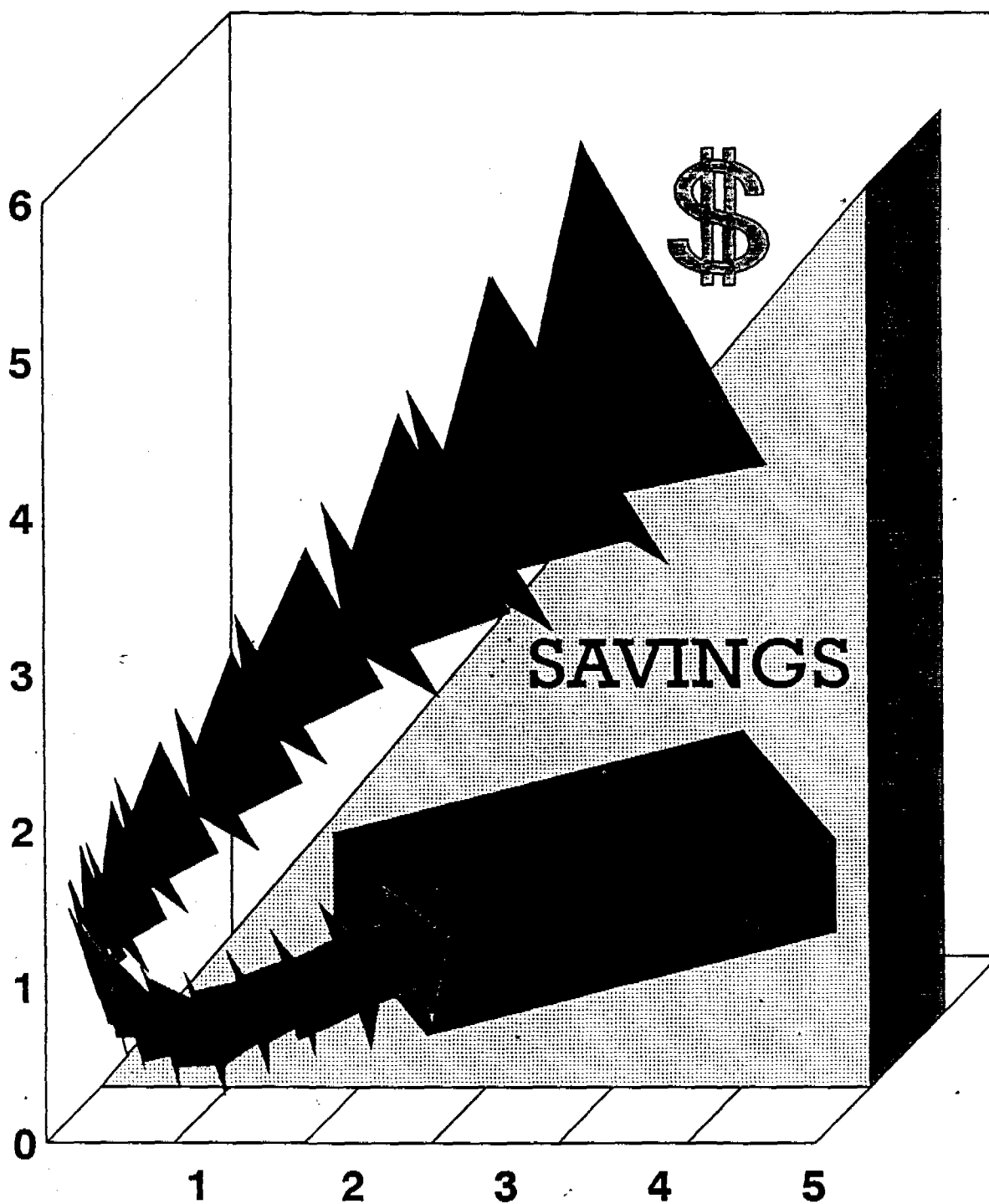
Fig 6

INVESTMENT REQUIRED FOR 750 MILLION
RURAL POPULATION BY 2000



Cost Saving Technology Geo-physical Investigation

Cost in million \$



% Increase in successful bores

Cost Saving Technology HYDROFRACTURING

