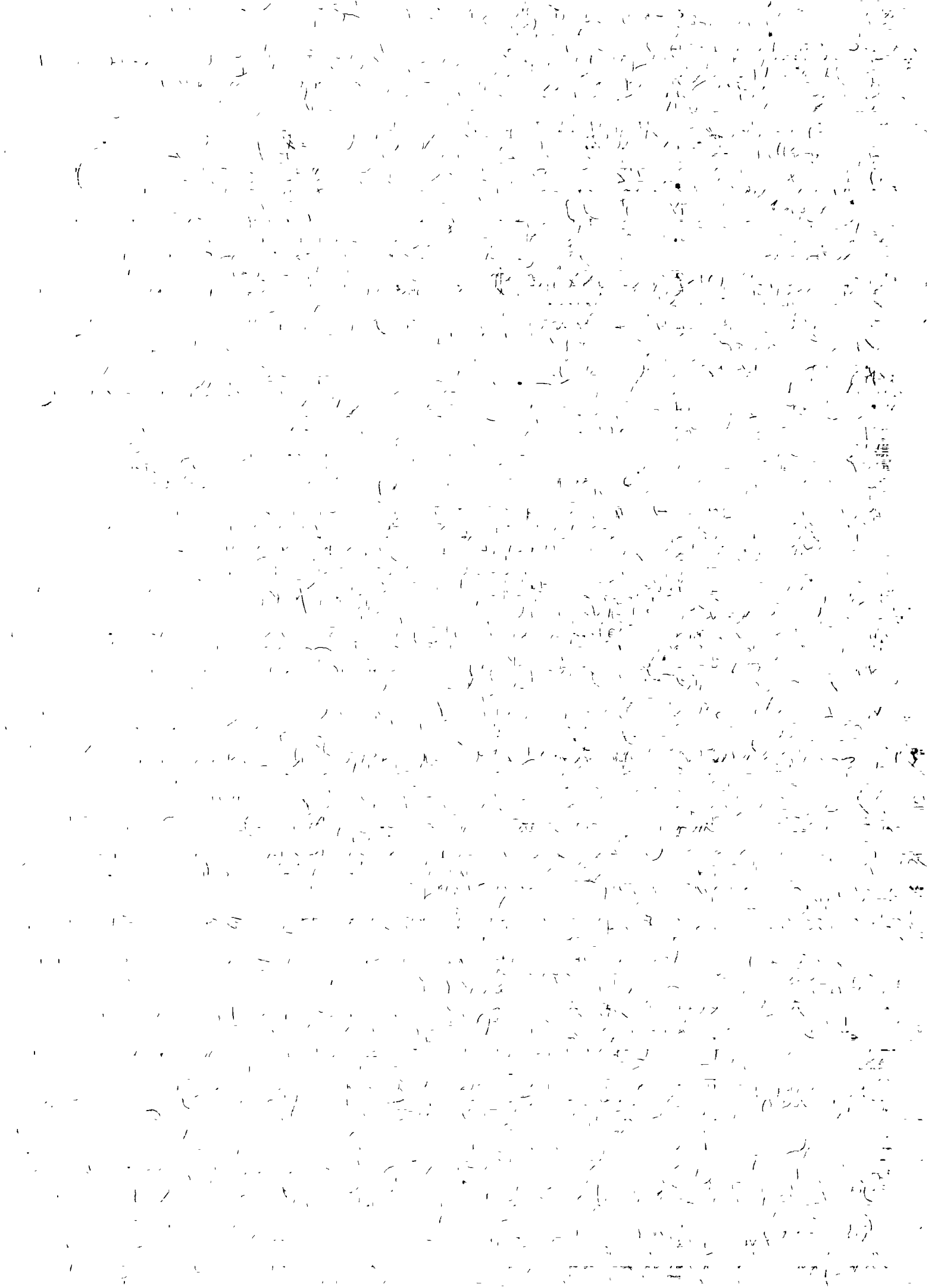
An approach to an operational model for decentralised O & M

A case of handpumps in rural Uttar Pradesh

November 1996



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Introduction

Operation and maintenance (O&M) of water supply systems in recent time have been receiving key attention of the policy planners, technocrats, researchers and development agencies both at the national and international level. The issue has gained prominence because of its social and cost implications which have important bearings on long run sustainability of the accrued benefits to the community. In the state of Uttar Pradesh, at a given point of time an estimated 30% of handpumps remain in various state of non-functioning. An approach to O&M of these handpumps thus becomes a matter of serious concern sans which sustainability of the existing water supply systems may not fructify.

A functional approach to O&M warrants restructuring and redefining the role and activities of the implementing agencies and the communities as well as alternative sources of resource mobilisation. As funds for maintenance are dried up, the state needs to tap alternative sources of fund and the communities need to assume increasing responsibilities in the O&M of water supply systems - both in terms of technical as well as financial management. As far as the O&M is concerned a gradual shift from agency-based to a community-based system is warranted for the sustainability of the water systems. This paper attempts to delineate one such model for O&M of handpumps which is currently being implemented under the Indo-Dutch rural water supply and sanitation programme in UP.

1. A case for decentralised O&M

1.1 Dimensions of assets

The water supply programme in Uttar Pradesh was initiated as far back as in the year 1967 in response to severe drought conditions in the rural areas of the State. During the last three decades it has attempted to address the qualitative and quantitative aspects of drinking water, largely in terms of technical interventions. In the process, over the years out of a total of 2,74,641 habitations 1,74,129 (63.40%) have been fully covered with safe water source and 74,851 have been partially covered resulting in the creation of an enormous physical asset in the form of approximately 5 lakhs handpumps and 6000 piped water supply schemes (the figures are for both the rural and urban areas). To this, on an average around 30,000 handpumps and several piped water supply schemes are added every year which by the turn of the century would lead to the creation of 6.5 lakh handpumps and an equally growing number of piped water supply schemes.

However, although rural water supply has been established as a priority area with considerable development funds being directed to the sector the results have not been commensurate with the efforts primarily because of two inter-related factors - ***firstly, the failure to establish a need for safe water and sanitation in the context of health and enhanced quality of life and to instill a sense of responsibility among the users and secondly the failure to establish a viable system of operation and maintenance.***

1.2 Social and financial implications on O&M

The poor status of O&M has been receiving considerable attention in the last few years and the causes have been universally identified as a combination of political, social, technical, institutional and economic factors. These factors include insufficient and inefficient use of funds, poor use and management of facilities, inappropriate system design and technology choice, inadequate policies, overlapping responsibilities, political interference, inadequate information system and data generation and the overall low profile and priority accorded to O&M. This in turn leads to costs increase and the benefits of improved water supply not being optimally realised. When the handpumps are not maintained or repaired regularly, it on one hand negates the health benefits of safe water, loss of man hour and decrease in productivity. On the other hand prolonged neglect of the handpumps lead to higher costs of rehabilitation and replacement and a consequent decrease in user satisfaction.

With the existing breakdown rates varying between 30-40% and present reboring and reinstallation rate being 5% the O&M of the existing handpumps will impose a heavy burden on state exchequer by the turn of the century. This is based on the following sets of assumptions supported by the trends experienced in the IDC project in UP and information obtained from UPJN :

- an addition of 30,000 new handpumps every year;
- a current annual expenditure of Rs. 300 per handpump for regular maintenance;
- a break down rate of 30-40% per year requiring a current expenditure of Rs. 1756.92 per handpump at the rate of Rs. 1200 per handpump at 1992 prices;
- an annual rate of 5% re-boring as well as reinstallation cases which would require an average expenditure of Rs. 14,500 at least and Rs. 17,000 at most per handpump; and
- a 10% annual rate of inflation.

With Rs. 17,000 per handpump reboring cost current trends indicate that total cost which includes O&M cost as well would vary between Rs. 148 and Rs. 164 crs. in the year 2000 (*The methodology of cost calculation has been described in* ***Annexure B*** **and C**) . If the average cost of reboring and reinstallation i.e. Rs. 14,500 per handpump is considered then total cost would vary between Rs. 137 and Rs. 153 crs. in the year 2000 *(See* ***Figure 1-4****, and* ***Table 1-4*** *in the*

Annexure A) This variation in total cost is attributable to variation in (a) breakdown rate and (b) per handpump reboring cost. It is thus obvious that total maintenance cost of handpumps can be reduced if breakdown rate is brought down from the present 30 to 40 per cent range and/or cases of reboring and reinstallation are slashed down. High percentage of both these cases in a way indicates an inefficient system of both implementation and maintenance which needs to be taken care of. An improvement in preventive maintenance may restrict the number of breakdown as experienced in the IDC project. Similarly, an improvement at the stage of installation with proper selection of site and water quality test may help to reduce the cases of reboring and reinstallation which has also been experienced in the IDC project. Both these improvements are actually effected by the active involvement of local community in handpump installation, maintenance and fund generation

The present O&M and breakdown cost suggest that annually Rs. 60 need to be mobilised from every rural household using the handpumps. This is based on the assumptions that (a) a handpump is installed for 250 heads in a rural area, and (b) average size of a rural household is 7. Given the existing number of handpumps this implies generation of Rs. 8.50 annually from each rural household on account of regular O&M expenditure. Another Rs. 51.42 need to be mobilised from each rural household for the annual breakdown expenditure. Hence, approximately Rs. 60 per annum requires to be tapped from the rural households for regular and breakdown maintenance of the installed handpumps. Presuming an annual 10% rate of inflation the requirement of fund generation from each rural household in the year 2000 would be Rs. 84. This in turn implies monthly mobilisation of Rs. 7 from each household for a handpump for its annual maintenance expenditure. The implication of this fund generation is far reaching as it calls for active involvement of community in fund generation and maintenance of handpumps. And, hence it ensures improvement in regular maintenance and helps to reduce the cases of breakdown.

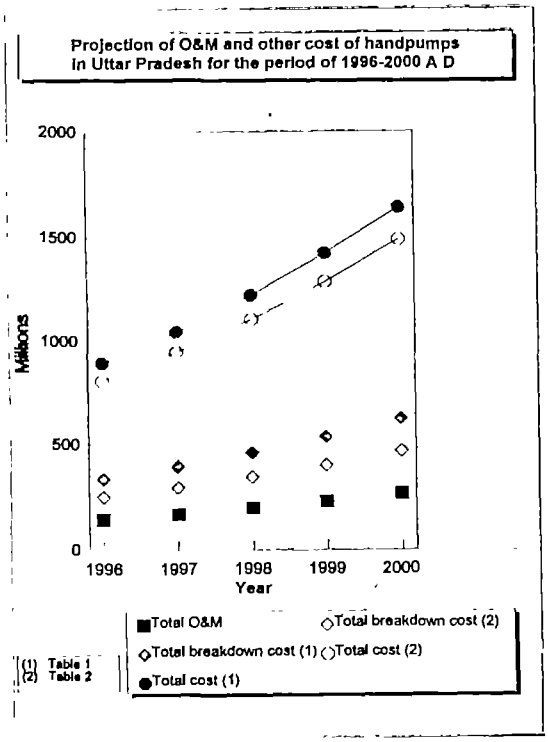


Figure 1

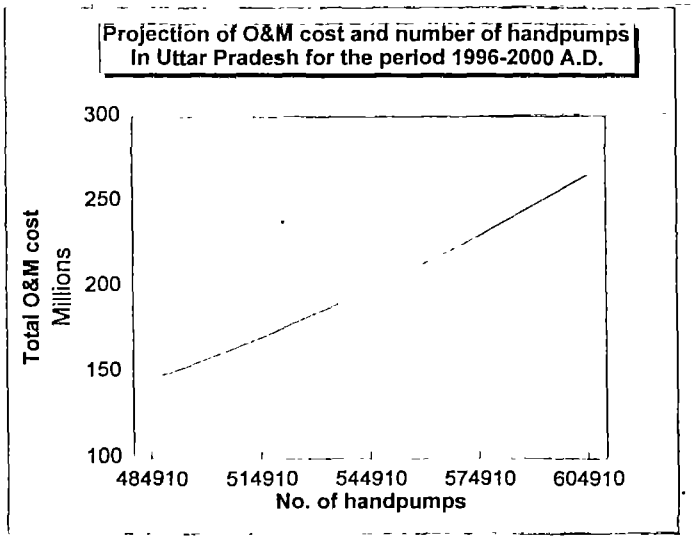


Figure 2

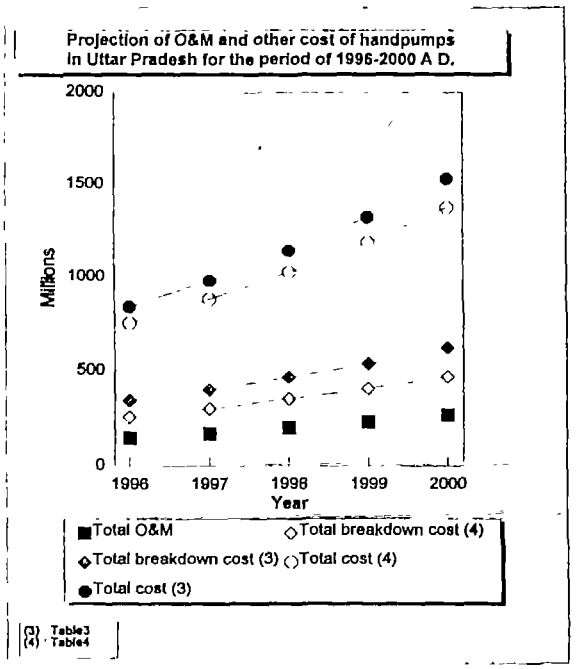


Figure 3

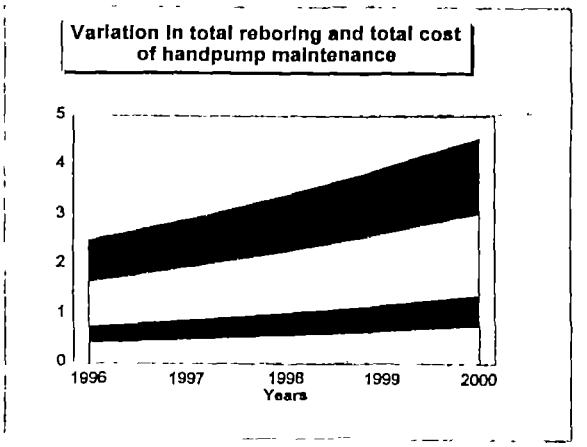


Figure 4

Note :

1 Shaded region represents variation in cost

2 Ref Table 1 and Table 3 in Annexure A

It is not surprising therefore, that the operations and maintenance of rural water supply, which is in the hands of a single centralised agency, the UP Jal Nigam, suffers from a persistent resource crunch and an insufficient institutional arrangement. The maintenance activities are normally carried out as an additional task by the construction division of UPJN (maintenance divisions exist in some districts) and therefore it fails to get the warranted attention. Further, as the existing norms for fund flow from government sources is not only inadequate but is also rarely met the gap between investment and maintenance has widened leading to a policy whereby only the essential maintenance is attended to and a breakdown approach rather than a preventive approach is adopted.

1.3 Policy trends

The Eighth Five Year Plan document of the Government of India in fact has noted that the O&M of water supply in most of the states is badly neglected with a huge backlog of maintenance building up at a time when resources was scarce. Therefore, it advocate that water should be treated as a commodity and local bodies, both in rural and urban areas, should be made responsible for the O&M with technical guidance from the government agencies. It further states that in order to reduce costs it is desirable that the programmes of drinking water supply and sanitation are implemented in a more decentralised manner with the involvement of the communities at all stages including O&M. It also suggests that the district planning machinery should facilitate the local bodies for creation and maintenance of assets. As most states face resource problems and therefore tend to neglect maintenance , an effective mechanism needs to be evolved through beneficiary participation. This policy has been further re-iterated at the recently held National workshop on Operation and Maintenance of Rural Water supply and Sanitation Systems (September, 1996, New Delhi)

This policy trend has been validated by the experience of the Indo-Dutch (IDC) water and sanitation programme in the State which has shown that even a minimum amount of mobilisation in the community leading to their donning the responsibility of effective preventive maintenance

reduces the breakdown rates. Then again wherever the community is required to pay for the repairs it has been observed the the handpumps are better handled, thus again reducing the breakdown rates.

1.4 Decentralised maintenance and the Indo-Dutch model

Under the IDC programme the PSU Foundation along with the UP Jal Nigam has over the last '8 years been involved in the planning and implementation of several rural water supply projects in the State covering approximately 50,000 villages spread across 15 districts, where the critical factor has been the co-ordinated integration of the technical and social components and in the process has evolved a community based model for operation and maintenance of handpumps.

The IDC model focuses on certain critical and timely interventions implemented in carefully planned stages. Broadly, these pertain to:

- a participatory process of awareness generation on safe water, hygiene, cost of services and the need for community participation;
- involvement of the community in the siting of water sources and the construction and upgradation of additional facilities like bathing platforms, etc.;
- establishment of water based institutions at the community level, bringing them within the legal and institutional scope of the *gram panchayats* and facilitating the latter to manage the task of O&M as well as interface with the government and technical agency;
- supporting the community based institutions to develop technical and financial resource base; and finally
- supporting the government network in operationalising the system of decentralised maintenance *vis-a-vis* interface with the community.

The issue of the participation of the community is central to the process - communities must become aware of the need for safe water and also appreciate their responsibility towards its maintenance in order to reap the full benefit of the facilities and effecting optimum utilisation. Devolution of maintenance responsibilities to community based institutions equipped with the ability to generate funds and undertake corrective interventions has proved to be a viable alternative under the IDC. The results have been substantial with over 44070 *Jal Samitis* having already been formed and a total of Rs.7.27 lakhs generated from around 3200 hand pumps as O&M funds under a project which was practically initiated towards the end of 1995. Similarly, under a pilot project initiated earlier in 6 selected blocks covering around 2000 handpumps a total of Rs. 2 lakhs has been generated out of which around 25% has been spent on minor and major repair works. The expenditure only pertains to the labour cost because at present the spares are being supplied free of cost by UP Jal Nigam, although the strategy is to gradually equip the community to purchase these from the funds generated. (the figures are as on September 1996). Further apart from financial resources, 88 cluster level mechanics have also been trained in the pilot blocks and provide immediate repair service.

The entire process has been evolved in partnership with the district administration and the *panchayats* at the block and village level with the necessary directives being issued at every stage. This together with the overall improvement in the upkeep of the handpumps effected through awareness generation and the responsibilities being discharged by the handpump caretakers has reduced the rate of breakdowns.

2. Operational strategy

2.1 Operational scope

Under the IDC programme the model is at various stages of successful implementation in the different Sub-projects. Although, it is presently confined to the IDC project villages, information

regarding the approach has percolated to several neighbouring non-IDC villages. Further, as the administration at the District and Block level is a close partner in the implementation process, in the 11 districts (Aligarh, Badaun, Moradabad, Kanpur (dehat), Unnao, Ballia, Basti, Baharaich, Gonda and Lakhimpur) under the water supply programme a large part of the planning and preparatory phase has been completed. These districts can hence be taken for total coverage in the first phase of implementation.

2.2 *Critical success factors*

The success of the model however, is largely dependent on the following factors:

- firstly, a political and administrative will to support the programme in terms of devolution of responsibilities to rural local bodies and a clear perception of the need for taxing communities for services rendered, without letting political consequences impair judgment;
- secondly, a planned strategy where every phase is gradually implemented with clear-cut objectives and activities. Close monitoring is a pre-requisite;
- and lastly, clearly defining the role and responsibilities of each of the implementing agencies with the NGO playing the critical facilitating role.

2.3 *Approach to the model*

The community- based operations and maintenance model adopts a capacity building and empowering approach wherein the focus is on (i) appropriate institutional arrangements, (ii) resource mobilisation and management, and (iii) capacity building within the community. It envisages a multi-pronged and phased strategy with participation of stakeholder and information sharing being the key elements.

2.3.1 *Institutional arrangement*

The model, which conceives a shift from a centralised agency- based system of operation and maintenance to a decentralised community- based one, calls for certain specific institutional arrangements Based on the observation that maintenance of a handpump is of utmost interest to its immediate users, micro level committees at the ward level can best assume and discharge the maintenance functions. Then again considering the magnitude of the handpumps installed so far in the State and in view of the yearly additions to the existing stock, institutionalisation of these committees within the framework of an established and tested governing structure - in this case the *Panchayati Raj* - is not only expedient but essential.

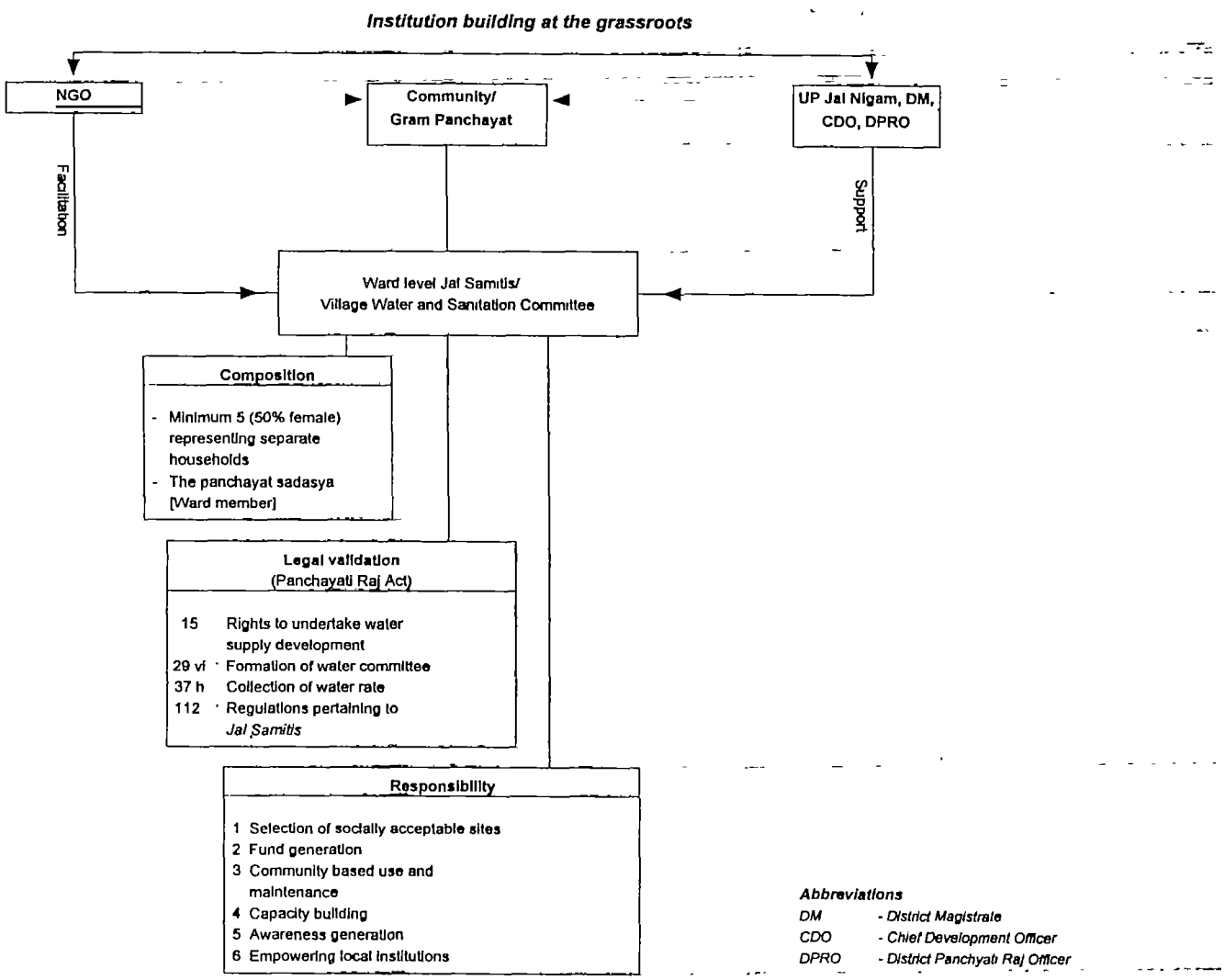
The *Panchayat Raj* Act (1947) provides for formation of sub-committees, their composition and functions, the modalities for organisation of meetings, the levy of taxes, the maintenance of funds, the auditing of accounts and the maintenance of hygiene and cleanliness around handpumps. The sections of the Act pertaining to the above are Section 112 (1) (A) and Rules 243,244 and 245 for formulation of by-laws, 15 for undertaking water supply development, section 29 (vi) for formation of sub-committees, Section 37(h) for levying of water charges and Section 40 for auditing of accounts. The micro level committees are so constituted and empowered that they are able to discharge their regulatory functions within these provisions of the Act.

The model therefore, adopts the following institutional arrangement:

- The functional responsibilities of O&M rests with **ward level *Jal Samitis*** (WJSs). The WJS consist of a minimum of 6 representatives from the households within the ward, including the ward representative of the *panchayat* with at least 50% of the members being women The major responsibilities of these *Samitis* are (i) selection of sites for new handpumps and monitoring the process of installation, (ii) monitoring the maintenance of existing drinking water sources within their respective wards, (iii) the overall sanitation

of the ward (iv) selection of a handpump caretaker for each of the handpump within its jurisdiction and monitoring the work of the cluster level mechanics (CLMs) and (v) finally, ensuring the timely collection of maintenance funds from each of the household and representing the interests of the ward at village level meetings where decisions are taken regarding the utilisation of the funds generated for water and sanitation related activities.

- At the village level village water and sanitation committees (VWSCs), consisting of representatives of the ward committees are formed with the *Gram Pradhan* and the *Gram Panchayat Adhikari* further lend institutional sanctity as the funds generated at the ward level are deposited at the village level in a separate account - *Khata 3* - jointly operated by the *Pradhan* (or his nominee) and the GPA. Major decisions on any water and sanitation related issues are arrived at through open meetings at the ward or village level as the case may be.
- On the executive side of the arrangement the process of establishment of this local government structure is supported by a District Co-ordination Committee (DCC) consisting of the DM, CDO, DPRO, Executive Engineer-UPJN, *Basic Shiksha Adhikari*, CMO and any other relevant departmental heads according to the specific requirements of each district as well as the local NGO representative (only for the duration of the process of transfer from an agency based to a community based system). The DCC is responsible for issuing the necessary directives and monitoring the process of implementation. Directives are issued through the channel of the DM, BDO, DPRO, the *Block Pramukh* and the *Gram Pradhan*.



- During the process of transfer UPJN plays the role of the technical support agency which provides training to the caretakers and handpump mechanics (together with the NGO), ensures the provision of spares and above all monitors the technical quality of the work of the mechanics. It will however, continue to provide technical advise to the local committees as and when required, even after the transfer has been effected. The model assumes that by the end of the transfer process adequate arrangements would have been made for the procurement of quality/standard spares from sources other than UPJN (Rural Sanitary Marts or the open market).

2.3.2 *Resource mobilisation*

Once the local communities assume the responsibility of the operation and maintenance of the handpumps and other water sources in the village they have to generate their own funds for the purpose. The amount to be collected and the periodicity of collection is jointly determined by the ward level committees of individual *Gram Panchayats*, based on their maintenance requirements, the information for which is regularly provided by the UPJN. The decision is ratified by the respective Block Development Committees.

Transparency and accountability is introduced into the whole system of fund generation and management through the establishment of certain procedures and norms. Thus, funds are collected from individual households by the WJS, the record of which is maintained at three levels - (i) on specially developed consumer cards kept with each household (in lieu of individual receipts), (ii) in registers maintained by each committee and finally (iii) when the committee deposits this amount in the village level account maintained by the *Gram Pradhan* and the GPA in the form of *Roop Patra 7*, a receipt issued to each WJS The *Pradhan* in turn, as stated earlier operates a separate account along with the with the *GPA - the Khata 3*. As only the funds generated as service charges for water and sanitation facilities are entered into this account transparency of transactions is maintained.

Similarly on the expenditure side, the remuneration for the CLMs is fixed by the DCC and the payments are made by the *Pradhan* after the repairs undertaken have been verified by the concerned WJS. Decisions regarding any other water and sanitation related expenditure are taken at ward and village level meetings.

Account of expenditure incurred as well as the nature of the expenditure on each handpump is maintained by the respective WJS as well as the Pradhan, thus minimising any opportunity for mismanagement of funds.

2.3.3 *Capacity building*

As the model is build around the community assuming the responsibility of maintenance of the drinking water sources, a critical input specially during the process of transition, is building capacities within the community. This not only includes equipping them with technical skills but, equally important, also with the skills of basic management Each district will have a training team equipped with the requisite skills and training modules and tools.

On the technical front the model adopts a two pronged strategy wherein in the first stage, hand pump based caretakers selected by the WJS, are trained to undertake preventive maintenance. The caretakers, primarily women, responsibilities include the checking and monitoring of the above ground status of handpumps and promptly reporting major defects to the concerned CLM. This, while making minimum preventive maintenance preventive maintenance resource available locally would take a substantial amount of burden off UPJN. In the second stage mechanics for each conveniently clustered villages are identified and trained for undertaking major repairs at the request of the WJS. The caretakers discharge their responsibilities on a voluntary basis whereas the CLMs are paid for their services from the contributions made by the community.

Apart from technical resources the community based institutions also need to acquire the skills of management in terms of convening and organising meetings, taking decisions, accounting for income and expenditure, monitoring the activities of the mechanics and co-ordinating with relevant government departments and agencies. Training are therefore designed for the WJS members and the Panchayats with the objective of imparting rudimentary skills of functional management.

Further, specially designed training will also be imparted to the concerned government functionaries for implementing the model

2.3.4 Awareness generation

Optimisation of O&M and hence the benefits of handpumps have also been severely effected because of the lack of awareness about the need for safe water sources amongst the rural communities. Therefore awareness generation is a recurring input from the start of the project and takes the form of constant participatory ways of information sharing and learning.

2. 4 Phased implementation of the model

The structure and process of implementation of the model demands a step by step 3-phased strategy with certain specified objectives and goals being reached at the end of each stage.

2.4.1 Phase I : Planning and Preparation

The first phase focuses on preparing the district for implementation of the model with the desired output at the end of the stage being the preparation of a district plan of action. The major activities during this phase are:

- the formation of District Co-ordination Committees,
- preparation of village inventories and notional maps of the villages which would provide a socio-economic data base as also the settlement pattern indicating the existing sources of drinking water,
- preparation of *panchayat* profiles, and
- organising district level workshop of concerned district and block officials and district and block *panchayat* members.

The District level workshop is the first organised forum on a large scale where the concept and modalities of the model is delineated and the draft plan of action prepared by the DCC ratified. During this phase wide-spread coverage of the programme is given through the local media and other appropriate sources.

The GPA will be responsible for the preparation of the village inventory as well as the *panchayat* profile while the JE - UPJN will be responsible for the preparation of the village maps. Both the GPA and the JE will be given the required orientation prior to undertaking the preparation of the data base.

Phase I will be implemented within a period of 6 to 8 months.

2.4.2 Phase II : Institution development

The objective of Phase II is to establish community based institutions at the ward and village level within the framework of the *Panchayati* Raj. The critical activities of the phase will include :

- block level workshops;
- open meetings of the gram *panchayats;*
- formation of ward and village level committees;

- and ward level meetings to propagate and familiarise the community with the arrangements. The meetings will be convened through the appropriate channels and records of decisions taken maintained and communicated to the community and the concerned agencies/ officials.

The institutional development activities will be supported by by the physical interventions, during which period the major activities will be the review and corrective interventions of existing handpumps and the installation of new handpumps wherever provided for. The mobilisation of funds from the communities will also be simultaneously effected with accounts being opened at the village level.

The community's participation at this stage will also take the form of promptly reporting defects to UPJN and selecting sites for installation of new handpumps. The community will also start making the first expenditure from its own funds in terms of extension of drains and construction of bathing platforms wherever necessary.

The BDOs, GPA, PRA and the *Pradhan*, as well as the JE of UPJN will be responsible for organising the meetings for which the requisite training and orientations will be provided. The JE -UPJN and the ward and village level committees will play a major role during this phase, which, depending on the volume of corrective interventions and installation activities would take between 2 to 2½.

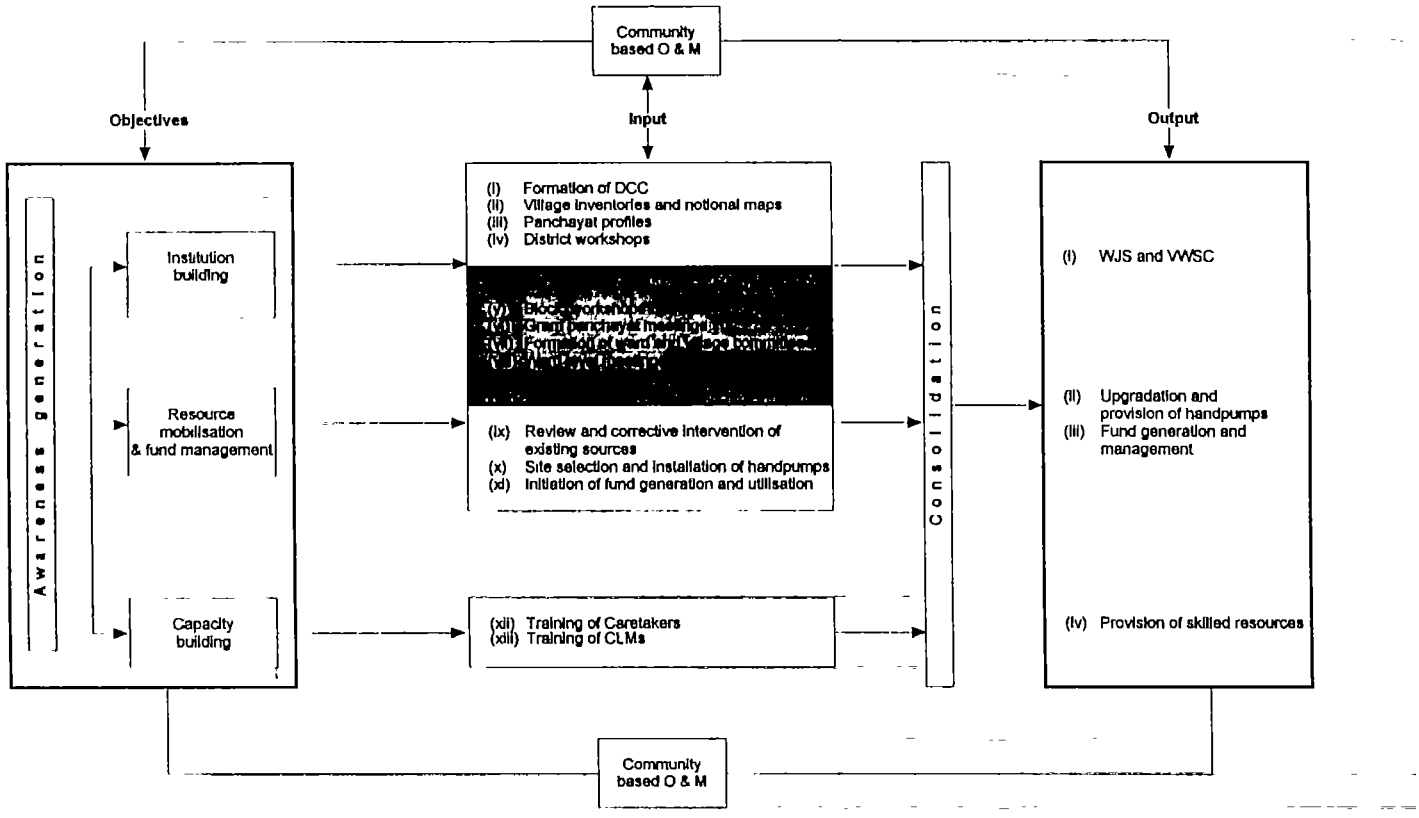
2.4.3 Phase III : Capacity and resource creation

Phase III itself will be implemented in two stages:

- in the first stage caretakers identified for each handpump will be trained to undertake preventive maintenance, and
- in the second stage mechanics for each cluster of villages(villages will be grouped in convenient clusters according to their physical proximity and accsesibility)y will undergo vigorous training for repairing major faults in handpumps. The trainings will be conducted by block level training teams consisting of both technical (JE-UPJN) and social experts (NGO) . The trainings ,which will commence soon after the corrective interventions and installations have been completed in each cluster of villages will be completed in each of the district within a period of 1 year.

2.4.4 Consolidation of the maintenance system

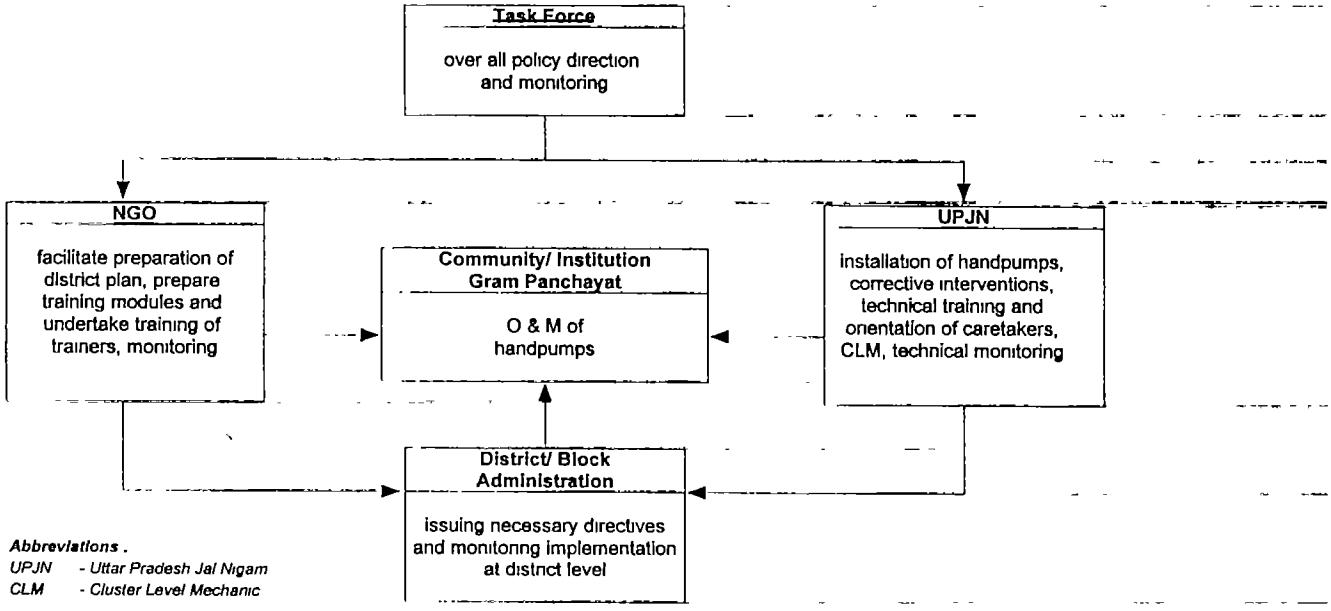
The 3 phases will be completed within a period of 3 years with one phase over-lapping into the other. However, consolidation of the system, may require intensive support from the implementing agencies and the government for another period of 1-2 years. During the consolidation phase close monitoring of the functioning of the system will be made with the UPJN providing the technical monitoring support as well identifying alternative sources for procurement of spares and material. At the end of the consolidation phase, once the system has been firmly established, it would be completely handed over to the *pancahayats* and the community based institutions. The DCC, the UPJN and the NGO will play a crucial role during this phase of consolidation. Awareness creation will be a continuous input through all the phases for which participatory methods of communication will be an important input.



Abbreviations :
WJS - Ward level Jal Samiti
VWSC - Village level Water and Sanitation Committee
DCC - District Co-ordination Committee
CLM - Cluster Level Mechanic

2.5 *Key implementing agencies*

The model envisages a radical shift in responsibilities and function and hence require the support of critical agencies whose roles and responsibilities during the period of transition and thereafter is clearly defined. The major agencies /departments involved in the operationalisation of the model are the *Panchayati Raj* Department and Department of Urban / Rural Development at the state level, the district and block administration, the block and *gram panchayats*, the UPJN and a nodal NGO. Each of the agencies/ departments will have the following responsibilities·



Abbreviations .
UPJN - Uttar Pradesh Jal Nigam
CLM - Cluster Level Mechanic

- at the State level a Steering Committee / Task Force consisting of the Secretary/ Special Secretary of DUD /DRD and PRD, Chief Engineer UPJN and a nodal NGO will be responsible for overall policy direction and monitoring of the programme;
- the district and block administrations through the offices of the DM and the BDO will be responsible for the overall implementation of the programme in the district ;
- the UPJN will be responsible for the technical aspects, namely undertaking the initial corrective interventions, installation of new handpumps, technical orientation and training to the community and the resource persons, technical monitoring of the O&M during the period of transition and the consolidation phase and support as and when asked for after the transfer has been effected, timely and regular supply of spares during the period of transition (including the consolidation phase) and support in identifying and establishing alternative sources of spares thereafter;
- the NGO will play a facilitating role in the overall process and will support the preparation of district plan of action, prepare training modules and undertake training of trainers, monitor the implementation and undertake concurrent evaluation during all the phases. The NGO will also be the Member -secretary of the DCC.

Table 1
Projection of O&M and other costs of handpumps in Uttar Pradesh
(1996-2000 A D)

Year	No. of handpumps	Expected no. of breakdowns	Expected no. of reboring etc.	Per handpump O&M cost (In Rs.)	Total O&M cost (in Rs.)	Per handpump reboring cost	Total reboring cost	Per handpump breakdown cost (In Rs.)	Total breakdown cost	Total cost (in Rs.)
1996	484910	193964	24245 5	300 00	145473000 00	17000.00	412173500 00	1756 92	340779230 88	898425730 88
1997	514910	205964	25745 5	330 00	169920300 00	18700 00	481440850 00	1932.61	398048497 97	1049409647 97
1998	544910	217964	27245 5	363.00	197802330 00	20570 00	560439935 00	2125 87	463363826.16	1221606091 16
1999	574910	229964	28745 5	399.30	229561563 00	22627 00	650424428.50	2338 46	537761735.02	1417747726.52
2000	604910	241964	30245 5	439 23	265694619 30	24889 70	752801421 35	2572.31	622405587 39	1640901628 04

Note

(a) Expected number of breakdowns each year has been taken to be 40% of the existing handpumps.

(b) Presuming inflation rate to be10% per annum per handpump O&M cost has been derived with per handpump O&M cost in 1996 taken as the base

(c) Per handpump breakdown cost has been calculated by considering that in 1992 as Rs. 1200 and a lso presuming annual inflation rate of 10%

(d) Presuming that every year number of handpumps is incressed by 30000 and hence every year rehabilitation cost is applicable to these additional 30000 handpumps with 1996 as the base

(e) Both expected number of rebornngs and reinstallation have taken to be 5% of existing handpumps each year

(f) Total cost is equal to total O&M cost plus reboring cost plus breakdown cost.

Table 2
Projection of O&M and other costs of handpumps in Uttar Pradesh
(1996-2000 A.D)

Year	No. of handpumps	Expected no of breakdowns	Expected no. of reboring etc.	Per handpump O&M cost (In Rs.)	Total O&M cost (in Rs.)	Per handpump reboring cost	Total reboring cost	Per handpump breakdown cost (In Rs.)	Total breakdown cost	Total cost (in Rs.)
1996	484910	145473	24245 5	300 00	145473000 00	17000 00	412173500.00	1756 92	255584423 16	813230923 16
1997	514910	154473	25745 5	330.00	169920300 00	18700 00	481440850 00	1932 61	298536373 48	949897523 48
1998	544910	163473	27245 5	363.00	197802330 00	20570 00	560439935.00	2125 87	347522869.62	1105765134 62
1999	574910	172473	28745 5	399 30	229561563 00	22627 00	650424428.50	2338 46	403321301.27	1283307292.77
2000	604910	181473	30245 5	439 23	265694619 30	24889 70	752801421.35	2572.31	466804190 54	1485300231 19

Note

(a) Expected number of breakdowns each year has been taken to be 30% of the existing handpumps.

(b) Presuming inflation rate to be10% per annum per handpump O&M cost has been derived with per handpump O&M cost in 1996 taken as the base

(c) Per handpump breakdown cost has been calculated by considering that in 1992 as Rs. 1200 and a lso presuming annual inflation rate of 10%

(d) Presuming that every year number of handpumps is incressed by 30000 and hence every year rehabilitation cost is applicable to these additional 30000 handpumps with 1996 as the base

(e) Both expected number of rebornngs and reinstallation have taken to be 5% of existing handpumps each year

(f) Total cost is equal to total O&M cost plus reboring cost plus breakdown cost.

Annexure A

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Table 3
Projection of O&M and other costs of handpumps in Uttar Pradesh
(1996-2000 A.D.)

Year	No. of handpumps	Expected no. of breakdowns	Expected no. of reboring etc.	Per handpump O&M cost (In Rs.)	Total O&M cost (In Rs.)	Per handpump reboring cost	Total reboring cost	Per handpump breakdown cost (In Rs.)	Total breakdown cost	Total cost (In Rs.)
1996	484910	193964	24245.5	300.00	145473000.00	14500.00	351559750.00	1756 92	340779230.88	837811980.88
1997	514910	205964	25745 5	330.00	169920300 00	15950 00	410640725.00	1932.61	398048497.97	978609522 97
1998	544910	217964	27245 5	363.00	197802330 00	17545.00	478022297.50	2125.87	463363826.16	1139188453 66
1999	574910	229964	28745.5	399.30	229561563 00	19299 50	554773777.25	2338.46	537761735.02	1322097075.27
2000	604910	241964	30245 5	439.23	265694619.30	21229 45	642095329.98	2572.31	622405587.39	1530195536.66

Note

(a) Expected number of breakdowns each year has been taken to be 40% of the existing handpumps.

(b) Presuming inflation rate to be10% per annum per handpump O&M cost has been derived with per handpump O&M cost in 1996 taken as the base.

(c) Per handpump breakdown cost has been calculated by considering that in 1992 as Rs. 1200 and a lso presuming annuel inflation rate of 10%

(d) Presuming that every year number of handpumps is increased by 30000 and hence every year rehabilitation cost is applicable to these addtional 30000 handpumps with 1996 as the base

(e) Both expected number of rebonngs and reinstallation have taken to be 5% of existing handpumps each year

(f) Total cost is equal to total O&M cost plus reboring cost plus breakdown cost.

Table 4
Projection of O&M and other costs of handpumps in Uttar Pradesh
(1996-2000 A.D.)

Year	No. of handpumps	Expected no. of breakdowns	Expected no. of reboring etc.	Per handpump O&M cost (in Rs.)	Total O&M cost (In Rs.)	Per handpump reboring cost	Total reboring cost	Per handpump breakdown cost (in Rs.)	Total breakdown cost	Total cost (in Rs.)
1996	484910	145473	24245.5	300 00	145473000.00	14500.00	351559750 00	1756 92	255584423 16	752617173 16
1997	514910	154473	25745.5	330.00	169920300.00	15950.00	410640725.00	1932 61	298536373.48	879097398.48
1998	544910	163473	27245 5	363.00	197802330.00	17545.00	478022297.50	2125 87	347522869.62	1023347497.12
1999	574910	172473	28745.5	399.30	229561563.00	19299 50	554773777.25	2338.46	403321301.27	1187656641.52
2000	604910	181473	30245.5	439.23	265694619.30	21229.45	642095329.98	2572.31	466804190.54	1374594139.82

Note

(a) Expected number of breakdowns each year has been taken to be 30% of the existing handpumps.

(b) Presuming inflation rate to be10% per annum per handpump O&M cost has been derived with per handpump O&M cost in 1996 taken as the base

(c) Per handpump breakdown cost has been calculated by considering that in 1992 as Rs 1200 and a lso presuming annual inflation rate of 10%

(d) Presuming that every year number of handpumps is increased by 30000 and hence every year rehabilitation cost is applicable to these additional 30000 handpumps with 1996 as the base

(e) Both expected number of reborings and reinstallation have taken to be 5% of existing handpumps each year

(f) Total cost is equal to total O&M cost plus reboring cost plus breakdown cost.

Annexure A contd...

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Annexure B

Calculation of handpump maintenance cost

An attempt has been made here to project the O&M and other costs of the handpumps for the period 1996-2000 A D. in Uttar Pradesh The other costs include breakdown and reboring cost Breakdown refers to minor replacements of parts of an installed handpump including repairs of its platform etc. Presuming that every year 30,000 new handpumps are installed in the entire state *(Source: UPJN)*, projection of number of handpumps can be made for the period 1996-2000 taking 1996 as base ***(Ref: Table 1 and 2 In Annexure A)*** Assuming the average O&M cost in 1996 to be Rs. 400 approximately *(Source: UPJN)* and an annual 10% rate of inflation, per handpump O&M cost has been projected. Total O&M cost every year is derived by multiplying existing number of handpumps every year by the per handpump O&M cost. Expected number of breakdown varies from 30-40% of existing number of handpumps annually *(Source: UPJN)*. Expected number of breakdowns every year is 5% of existing handpumps every year *(Source : UPJN)* In 1992 per handpump breakdown cost incurred by UPJN (*Source· Appraisal Report(Rejoinder) SP VIII : UPJN - Dec 1992)* was Rs. 1200 Presuming 10% annual rate of inflation per handpump annual breakdown cost has been derived for the period 1996-2000 taking 1992 as the base. Multiplying existing number of handpumps by the per handpump annual breakdown cost, total breakdown cost has been calculated. Expected number of reboring cases every year is 5% of the existing number of handpumps *(Source: UPJN)*. In 1996 average reboring cost is Rs 17000 (Source: UPJN) Presuming 10% annual rate of inflation total reboring cost is projected for the period 1996-2000. Total annual cost is obtained by adding O&M with total breakdown and reboring cost.

The figure 1 and 2 give projection of O&M breakdown and reboring cost for the period 1996-2000. As our projection indicates Rs. 35.4 crores will be required on account of O&M in 2000. Considering 30% rate of expected breakdown, Rs 46.6 crores (*approximately*) will be required for breakdown maintenance and if the expected rate of breakdown is 40% then Rs. 62.2 crores will be needed. For reboring Rs. 75 crores need to be spent in 2000. With 30% breakdown rate total cost would then be Rs. 157 crores and with 40% breakdown rate it will be Rs. 173 crores. Figure 3 similarly indicates total O&M, breakdown and total cost given the average reboring cost of Rs. 14,500 per handpump. Figure 4 indicates the variation in total reboring and total maintenance cost. The shaded region indicates this variation. However, the cost can be reduced if breakdown and/or reboring rates are brought down

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Annexure C

Methodology of handpump maintenance cost calculation

Total cost of handpump maintenance at a time as described in Annexure B is calculated using the following formula :

$$TC_t(x) = P_1 f_{O\&M}(x) + P_2 f_{BD}(x) + P_3 f_{RB}(x)$$

where	$TC_t(x)$	=	Total maintenance cost
	P_1	=	Per handpump O&M cost = $(1+i)^t P_{0(O\&M)}$
	P_2	=	Per handpump breakdown cost = $(1+i)^t P_{0(BD)}$
	P_3	=	Per handpump reboring cost = $(1+i)^t P_{0(RB)}$
	$f_{O\&M}(x)$	=	Existing number of handpumps for O&M
	$f_{BD}(x)$	=	Existing number of breakdown
	$f_{RB}(x)$	=	Existing number of reboring
	x	=	Existing number of handpumps
	t	=	0, 1,2,3, ... and denotes time (In our case it denotes a year).
	i	=	annual rate of inflation
	$P_{0(O\&M)}$	=	Per handpump O&M cost in the initial period which is 1996 here.
	$P_{0(BD)}$	=	Per handpump breakdown cost in the initial period which is 1996 here.
	$P_{0(RB)}$	=	Per handpump reboring cost in the initial period which is 1996 here.
Now,	$f_{O\&M}(x)$	=	$x + (\delta x)^t$ where δx refers to increase in number of handpumps at a time and t = 0,1,2,3,....
	$f_{BD}(x)$	=	αx where α is the breakdown rate
	$f_{RB}(x)$	=	βx where β is the reboring rate

It can noted from the above formula that given x and δx total maintenance cost of handpumps will depend upon P_1, P_2, P_3, α and β. Moreover, prices are influenced by external factors. Hence, breakdown and reboring rate plays the most important role in explaining the total maintenance cost at given point of time. But given x, δx, α and β total maintenance cost is determined by the per handpump O&M, breakdown and reboring cost. Any change in any one of these per handpump cost will positively affect the total cost.

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