Report
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Review of Effectiveness of Rural Water Supply Schemes in India

The World Bank
June 2008

Sustainable Development Unit
South Asia Region

This Report has been prepared by Smita Misra (Sr. Economist, SASDU, World Bank), the Task Manager of this study.

The study was carried out under the overall guidance of Sonia Hammam, Sector Manager, Water and Urban, SASSD, World Bank. Data analysis has been undertaken by Professor B.N. Goldar and his research team at the Institute of Economic Growth, Delhi and the consumer survey was carried out by the ORG Centre for Social Research (a division of A.C. Nielsen ORG MARG Pvt Ltd). Comments and inputs at various stages of preparation from the following World Bank persons are gratefully acknowledged: Michael Carter, Rachid Benmessaoud, Clive G. Harris, Alain R. Locussol, Francis Ato Brown, Alexander E. Bakalian, Oscar E. Alvarado, G.V. Abhyankar, R.R. Mohan, S. Satish, N.V.V. Raghava, and Catherine J. Revels (WSP-SA). Special thanks are due to the Department of Economic Affairs, Ministry of Finance, the Department of Drinking Water Supply, Ministry of Rural Development, and the Rajiv Gandhi National Drinking Water Mission for their interest and collaboration in the study. Comments and data inputs during the preparation of the Report are gratefully acknowledged from R.P. Singh and M. Nagaraju (DEA), Bharat Lal and R.K. Sinha (RGNDWM) and their team, and the respective State Government officials.

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Foreword

The Government of India spends about a billion dollars each year for providing drinking water to its rural areas. As on April 1, 2007, the official figures of the Department of Drinking Water Supply show about 74 percent habitations are fully covered and 15 percent are partially covered. While there has been a steady increase in coverage over the years, many fully covered habitations have been continuously slipping into 'partially covered' or 'not covered' status. The Government is committed to ensuring that village communities have access to safe and reliable water supply. Policy-makers and consumers are equally anxious to know whether the outlays of public finances are achieving the outputs that these are meant for. As an attempt to understand how effective the expenditure on its rural water supply program is, the Government of India requested the World Bank to review the service delivery aspects of rural water schemes in various Indian states.

Has the public spending resulted in improved services on the ground? What are the inefficiencies in the existing system of service provision? Is there a scope for improvement? Can the improvements be made without increasing Government spending or imposing too high a cost on the consumers? What can be done to improve the sustainability of schemes? This *Review of Effectiveness of Rural Water Supply Schemes in India* seeks to answer these questions through a survey that covers about 40,000 rural households across 10 states in India.

The study, covering more than 600 rural drinking water supply schemes, is a large-scale empirical analysis of the traditional target-driven (supply-driven) programs of the Government and the more recent model of decentralized community-driven approaches. It looks at various aspects of rural water supply, including flow of funds and expenditure incurred, performance of schemes, cost of supply, household coping strategies and costs, as well as household willingness to pay and affordability. The study focuses on the cost and performance of service delivery and does not seek to analyze either the health impacts, or the sustainability of sources for rural water supply. Both aspects are crucial elements of success in the delivery of rural water, but would require separate detailed studies. On the supply side, according to data and information from the field, there appears to be ample scope for reducing costs under the traditional supply-driven programs. The study shows that the large public entities in some cases incur excessive institutional costs like salaries and overheads; at times incur unnecessary high capital expenditures; and, most significantly perhaps, spend less than half what they should be spending on operating and maintaining their running (piped water) schemes. As a result, only a fraction of the public finances is actually available for improving rural water supply services. The data also shows that, in contrast, the cost-recovery performance of schemes managed by village communities is distinctly better than the public entity-managed schemes. The institutional costs are also low in the decentralized community-driven (demand-driven) programs. Hence, a relatively larger fraction of the money spent through demand-driven programs can be utilized for creating infrastructure for rural water supply services.

On the consumer side, the study shows that contrary to popular belief, rural households already spend a considerable part of their limited incomes on acquiring clean drinking water, often having to tap a range of different schemes running in their villages, in addition to private provisions like investing in borewells, storage tanks, and so on. The average spending on water by a rural household is Rs 81 per month, and the Willingness to Pay survey shows that they are quite open to spending up to Rs 60 a month on just operating and maintaining a water scheme, provided they are assured a regular and dependable supply. At the same time, the study points out that the mere adoption of the 'decentralization' agenda cannot by itself improve the functionality and sustainability of schemes. Rather, there is need to develop mechanisms for enhancing 'accountability' in service delivery, including distinct roles and responsibilities of institutions at the state, district, and the Gram Panchayat level. This study should help in opening up the debate on institutional, economic, and policy reforms in the sector, and not be seen as the last word.

Isabel M. Guerrero
Country Director
World Bank in India

List of Abbreviations

APL	Above Poverty Line
ARWSP	Accelerated Rural Water Supply Program
BPL	Below Poverty Line
CBO	Community Based Organization
CV	Contingent Valuation
EAP	Externally Aided Project
FC	Fully Covered
GDP	Gross Domestic Product
GoI	Government of India
GP	Gram Panchayat
HP	Handpump
IEC	Information Education Communication
IM	India Mark
LPCD/lpcd	Liters per capita per day
MNP	Minimum Needs Program
MVS	Multi Village Scheme
MWS	Mini Water Scheme
NABARD	National Bank for Agricultural and Rural Development
NC	Not Covered
NGO	Non-Government Organization
O&M	Operation and Maintenance
PC	Partially Covered
PHED	Public Health Engineering Department
PMGY	Prime Minister's Gramodaya Yojana
PMU	Project Management Unit
PRI	Panchayati Raj Institution
RWS	Rural Water Supply
RWSS	Rural Water Supply and Sanitation
SDP	State Domestic Product
SO	Support Organization
SRP	Sector Reform Project
SVS	Single Village Scheme
USEPA	United States Environmental Protection Agency
VWSC	Village Water and Sanitation Committee
WSS	Water Supply and Sanitation
WTP	Willingness to Pay
Abbreviations used for States	
AP	Andhra Pradesh
KAR	Karnataka
KER	Kerala
MAH	Maharashtra
ORSS	Orissa
PUN	Punjab
TN	Tamil Nadu
UP	Uttar Pradesh
UTTK	Uttarakhand
WB	West Bengal

Exchange rate: US$1 = Rs 44 (2005-06)

Summary

Substantial expenditure has been incurred by the Government of India (GoI) on rural water supply during the last decade. But, very little is known on how effective this expenditure has been in providing safe water to rural people. Also, there is hardly any analysis of the cost of water supply schemes, cost recovery and subsidies, and the impact of technology choice and institutional arrangements on the cost of service. This study is a 'reality check' on the existing design of schemes, with the main intention of providing directions and alerting the policy-maker with respect to the functionality and sustainability of schemes. This study, the first of its kind, has been carried out at the request of the GoI.

A 10-state analysis has been carried out, the states accounting for about 60 percent of India's rural population. Using a large body of data on various aspects of rural water supply in 10 states (Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal), the effectiveness of schemes is analyzed across technology (handpumps, mini water schemes, single village schemes, multi village, and regional schemes) and institutional arrangements: schemes managed by state utilities (engineering departments, boards, and so on), district government functionaries (Zilla Parishad), village local government (Gram Panchayat), and communities. Decentralization and reform receive a particular attention in the study. A comparative assessment of performance is made of schemes under the 'demand responsive' reform programs and those under the traditional 'supply' (target)-driven mode.

A combination of primary and secondary data is used for the analysis. Primary survey data relates to 2005 and 2006; secondary data covers the period 1997-98 to 2005-06. Representative schemes and consumers associated with the schemes are covered. Schemes vary in terms of water source, technology type, and size. Primary data for schemes and households has been collected through field surveys using structured questionnaires. The sampling design for capturing representative schemes along with beneficiary households has been carefully worked out with the respective state rural water departments. Secondary data on fund flow has been collected from various state-level agencies.

Findings

Rural water supply schemes are commonly weak in performance. The survey data bring out serious inadequacies of the water supply schemes. The quantity of water supply and hours of supply commonly fall short of design, especially in summer. Sizeable sections of households face problems caused by frequent breakdowns, non-availability of daily supply, and insufficient water supply compared to the requirement. Due to the inadequacies of water supply schemes, the rural households typically depend on multiple water sources, including their private sources. Further, a water quality

study showed that the quality of water supplied fails to meet standards in a sizeable proportion of cases.

Rural households are bearing huge coping costs. The most important component of coping cost is the opportunity cost of time they have to spend on water collection. Other components include the expenditure incurred by them on the repair of public water sources and for the maintenance of household equipment for private water supply arrangements. The overall average coping cost per household is Rs 81 per month (US$1.8), ranging from Rs 32 (US$0.7) to Rs 287 (US$6.5) per month across different categories of schemes in the 10 states.

Supply-driven programs incur large institutional costs, substantially raising the cost of service provision. The average level of institutional cost in supply-driven programs (24 percent) far exceeds that in demand-driven programs (11percent). Wide inter-state variation in institutional cost of supply-driven programs (15 to 50 percent of the expenditure) further confirms that significant reduction in institutional cost is possible. However, despite the relatively low institutional cost and other known advantages of demand-driven programs, including better O&M cost recovery, the share of demand-driven programs in the overall flow of funds for rural water supply remains small (about 10 percent).

Capital cost of piped water supply schemes is excessive. Capital cost exceeds the norm by 50 percent or more in about 18 percent cases. There are indications that the overall cost of rural water supply infrastructure in the country can appreciably be reduced by increasingly shifting to a demand-driven mode. The cost of infrastructure of piped water supply schemes implemented by the community is far less than the cost of schemes implemented by public utilities or government agencies.

O&M expenditure is inadequate, causing schemes to perform below design and shortening their useful life. On an average, the actual O&M expenditure of piped water schemes is about half of the good practice 'design performance O&M cost' (that is, O&M expenditure needed to run the scheme regularly, supply water at the design lpcd level, and undertake proper maintenance). The implication is inadequate maintenance with an adverse effect on the functional status of the schemes. The deep tubewell handpumps are no better in this regard.

Significant wastage of resources arise from over-provisioning by some schemes, defunct schemes, and the existence of multiple schemes. The number of households sharing a handpump or a standpost is commonly much lower than the government stipulated norm of 50 households per handpump/standpost. In Uttar Pradesh, for instance, more than half of the handpumps are shared by 10 households or less. Many schemes get defunct before they complete their useful life (10 to 28 percent of spot sources are defunct in 5 of the states studied). About 30 percent households are using multiple schemes to meet their water requirements.

O&M cost recovery is low. Overall, the O&M cost recovery in piped water schemes is about 46 percent (in handpump schemes cost recovery is almost nil), but, in comparison with the good practice O&M cost, the revenue collected is only about 27 percent. The cost recovery performance of community-managed schemes (71 percent on average) is distinctly better than the public utility-managed schemes (21 percent). The Gram Panchayat (GP)-managed schemes have higher cost recovery than government/public utility-managed schemes, but less than that of community-managed schemes. Owing to the low recovery of cost, there is a huge subsidy to rural water supply, constituting about 0.2 percent to 0.4 percent of the SDP of the states studied. On an average the subsidy is 160 percent of state rural water supply funds.

Effectiveness of schemes is 'low to moderate'. To study effectiveness, 17 important indicators have been developed for piped water supply schemes and 4 indices of effectiveness have been constructed, representing:
(a) adequacy and reliability, (b) affordability, (c) environmental sustainability, and (d) financial sustainability. The average values of indices for the schemes studied indicate that the level of effectiveness of the schemes is generally low, or at best moderate. The worst performance is found in respect of financial sustainability. In

regard to the effectiveness of piped water supply schemes, no great differences are found between technologies or between institutional arrangements for management of schemes. However, community-managed schemes are found to be doing somewhat better than public utility-managed schemes.

Total cost of piped water schemes is much higher than efficient cost of service delivery. The total cost of piped water schemes per KL of water consumed (which measures overall efficiency in resource use, based on the capital and O&M cost of the main scheme, the cost of supplementary schemes, and the coping costs borne by households) is high with an average of about Rs 26 (US$0.6) per KL (it is Rs 37 per KL including institutional cost and indirect power subsidy), compared to an economic cost of Rs 16 (US$0.3) per KL for a good performing scheme. The schemes under demand-driven programs have a distinctly lower cost per KL of water supply as compared to schemes under supply-driven programs, signifying their superior overall efficiency. This inefficiency of water supply schemes and concomitant resource wastage cause a loss of investible resources and hence a loss of output in other sectors of the economy. If the water supply schemes were operated efficiently and the resources saved were invested, it would have raised the state domestic product of the 10 states studied by about 1 percent.

And only a part of the expenditure trickles down to the beneficiaries. The leakages in the form of high institutional costs, resource wastage due to over-provisioning in some schemes, partially or fully defunct schemes, and high O&M subsidies result in a fraction of the expenditure reaching the beneficiaries. The leakages are relatively greater for supply-driven programs than for demand-driven programs. In consequence, while Rs 75 trickles down to the beneficiaries out of an expenditure of Rs 100 on rural water supply under demand-driven programs, only about Rs 50 reaches the beneficiaries under supply-driven programs.

Economies of scale are yet to be realized. Econometric analysis indicates that the schemes can be made more cost-effective by reaping economies of scale and avoiding diseconomies that set in beyond a stage. A study of cost variation with scheme size in terms of the number of households covered shows that for groundwater-based supply, the size classes 500 to 1,000 households and 1,000 to 1,500 households have relatively lower costs, compared to smaller or larger piped water supply schemes. Since a sizeable portion (one-third) of the existing groundwater-based schemes are in size below 200 households, economies of scale are not realized. On the other hand, there are a number of surface water schemes serving more than 7,000 households, with significant diseconomies in scale.

Multi village schemes use more resources without commensurate service benefits. Multi village schemes (including regional schemes) cost much more than single village schemes. The cost of infrastructure and related institutional cost for designing, implementing, and maintaining multi village schemes is much higher as compared to single village schemes. These high costs are not counter-balanced by a better service delivery. Rather, in terms of the reliability and adequacy of services provided, the multi village and regional schemes are not performing as well as the single village schemes.

There is strong demand and willingness to pay. Assessment of rural household willingness to pay (WTP) for improved services based on the Contingent Valuation (CV) method reveals a strong demand for service improvement. The households using private connections are on average willing to pay about Rs 60 (US$1.4) per month for the O&M cost of improved services, and those using standposts of piped water schemes, about Rs 20 (US$0.5) per month. Among households currently using handpump schemes, the average willingness to pay for better maintenance of the existing public handpumps is about Rs 6 per month, and that for a new handpump is about Rs 8 per month. The estimates of average willingness to pay can cover most of the O&M cost for service improvements. If the households were charged according to their willingness to pay, cost recovery would be much better than at present, and the additional resource made available could enhance coverage by about 14 percent.

And service improvements are affordable. Analysis of affordability brings out that affordable payment for a private connection is Rs 50 to Rs 60 per month or higher for a majority of states. As regards standposts, the affordable payment level is generally about Rs 20 to Rs 25 per month. Affordable capital cost contribution is about Rs 900 to Rs 1,000. Thus, the costs of improved water supply in rural areas are commonly within affordable limits.

Policy Directions for Improving Reliability, Sustainability, and Affordability of Services

Based on a set of indicators aimed at measuring reliability, affordability, and financial and environmental sustainability, the analysis in this Report shows that the effectiveness of rural water supply schemes is mostly moderate to low, thus alerting the need for policy direction to improve service delivery. The key policy recommendations, taking into consideration the most efficient way to improve effectiveness of schemes, are given below. These will differ from state to state, based on the requirements of each state.

Enhance Accountability

Un-bundle and clarify responsibilities. The adoption of the 'decentralization' agenda cannot by itself improve the functionality and sustainability of schemes. Rather, there is need to develop mechanisms for enhancing 'accountability' in service delivery. The roles and responsibilities of institutions at the state, district, and GP level need to be better defined with regard to policy formulation, financing, and regulation (that should remain the state's responsibility), and ownership and development of assets and operation of service (that should be devolved to local levels). Shifting the role of the states and of their engineering agencies to that of a facilitator in charge of providing technical support for planning, construction, and operation of schemes would help reduce the currently high institutional costs encouraged by the absence of competition and contractual obligations. At the same time, the 'trade-off' between high institutional costs of supply-driven schemes versus the capacity building and NGO/Support Organization cost for decentralized service delivery needs to be carefully considered.

Improve Scheme Planning, Design, and Monitoring

Adopt 'flexible norms' for service delivery. The 'fully' covered, 'partially' covered, 'not' covered classification tends to encourage inadequate O&M as 'slippages' from 'fully' to 'partially' covered status often lead to the construction of a new system to replace the poorly maintained existing system. The existing GOI norms (40 lpcd within a 1.6 km distance and 100 m elevation) could still be used to measure achievement towards the 'fully covered', but often do not correspond to what rural households desire and are willing to pay for. The study shows a clear preference for domestic connections and willingness to pay for piped water. Hence the rural communities should be offered a higher level of service, subject to availability of water and willingness to contribute through user charges that recover O&M and partial capital costs.

Reconcile bottom-up demand with top-down 'district level' planning. It is important to reconcile the demand for schemes (bottom-up) with top-down planning to improve the sustainability of 'source' and to ensure that 'least cost option' is implemented. A district level planning exercise should be carried out to identify areas where multi village schemes would be more cost-efficient and sustainable, based on watershed and aquifer information. Surface water-based multi village schemes would be justified mostly in areas marked by over-exploited aquifers or by serious groundwater quality problems with no alternate safe and sustainable source available locally.

Consider economies of scale for design of schemes. The study shows significant scale economies in rural water supply, with the implication that small schemes serving 200 or less households would not be able to reap such economies. It would be more economic to have scheme sizes of 500 to 1,000 households or 1,000 to 1,500 households rather than schemes of a much smaller size, unless the local conditions are such that only a small scheme is viable. Many groundwater-based schemes are very small in size, serving less than 200 households. These are not able to reap the economies of scale. Some multi village schemes are often very big and thus suffer from scale diseconomies. Their performance is also relatively poor (as brought out by the study) in respect of several important parameters. There is a strong case for breaking up MVS and regional schemes into smaller schemes at the village level and handing over the responsibility to the village community/GP with contractual agreements and performance improvement targets between user groups and the bulk water providers. Further, the 'trade-off' between a large scheme size for reaping economies of scale and the associated institutional cost need to be carefully considered for improving the cost-effectiveness of schemes.

Implement performance monitoring systems. Performance improvement targets should be clearly defined and monitoring and evaluation indicators need to provide a comprehensive coverage of inputs, processes, outputs and outcomes, with independent assessments and public disclosure.

Improve Financing Procedures

Clarify cost sharing principles. The O&M cost needs to be properly assessed and fully recovered through user charges, except for high cost schemes. A transparent criteria needs to be developed to determine 'affordable' contributions, including criteria for socially disadvantaged groups. State-wise, uniform cost sharing principles need to be worked out, irrespective of types of programs or sources of financing.

Carry out independent appraisal of multi village schemes. An important issue is the need for independent appraisal and approval of MVS proposals. The technical and economic criteria need to be clearly defined to ensure that the 'least cost' option is implemented. Guidelines, processes, and procedures need to be prepared for the appraisal and approval of MVS. Multi village schemes, relying on surface water, would mostly be taken up in 'over-exploited' aquifers, or in 'quality affected' areas.

Provide special incentives for scaling-up reforms and improving performance of schemes: Incentives can be provided through GoI central funds, by linking these with matching or increasing state funds that are utilized for implementing a 'Swajaldhara'-type reform program. Special incentives could be provided to states that commit upfront to adopting sector-wide reforms.

Improve Operations and Maintenance

Transfer O&M responsibilities. State governments should hand over existing SVS to PRIs and/or user committees, after requisite rejuvenation and repair works to meet the requirements of beneficiaries. It is important that assets belong to the GPs and the cost of O&M is fully borne by the beneficiaries.

Decentralize MVS for improving service delivery. When MVS is justified, the bulk water supply and water distribution could be unbundled. Bulk supply could be managed by a professional public or private operator, who could enter into enforceable contracts with GPs and/or user committees that are responsible for distribution at the local level. Such contracts should specify the quantity and quality of water to be supplied and payment for water supplied.

Establish contractual relationships with performance improvement targets to improve service performance. The PRIs and user committees could contract the planning, designing, construction, and maintenance functions to agencies of their choice. These could include the state engineering agencies or private engineering consultants and operators.

Improve Environmental Sustainability

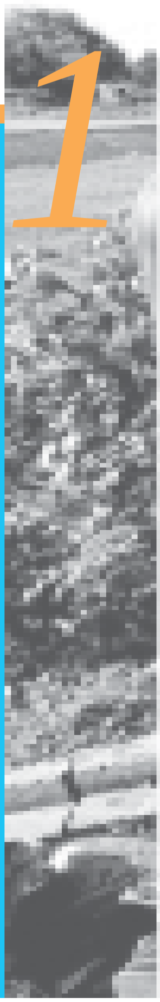
Implement groundwater management activities. Groundwater recharge initiatives may not be sufficient to increase the supply of drinking water. Groundwater management activities, including groundwater assessments for improved agricultural practices, need to be encouraged by local governments, especially in overexploited aquifers.

Implement Sector-wide Policy Reforms

Sector-wide reforms not only improve services but conserve resources as well. Finally, it needs to be pointed out that the policy directions indicated above would not impose an additional cost for improving service delivery across the sector. Rather, the improved effectiveness of schemes will enable the central and state governments to achieve more (in terms of consumer satisfaction) with lesser resources.

An analysis of fiscal implications of 'Business as Usual' versus 'Alternate Decentralized Service Delivery Models' carried out for Uttarakhand, as an illustration, reveals that in a period of about 15 years, a sector-wide policy reform will save resources worth more than Rs 1 billion per year.

CHAPTER 1



The sector background, including trends in expenditure, policies, and programs, is presented here, followed by the objective and design of this study

Introduction

The sector background, including trends in expenditure, policies, and programs, is presented here, followed by the objective and design of this study.

1.1 Background

In India, although the provision of rural water supply (RWS) is primarily the responsibility of the state government, the central Ministry (Government of India) contributes a significant part of the program funds for this sector. While the 73rd Amendment to the Constitution directs service provision to be decentralized to local governments, most of the work of designing, implementing, and operating water supply schemes continues to be executed by the state engineering agencies and state water boards. As cost recovery is limited, the state governments provide substantial operating subsidies, in addition to large development grants to rural water schemes. Monitoring and evaluation mechanisms, which are in place for rural water supply, primarily capture the progress in the construction and disbursement of funds at the state and the central level, and do not assess the functioning and performance of schemes in terms of the quality of services provided.

The Population Census data indicate that in 2001, about 78 percent of the rural population had access to a safe source of drinking water, up from 56 percent in 1991.[1] The Rajiv Gandhi National Drinking Water Mission (RGNDWM) had set a target of extending access to safe drinking water for 100 percent of the rural population by 2007. Although this target has not been fully achieved, the expansion of coverage attained during the 1990s, as reflected in the Census data, shows the objective of 100 percent safe water access should not be difficult to achieve in the next five years or so. Indeed, the Eleventh Five Year Plan (2007-08 to 2011-12) foresees the provision of safe drinking water to all rural habitations. However, a critical question that remains is with regard to the quality of services being provided. While official statistics on coverage suggest that most rural households have access to a 'safe' drinking water source, it is generally perceived that access to 'reliable, sustainable, and affordable' services is lagging.[2]

Macro Trends in Expenditure on Rural Water Supply and Coverage

The total expenditure on rural water supply schemes from 1993-94 to 2004-05 (2004-05 prices) was about Rs 500 billion (US$11 billion).[3] According to official statistics, the proportion of fully covered habitations reached 97 percent by April 2006 (Economic Survey, Government of India, 2006-07), up from about 75 percent in 1997.[4] This, however, does not take into account

[1] WHO/UNICEF, Joint Monitoring Program for Water Supply and Sanitation, Coverage Estimates of Improved Drinking Water, India. Updated 2004.
[2] *India: Water Supply and Sanitation: Bridging the Gap between Infrastructure and Services.* World Bank, 2006.
[3] Data source: Ministry of Rural Development. The year-wise figures have been adjusted for price change. Economic Survey, 2006-07, (p. 224), notes that from 1972-73 till 2006-07, there has been an investment in rural water supply of about Rs 660 billion (at current prices).
[4] *India: Water Supply and Sanitation: Bridging the Gap between Infrastructure and Services.* World Bank, 2006, Background Paper, Rural Water Supply and Sanitation, Page 12.

In the context of water supply to rural areas, the conditions on the ground remain far from satisfactory. A significant portion of the water supply infrastructure created does not function or functions much below its design or potential

the slippages that have taken place—habitations once fully covered have later slipped into 'partially covered' or 'not covered' status for various reasons (water sources going dry or getting quality affected; systems working below capacity due to poor operation and maintenance; increase in population in the habitations resulting in lower per capita availability; and so on). Indeed, the preliminary results of the Habitation Survey[5] (2003) provide indications of significant slippage and give the impression that coverage has not been increasing much. According to official data on the status of rural habitations in regard to safe water coverage (Economic Survey, 2006-07, p.224), in April 2006, there were 41,946 uncovered habitations, 195,813 quality affected habitations, and 252,060 slipped back habitations (out of a total of 1,422,283 habitations). Adjusting for the number of slipped back habitations, the proportion of fully covered habitations turns out to be about 79 percent, signifying that the progress in providing full coverage to rural habitations has been slow.

In the context of water supply to rural areas, the conditions on the ground remain far from satisfactory.[6] A significant portion of the water supply infrastructure created does not function or functions much below its design or potential, and has been a cause of slippages experienced by a significant proportion of habitations. In many cases, the households find the government provided a source insufficient to meet their water requirements, forcing them to use other supplementary sources. A high proportion of water points are accessed on community-basis, which limits the quantity of water that each beneficiary household can get. In addition, there are problems of seasonal shortage (acute in some regions). A severe decline in groundwater levels has taken place in most states in recent years, adversely affecting sustainability of the drinking water sources.[7]

Government Policy and Programs

Traditionally, rural water supply in India has followed a supply-driven approach with access to safe water being considered a social good, as evident from the Minimum Needs Program (MNP) and the Accelerated Rural Water Supply Program (ARWSP). The financial and operational limitations of the supply-driven approach of the ARWSP led to a fundamental policy shift in the sector by the end of 1990s, towards demand-driven approaches. The demand-responsive approach is based on the principles of community participation and decentralization of powers for implementing and operating drinking water supply schemes with the government playing the role of a facilitator. This approach was adopted by the GoI through the decentralization of responsibilities and pilots in the Sector Reform Project.

The Sector Reform Project was launched on a pilot basis in 26 states in 1999. By 2002, it was in operation in 67 districts of the country. This pilot project placed a priority on instituting demand-driven processes by ensuring that communities not only decide the water supply schemes of their choice but also ensured their sustained involvement through cost sharing. Ten percent of the capital cost and 100 percent of the O&M cost are to be borne by beneficiaries, with the central government providing the remaining 90 percent of the capital cost.

The Sector Reform Project was transformed into the Swajaldhara Program in 2003, thus scaling-up reforms to a national level. The principles of the Swajaldhara Program are similar to those of the Sector Reform Project. The demand-driven approach is central to the program, the key components of which are community-led decision-making processes, community sharing of costs, and emphasis on service delivery. While a change in policy for rural water supply has been adopted under the Sector Reform Project and Swajaldhara Program, the challenge continues to be the implementation of these demand-driven approaches.

The Sector Reform Project and its scaled-up version, the Swajaldhara Program, initiated since 1999 and 2003 respectively, account for only a small part of the investments being made in rural water supply. Externally aided projects

[5] Results of the Habitation Survey are reported in the website of the Ministry of Rural Development.
[6] *India: Water Supply and Sanitation: Bridging the Gap between Infrastructure and Services*. World Bank, 2006; Water Supply and Sanitation, India Assessment 2002, Planning Commission, Government of India.
[7] *India: Water Supply and Sanitation: Bridging the Gap between Infrastructure and Services*. World Bank, 2006, Background Paper, Rural Water Supply and Sanitation, Page 25. For a discussion on the current groundwater situation, see the *Report of the Expert Group on Ground Water Management and Ownership*, Planning Commission, Government of India, September 2007.

(including the World Bank projects) are similar in nature to those under Swajaldhara. Although eight years have passed since a major change was made in government policy for rural water supply, the programs adopting the demand-driven approach still play a minor role in the sector, accounting for about 10 percent of the total expenditure. The sector is dominated by ARWSP, MNP, and other supply-driven programs. A brief discussion on these programs follows.

ARWSP: While the primary responsibility of providing drinking water facilities in the rural areas rests with state governments, the Government of India has been extending policy, technological, and financial support through the ARWSP, a centrally sponsored scheme, supplementing the efforts of the state governments.[8] Under the ARWSP, the state governments are empowered to plan, sanction, implement, and execute rural water supply projects. Funds under the ARWSP are provided to the state governments based on predefined criteria, which take into account four parameters: the size of the rural population, geographical conditions, the number of habitations not covered (those with access to less than 10 lpcd) and partially covered (those with access to more than 10 lpcd but less than 40 lpcd) by drinking water supply, and water quality status. The funds are utilized by state governments as follows—up to 15 percent of the total funds are released for the operation and maintenance (O&M) of existing rural water supply schemes; up to 5 percent are utilized for source sustainability; and the rest of the funds are utilized for the coverage of not covered and partially covered habitations. The norms governing the program include: (a) an ensured supply of 40 lpcd of 'safe' drinking water for humans (and an additional 30 lpcd for cattle in the Desert Development Program Areas); (b) one handpump or standpost for every 250 persons; and (c) the water source should exist within the habitation or within 1.6 km of the habitation in the plains and within 100 m elevation in the hilly areas.

In 1999, a Comprehensive Action Plan (CAP 99) was prepared under the ARWSP with a priority to cover 'not covered' and 'partially covered' habitations. Some habitations have slipped back and become 'not covered' or 'partially covered' after 1999. In addition, some habitations are affected by poor water quality. Under *Bharat Nirman*, a central government program that seeks to build rural infrastructure over a four-year period (2005-06 to 2008-09), it is expected that all the habitations identified as not covered under CAP 99 will be covered and, in addition, the problems of slippage and water quality will be addressed.

PMGY: The Prime Minister's Gramodaya Yojana (PMGY) was launched in 2000-01 in all the states and union territories with the objective of sustainable human development. This program, which operated for a few years but has now been discontinued, had a rural water supply component (PMGY-Rural Drinking Water). Under this program, additional central assistance was provided for rural water supply (70 percent as a loan and 30 percent as a grants-in-aid in the case of general category states, and 10 percent and 90 percent, respectively, in the case of special category states).[9]

The funds were for projects/schemes to tackle quality-related problems and to provide safe drinking water to not covered/partially covered habitations. In water stressed/drought affected areas, a minimum 25 percent of the funds were to be used for water conservation, water harvesting, water recharge, and sustainability of the drinking water sources.

MNP: The Minimum Needs Program (MNP) was initiated in the Fifth Five Year Plan with the objective of providing certain basic minimum needs, thus improving the living standards of the people. The program also covers rural water supply. The states' own efforts for the provision of water supply in rural areas are through the MNP, which is the matching component of the ARWSP (that is, ARSWP funds have to be matched by the funds mobilized by the state for MNP). However, the funds mobilized by the state governments for the MNP is much more than the matching amount required for utilizing the ARWSP funds. While the use of funds under the MNP is broadly guided by the same norms as that of the ARWSP, the state governments have greater autonomy in the use of MNP funds.

[8]The ARWSP was introduced in 1972-73 and continued till 1973-74. With the introduction of the Minimum Needs Program (MNP) in the Fifth Five Year Plan (from 1974-75), the ARWSP was withdrawn. The Program was reintroduced in 1977-78 when it was found that the MNP was not focusing enough on the identified problem villages.

[9] These include the hilly states: Assam, Jammu and Kashmir, Nagaland, and Uttarakhand.

1.2 Study Objectives and Design

Need for the Study

Over the last decade, the Government of India has incurred a huge expenditure on rural water supply; however, little is known about how effective this expenditure has been in providing safe assured water supply to rural households. Moreover, information is lacking on capital and O&M costs of rural water supply schemes and the levels of cost recovery in various states/ programs. Analysis of direct and indirect subsidies and cross-subsidies related to rural water supply schemes and the impact of technology choice and institutional arrangements on the supply cost and performance of schemes is also limited. Clearly, a better understanding of the effectiveness of existing government subsidy schemes and the potential for cost recovery in rural water supply schemes would contribute substantially to the redesign of water supply programs and ensure greater benefits to rural people from government subsidy. Based on a request from the GoI, this study is a 'reality check' on the existing design of schemes, with the main intention of providing directions and sensitizing the policy-maker with respect to the functionality and sustainability of schemes.

Objective of the Study

The prime objective of the study is to review the effectiveness of rural water supply schemes in different states in India. A total of 10 states have been covered in the study: Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal. A combination of primary and secondary data (primary survey-based data relates to 2005-06; secondary data covers the period 1997-98 to 2005-06) has been used to analyze the effectiveness of RWS schemes, based on the following criteria:

- Design versus actual service provision
- Reliability and adequacy of water supply
- Sustainability and affordability of schemes
- Cost of service provision and cost recovery
- Household willingness to pay for better services

The study explores the extent to which expenditure on rural water supply has been

effective in providing access to safe water to rural households in India. This has been assessed in terms of their reliability and adequacy, affordability, and sustainability. In addition, the study examines in detail the capital and O&M cost and the extent of cost recovery in rural water supply schemes.

In order to explore the effectiveness of rural water supply schemes, the study looks at the extent to which expenditure on rural water supply under various government programs gets translated into water supply infrastructure and services. This is based on an analysis of the flow of funds, institutional costs, Support Organization/non-government organization (NGO) costs, and other costs associated with the programs, as well as an assessment of direct and indirect subsidies for rural water supply.

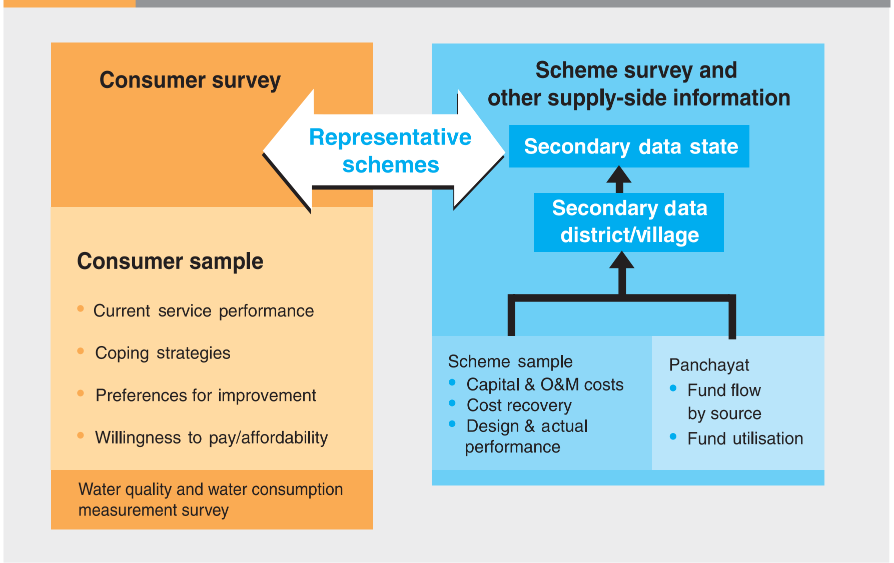
Some other key questions the study seeks to address are:

- What are the coping strategies adopted and coping costs borne by rural households arising out of the inadequacies/limitations of the current services?
- How strong is the household demand for service improvement, as reflected in their willingness to pay for improved services?
- What are affordable payment levels for improved services?

Approach

The study sample covers representative rural water supply schemes and associated representative consumers across 10 states in India (Figure 1.1). Different schemes[10] were selected, based on the source of water, technology type, size, and type of management. Users of different schemes and from a range of socio-economic backgrounds were covered. Both the supply and demand aspects of rural water supply schemes are reviewed in this Report.

Figure 1.1 **Study Design**



Schemes are categorized according to technology such as handpumps, mini water schemes, single village schemes, and multi village schemes (including regional schemes). Schemes are also classified according to the agency responsible for the implementation and management of schemes—for example, schemes under public utilities, PHED, and other such government agencies under the direct control of the state government, Zilla Panchayat or Zilla Parishad (the apex body at the district level in the Panchayati Raj system of local self-government institutions), village-level Gram Panchayat (GP), and communities/user groups.

Both primary and secondary data are used in the analysis. Data on schemes and households were collected through field surveys using structured questionnaires. Secondary data from various state-level agencies were used to collect information on fund flows and so on. Data collected from state agencies and the survey of schemes provide supply-side information on various aspects, including the fund flow under different programs; the details of expenditure incurred under the programs; the technical details of the schemes covered in the survey; the performance of the schemes in terms of quantity of water supply in summer and other seasons; the capital and O&M cost of the schemes (with break-up under major heads); tariff and cost recovery; and number of days of non-functioning of schemes due to drying up of source, breakdowns, and so on. In the household survey, detailed information was collected on a large number of items. These include sources of water, quantity of water use, proximity of water points and time spent on collection, number of hours of supply per day, consumer's assessment of water quality and reliability, investments made in water storage, expenditure incurred on private water sources, capital cost contribution made by the households, water charges paid, and willingness to pay for improved services. Data were also collected on various socio-economics characteristics of the respondents and their family including the income class to which the households belong, the monthly expenditure incurred on various heads, and the age-sex-education profile of the respondents.

In addition to the household and scheme survey (also a Panchayat-level survey to collect supplementary information), a study of water quality and water consumption has been undertaken. Among the schemes surveyed, a portion has been covered in the water quality study: water samples have been taken at source, at distribution end, and at consumer end, and tested for a number of quality parameters.

[10] For purpose of the survey and the analysis presented in the subsequent chapters of the report, a scheme is defined as a spot source or a common access point for water for all types of water supply technology other than piped water supply or mini water schemes. For the latter, the common water source supplying water through a network of pipelines and water supply points (tap or standpost) constitute a scheme.

As mentioned earlier, the states covered in this study are Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal (Map 1.1). These states among them account for about 60 percent of India's rural population. The approach and methodology for the analysis is given in Annex 1.1.

Sampling Design

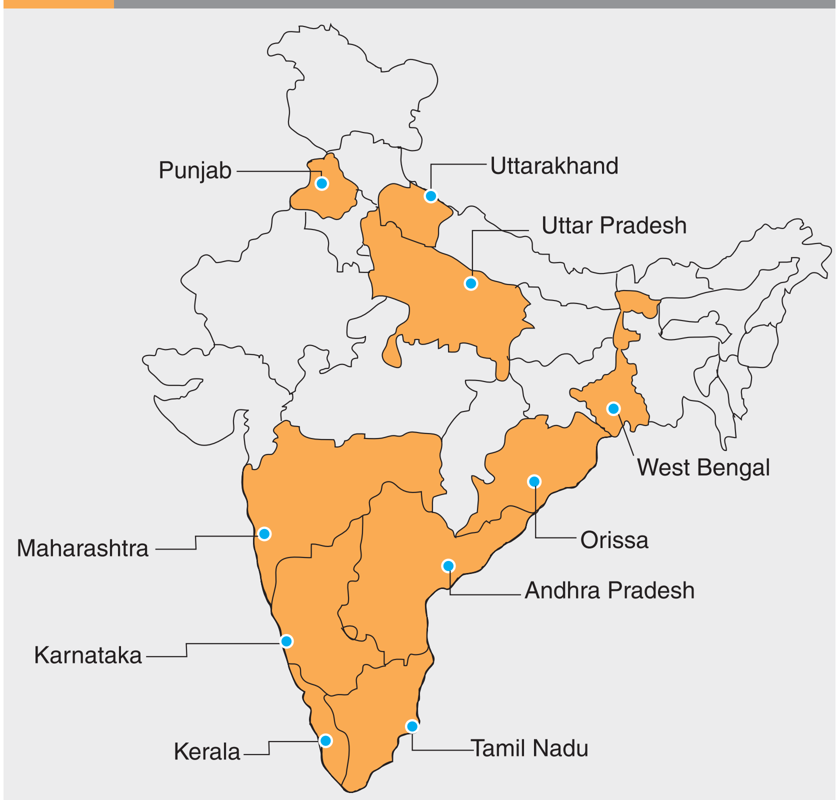
The sampling for the study was carefully designed to ensure that the sample of schemes and households taken are representative. Multi-stage stratified sampling was undertaken to select schemes and consumers. The state governments were actively involved in the sampling process and the choice of the schemes to be surveyed was made with the concurrence of the state government (relevant agency/body). The districts in each state were classified into four groups according to water quality and groundwater exploitation situation.

- Districts with only water quality problem;
- Districts with only groundwater exploitation problem;
- Districts with both water quality and groundwater exploitation problems; and
- Districts with neither water quality nor groundwater exploitation problems.

In consultation with the state governments and the state water utility agencies, one district was selected from each of the above four groups,[11] on the basis of the following two criteria: (i) availability of representative scheme types (handpumps, mini water schemes, single village piped water supply, multi village/regional piped water supply); and (ii) availability of schemes under supply-driven and demand-driven institutional arrangements. Schemes were so chosen as to be representative of scheme technology relevant to the state and institutional arrangements. To the extent possible, schemes under both supply-driven and demand-driven institutional delivery and management were chosen for each representative type of scheme.

After choosing the scheme, a random sampling method was adopted to select a sample of representative households. For all piped water supply schemes, the level of service delivery (private connection versus standpost users) added a further stage to the sampling process. For most of the schemes surveyed, representative beneficiary households were also covered in the study. However, in order to get more observations/responses on the cost of schemes, additional surveys of schemes were done without a corresponding survey of the households

Map 1.1 States Covered in the Study



[11]For Karnataka, Kerala, Uttar Pradesh, Uttarakhand, and West Bengal, more than four representative districts were covered in the study. The Uttar Pradesh study covered six districts—one had demand-driven programs and the others supply-driven programs. Eight districts were covered in West Bengal: four arsenic affected, one fluoride affected, and three unaffected by arsenic or fluoride. Among them, six have a groundwater exploitation problem, and two do not have such a problem. Details of the sampling design for each state are provided in the *Background Report on 10 States Analysis.*

Table 1.1	Sample Size: Number of Schemes and Households Covered in the Study		
	Schemes covered		
State	Handpumps	Mini water/piped water schemes	Number of households covered
Andhra Pradesh	16	45	3,148
Karnataka	17	81	4,498
Kerala	10	68	4,607
Maharashtra	13	42	3,135
Orissa	25	35	3,173
Punjab	10	48	3,138
Tamil Nadu	14	45	3,131
Uttar Pradesh	628*	52	4,155
Uttarakhand	9	47	2,659
West Bengal	23	58	6,389**
Total	**765**	**521**	**38,033**

*Note: * A large number of handpump schemes were surveyed in Uttar Pradesh to get a better understanding of the performance of these schemes. ** A relatively larger number of households were covered in West Bengal to give adequate representation to the arsenic affected and arsenic-free areas of the state.*

using the scheme. On an average, 40 representative schemes were surveyed in each state for both scheme and household data. States with World Bank rural water supply projects had an additional sub-sample. Efforts were made to sample a somewhat similar number of households and schemes across the 10 survey states. For West Bengal, a relatively larger number of households were covered to give adequate representation to arsenic affected and arsenic-free areas of the state. The largest number of schemes were surveyed in Uttar Pradesh: 628 handpumps and 52 mini water/ piped water schemes (Table 1.1). Given the high dependence on handpumps in Uttar Pradesh, a large number of handpumps were therefore surveyed to undertake a careful analysis of the performance of handpumps. The distribution of surveyed households according to the type of scheme accessed by them and the type of institutional arrangements under which the scheme functions is shown in Annex 1.2. The annex also shows the break-up of piped water schemes surveyed in the 10 states into demand-driven and supply-driven categories.

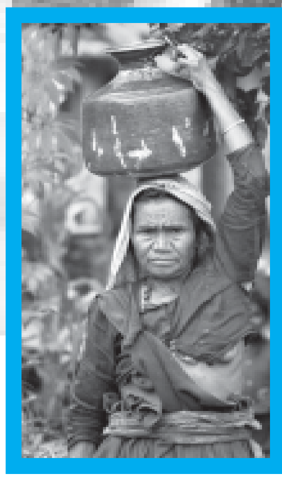
Study Teams

This study was undertaken in partnership with the respective state governments. The organizations that conducted the study are the World Bank, the Institute of Economic Growth (IEG), and the ORG Centre for Social Research (ORG-CSR, a division of AC Nielsen ORG Marg Pvt Ltd). The World Bank Task Team conceptualized and designed the study and supervised all aspects of preparation/design, survey, and analysis. The research team at the Institute of Economic Growth supported the survey design and carried out the econometric analyses. ORG-CSR was the survey partner for all the states except Uttarakhand, for which the survey was carried out by SMEC India Pvt Ltd. This Report is based on an analysis of data carried out by the IEG research team, and draws on the state-wise reports for Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, and West Bengal prepared by ORG-CSR.

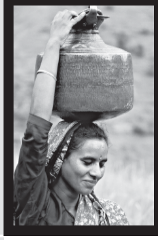
1.3 Organization of the Report

Chapter 2 presents the common issues across states and a more detailed analysis of the findings is presented in Chapters 3-7. Chapter 3 presents the analysis of flow of funds and estimates of subsidy in rural water supply. Chapter 4 looks at the cost of schemes while Chapter 5 examines their performance. The coping cost of households due to the inadequacies of rural water supply schemes is discussed in Chapter 6. Chapter 7 presents an analysis of household willingness to pay and the affordability for improved services. Finally, the main conclusions and recommendations of the study are presented in Chapter 8.

CHAPTER 2



The performance of schemes is much lower than the design and expectations of rural households and there is significant resource wastage



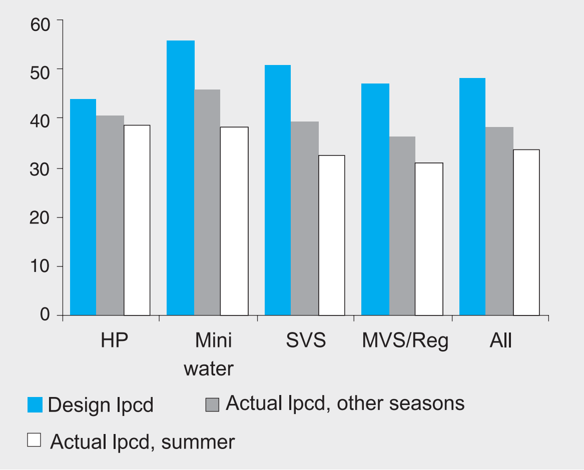
Common Issues Across States

The common issues concerning the effectiveness of schemes across the 10 states are: (i) the performance of schemes is much lower than the design and expectations of rural households; and (ii) there is significant resource wastage in the implementation and the operation of schemes. These aspects are summarized in the following sections: 2.1. Performance of Schemes; 2.2. Cost of Service Provision; 2.3 Effectiveness of Service Delivery; and 2.4. Fiscal Implications of Business-as-Usual versus Decentralized Service Delivery Models.

2.1. Performance of Schemes

This section compares the performance of schemes according to technology types—handpump (HP), Mini Water Supply (Mini Water), Single Village Schemes (SVS), Multi Village/Regional Schemes (MVS/Reg), and different agencies managing the schemes—Gram Panchayat (GP), Community (Comm), and Public Utility/Government (PU/Govt).

Figure 2.1 Design and Actual Lpcd



Source: Survey data, combined for 10 states.

Inadequacies in Service Provision

The survey data bring out serious inadequacies of the water supply schemes. The quantity of water supplied (a key parameter of service) is commonly less than the design, especially in summer months.

The actual hours of supply by piped water schemes are less than the design hours. The gap between design and actual hours is relatively higher for multi village schemes. Some of the piped water schemes (20 to 30 percent) do not function for many days in a year due to system breakdowns (annual breakdowns is 23 days in Karnataka, 24 days in West Bengal, and 36 days in Uttar Pradesh).

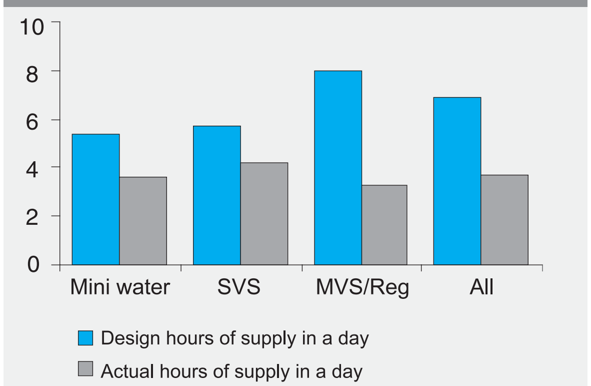
Around 30 percent households using piped water schemes do not get daily supply in summer (some do not get daily supply even in other seasons). The water supplied by the schemes does not fully meet the water requirements of the households, especially in summer.

About 80 percent households in Uttarakhand, 55 percent in Karnataka, 50 percent in West Bengal, 45 percent in Orissa, 30 percent in

The survey data bring out serious inadequacies of the water supply schemes. The quantity of water supplied (a key parameter of service) is commonly less than the design, especially in summer months

Kerala and Punjab, 23 percent in Tamil Nadu, and 20 percent in Uttar Pradesh are able to meet less than half of their water requirement in summer from the main water supply scheme accessed by them. Many households using piped water, particularly multi village schemes, have to combine it with other schemes, including public handpumps. *Due to the inadequacies of the water supply schemes, the rural households typically depend on multiple water sources, supplementing the main public source with other public and private sources.* Prevalent across all scheme types, the gap between design and actual lpcd is depicted in Figure 2.1 and that between design and actual hours of supply in Figure 2.2. About 70 percent households get daily supply of water in a week (Figure 2.3). The performance is more or less similar across different scheme technologies and agencies managing the scheme. Figure 2.4 shows that nearly 50 percent households depend on supplementary public and private sources, in addition to supply from their main scheme.

Figure 2.2 Design and Actual Hours of Supply (Non-Summer)



Source: Survey data, combined for 10 states.

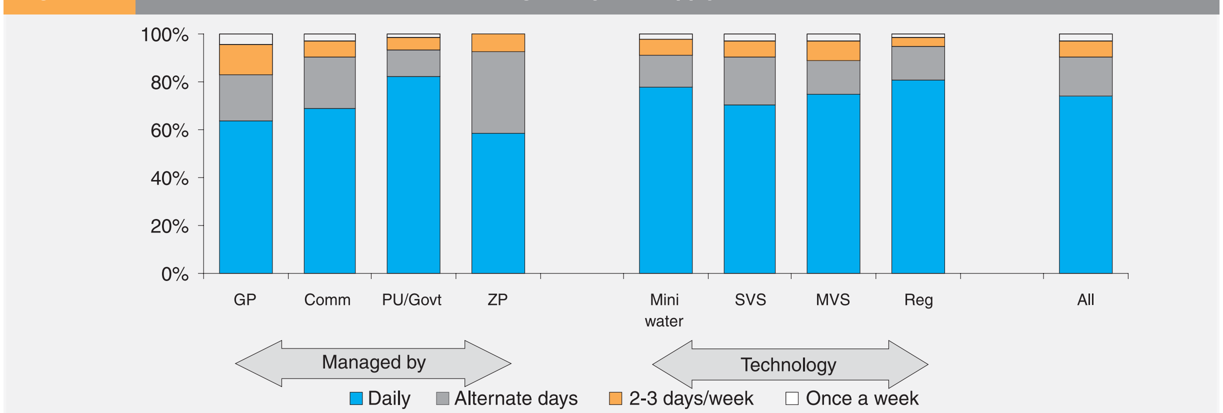
The relative importance of the problems faced by households in using the water supply schemes is shown in Figure 2.5, with most households reporting shortages in certain months of the year, frequent breakdowns, and inadequate supply.

Coping Strategies and High Costs Borne by Households

The coping strategies adopted by households in response to the inadequacies of water supply include traveling considerable distances and standing in long queues to collect water, storing water, incurring expenses on private water sources, and incurring expenses on repairing public water sources. These and other measures taken by households (for example, some households boil water) impose a heavy cost on them.

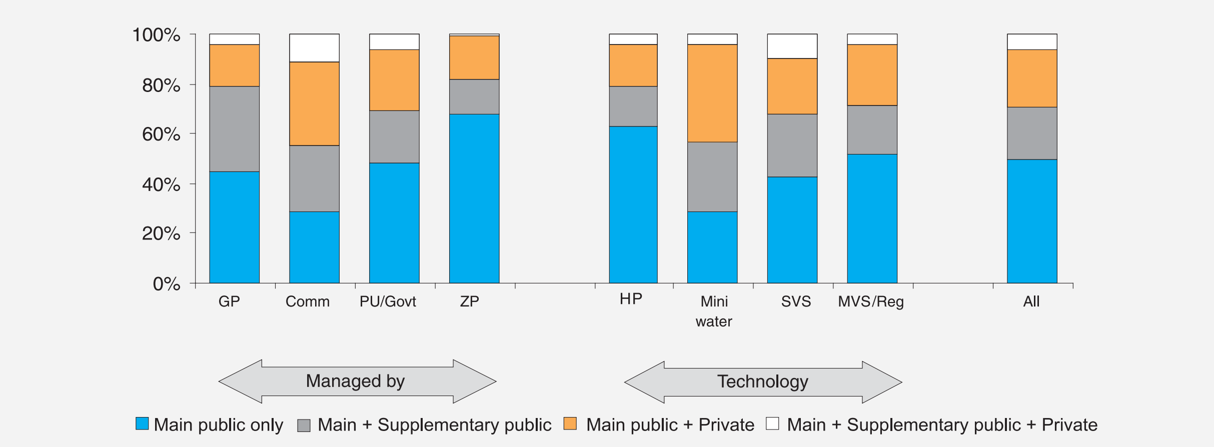
The average coping cost (cost of storage, expenditure on repair and maintenance of own water sources and public water sources, and opportunity cost of time spent on water collection) per household is Rs 81 (US$1.8) per month (about 3 percent of income), ranging from Rs 32 (US$0.7) to Rs 287 (US$6.5) per month across different categories of schemes.

Figure 2.3 Distribution of Households According to Days of Supply in a Week in Summer



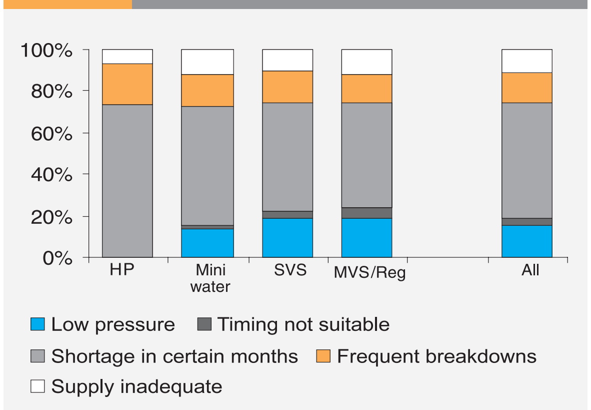
Source: Survey data for piped water schemes, combined for 10 states.

Figure 2.4 Dependence of Rural Households on Public and Private Water Sources



Source: Survey data of 10 states combined.

Figure 2.5 Problems Reported by Households (%HH)



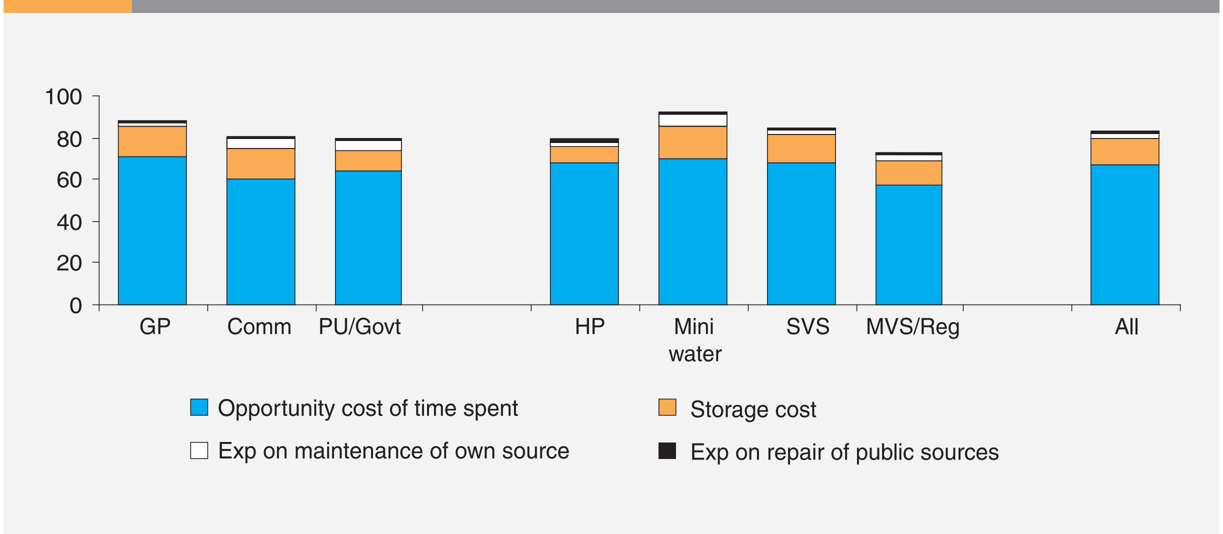
Source: Survey data of 10 states combined.

In most schemes, the cost borne by beneficiary households on average exceeds the per household O&M cost. The costs are relatively high in Tamil Nadu, Karnataka, and Kerala as compared with other states. Estimates of coping costs are presented in Figure 2.6. The estimates are shown separately for households grouped according to scheme technology and management agency.

2.2 Cost of Service Provision

Most schemes in the rural water sector continue to be designed and implemented in the traditional 'supply' (target)-driven mode by government engineering agencies. While two

Figure 2.6 Estimated Coping Cost Borne by Households (Rs per Month)



Source: Computed from household survey data. Aggregates based on weighted average of state-level estimates.

major ‘demand-responsive’ reform programs, the Sector Reform Project and the Swajaldhara Program, were launched in early 2000, there is hardly any assessment of the performance of these programs.

This study analyzes the overall cost of service provision, including costs across different types of programs (supply versus demand-driven), technology types (schemes), and managing agencies. The major areas of concern are presented here.

High Institutional Costs

The funds for expenditure on infrastructure are limited in supply-driven programs, due to large institutional costs and the cost of providing for the O&M of piped water schemes. In contrast, most of the funds available under the demand-driven programs are converted into infrastructure, as the cost of institutional arrangement is low. The share of institutional cost in RWS expenditure varies considerably across states. Taking only the supply-driven programs, to ensure better comparability, the relevant ratio is 50 percent in Karnataka, 40 percent in Kerala, about 30 percent in Uttar Pradesh and Uttarakhand, but much lower at about 15 percent in Maharashtra. These variations confirm that substantial reduction in institutional cost is possible. Overall, the share of institutional cost is about 21 percent, as may be seen from Figure 2.7.

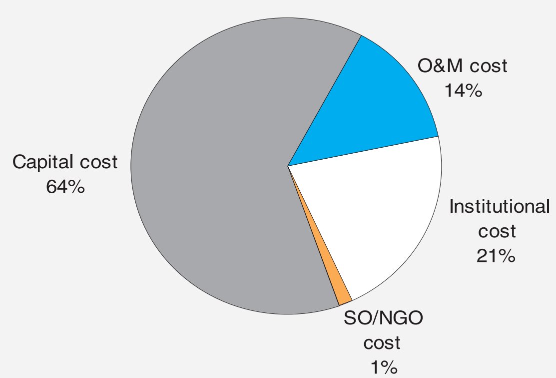
Table 2.1 shows the pattern of expenditure on supply-driven and demand-driven programs in the 10 states surveyed, during the period

Table 2.1 Pattern of Expenditure on Supply-Driven and Demand-Driven Programs in the 10 States Surveyed, 1997–98 to 2005–06

Item	Supply-driven programs (%)	Demand-driven programs (%)
Capital cost	61	75
O&M cost	15	0 (taken care of by the user community)
Institutional cost	24	11
SO/NGO cost	0	14
Total	**100**	**100**

Source: Computed from secondary data collected from 10 states.
Note: Supply-driven programs include ARWSP, MNP, and so on. The demand-driven programs include Swajaldhara, Sector Reform Program, World Bank projects, and others. The expenditure includes both central and state government expenditures.

Figure 2.7 Distribution of Expenditure for RWS in the 10 States Studied (1997–98 to 2005–06)

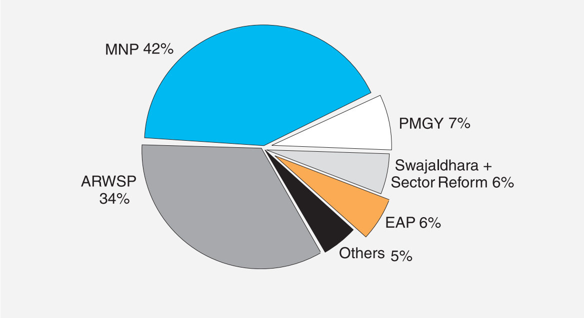


1997–98 to 2005–06. The table reveals that the share of institutional cost is distinctly higher in supply-driven programs.

Fund Flow Mostly for Supply-Driven Programs

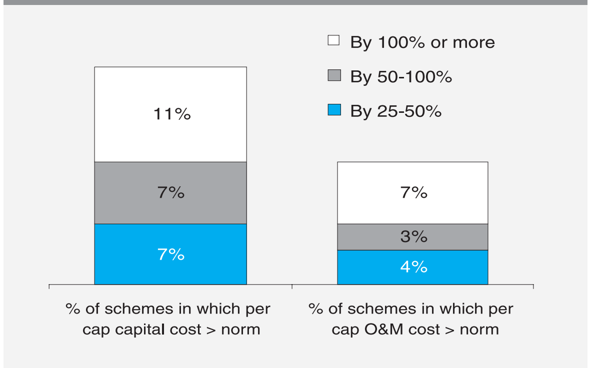
Despite the relatively low institutional cost of demand-driven programs and the advantages of O&M cost recovery from beneficiaries, a substantial portion of the fund flow continues through supply-driven programs, with ARWSP, MNP, and other such programs accounting for more than 85 percent of the funds. The share of Swajaldhara and the Sector Reform Project (demand-driven programs) is very small, about 6 percent. Externally aided projects (EAP) account for a negligible part of the fund flow in most states, except Uttarakhand (18 percent), Karnataka (22 percent), and Kerala

Figure 2.8 **Flow of Funds for RWS under Different Programs, 1997–98 to 2005–06**



Source: *Secondary data collected from the states.*

Figure 2.9 **Actual Cost of Piped Water Schemes vs Cost Norm**



Source: *Survey cost data of piped water supply schemes.*

(35 percent). Overall, the share of EAP in the flow of funds is about 6 percent. The share of different programs in the aggregate flow of funds in the 10 states surveyed is depicted in Figure 2.8. ARWSP and MNP account for the largest share among different programs.

Huge Capital Costs and Inadequate O&M Costs

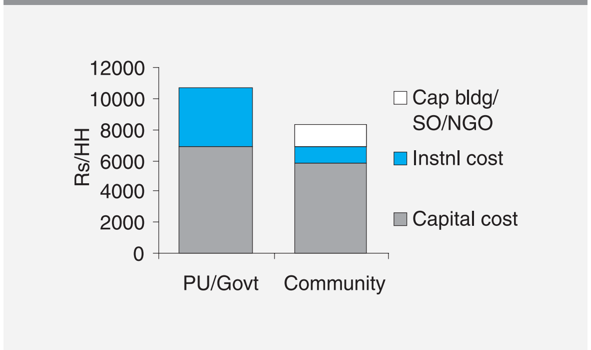
The average capital cost of piped water supply schemes per household is about Rs 6,000 (US$136), with costs ranging from below Rs 2,000 to over Rs 25,000.

Compared to the cost norms, the capital cost of schemes is found to be higher by 50 percent or more in 18 percent cases (Figure 2.9).[12] Capital cost per household is relatively lower in schemes implemented by communities as compared to those implemented by public utilities or government agencies.

A comparison of the cost of the infrastructure of piped water supply schemes, taking into account the institutional cost and the capacity building cost of local communities (Support Organization and NGO costs) shows that community implemented schemes are far less costly (Figure 2.10).

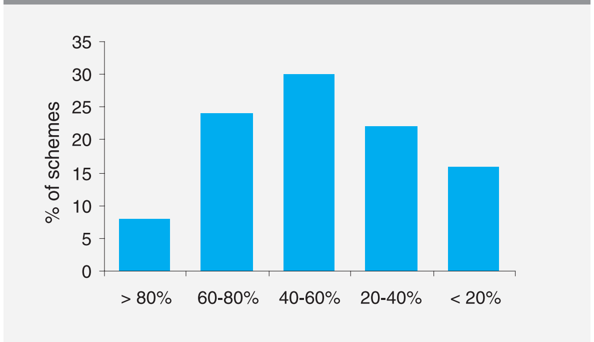
The O&M cost of piped water schemes per household varies from less than Rs 200 per annum to Rs 1,500 per annum. The average cost is Rs 360 (US$8) per annum or Rs 30 per month. An important issue is whether adequate expenditure on O&M is being carried out, and an alarming finding is that in about 60 percent

Figure 2.10 **Cost of Piped Water Supply Infrastructure by Implementor**



Source: *Cost data collected from survey of piped water supply schemes. Data for 10 states combined.*

Figure 2.11 **Gap between Actual and Good Practice (Design Performance) O&M Cost**



schemes, the actual O&M cost is less than half of the cost norm (Figure 2.11). The O&M cost being incurred in piped water schemes is commonly less than what is needed to run the scheme regularly, supply water at the design lpcd level, and undertake proper maintenance. On an average, the actual O&M cost is about

[12]The normative cost of schemes has been obtained from various World Bank reports (Economic Analysis of Rural Water Supply Projects) and Sector Study reports from RGNDWM.

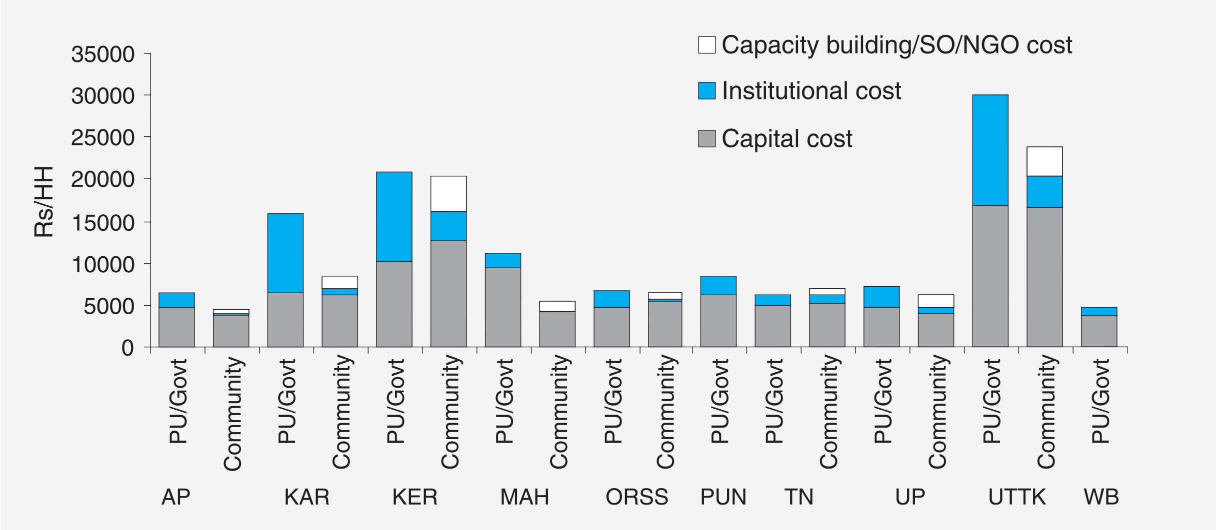
half of the 'good practice (design performance) O&M cost'.[13] The implication is inadequate maintenance with an adverse effect on the functional status of schemes. The low expenditure on the O&M of water supply schemes can be traced to inadequate fund allocation and low cost recovery from beneficiary households. Obviously, this calls for greater efforts at cost recovery and the allocation of more funds for the maintenance of schemes so that their useful life can be extended. How capital and O&M cost of piped water scheme compare with the norms is shown in Figure 2.9.

A comparison between schemes implemented by communities with those implemented by public utilities or government departments in respect of the cost of infrastructure per household shows high institutional cost incurred by public utilities/government departments (Figure 2.10), especially in Karnataka, Kerala, and Uttarakhand (Figure 2.12).

Over-Provisioning by Schemes

There are clear signs of over-provisioning by schemes in Uttar Pradesh, particularly in regard to deep-bore public handpumps, which is the main public water source for the rural people of Uttar Pradesh. Indeed, more than half of the handpumps are shared by 10 or less households (as against a norm of 50) and in 10 percent cases, a handpump is shared by four households or less. Such over-provisioning of services exists in other

Figure 2.12 **Cost of Piped Water Supply Infrastructure**



Source: Cost data collected from survey of piped water supply schemes.

Table 2.2 **Average Number of Rural Households Sharing an India Mark II/III Handpump or a Standpost**

Average number of households sharing:	Andhra Pradesh	Karna-taka	Kerala	Maha-rashtra	Orissa	Punjab	Tamil Nadu	Uttar Pradesh	Uttara-khand	West Bengal
Deep-bore public handpump	26	66	35	25	31	20	18	12	26	42
Standpost in a piped water scheme	16	25	12	12	24	16	16	11	11	31

Source: Household survey.
Note: The norm is 50 households sharing a handpump or sharing a standpost.

[13]The good practice (design performance) O&M cost is defined as the cost that schemes would incur if they run properly to meet the design lpcd level, provide water supply regularly, and carry out the proper maintenance of the system. Two adjustments have been made to the cost data to work out a good practice design O&M cost. First, an estimate of electricity requirement at the design performance level is worked out taking into account the population to be served, the design lpcd level, and the pumping head. Based on the electricity requirement, the cost of electricity is computed. The other adjustment relates to maintenance and repair. The annual expenditure required for the maintenance and repair for the design performance of schemes is taken as 2.5 percent of the capital cost (inflation adjusted).

states as well (with the exception of Karnataka) and is particularly noticed in the case of Tamil Nadu.[14] Over-provisioning tends to reduce the opportunity cost of time spent by households for water collection, but it leads to an increase in the per capita cost of infrastructure. The survey results indicate that the latter effect is much stronger than the benefits of time saving, with the consequence that the overall cost of service provision goes up. Table 2.2 gives state-wise data on the average number of households sharing an India Mark II/III handpump or a standpost, bringing out the phenomenon of over-provisioning.

Defunct Schemes

Another factor that tends to push up the cost of service provision is that many schemes get defunct before they complete their useful life. According to the results of the Habitation Survey undertaken in 2003, about 28 percent of spot sources in Kerala are defunct. This proportion in some of other states under study is 17 percent for Tamil Nadu, 14 percent for Maharashtra and Karnataka, and 10 percent for Uttarakhand. Information from other sources indicate that in Karnataka,[15] 19 percent of the handpumps, 8 percent of the mini water schemes, and 7 percent of the piped water schemes are defunct and in Uttar Pradesh, 10 percent of piped water supply schemes are defunct and 55 percent are only partially functional.

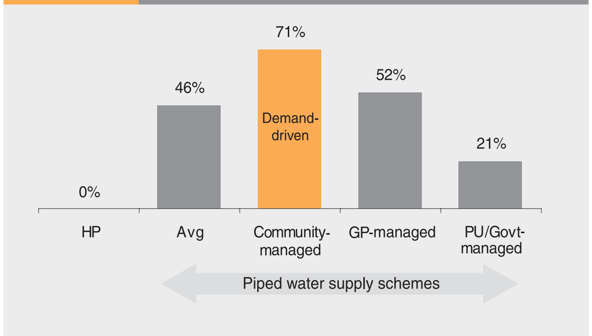
Existence of Multiple Schemes

Resource wastage arises also from the existence of multiple schemes in the same area. Often, the poor functioning of one scheme makes it necessary for it to be supplemented by another scheme. Needless to say, this raises the overall cost of service provision to the government. Survey results bring out the fact that about half of the households in Karnataka and Tamil Nadu are using more than one scheme. The same applies to the users of the piped water scheme in Uttar Pradesh. Overall, about 30 percent households are using multiple schemes to meet their requirements.

Low Cost Recovery from Beneficiaries

The extent of cost recovery varies across schemes. While in handpump schemes there is hardly any cost recovery, in piped water supply schemes, the extent of O&M cost recovery is on average about 46 percent. The recovery of O&M cost is relatively higher in community-managed schemes at an average of 71 percent, and lower in government/public utility-managed schemes, at about 21 percent. State-wise, cost recovery is best in Punjab, followed by Maharashtra and Kerala, while it is worst in West Bengal followed by Tamil Nadu, Orissa, Andhra Pradesh, and Uttarakhand (refer to Table 4.4 in Chapter 4). A comparison across types of schemes reveals that the level of O&M cost recovery is higher in mini water schemes (58 percent) and low in multi village and regional schemes (35 percent). These findings are in line with the difference in cost recovery between community-managed and public utility-managed schemes noted above. It needs to be emphasized that the O&M expenditure incurred for piped water schemes is much less than the requirement for the proper maintenance of schemes. Accordingly, the revenue realized from the households is fairly low in relation to good practice (design performance) O&M costs, that is, the expenditure on O&M needed for the proper functioning of schemes. The revenue realization is also low in comparison to the O&M cost norms (this is evident since actual O&M incurred is commonly less than the norm). In multi village schemes, for instance, the O&M cost norm is about Rs 60 per household per month whereas the revenue realization is on average only about Rs 11 per month.The O&M cost recovery for different types of schemes is shown in Figures 2.13 and 2.14. The latter figure

Figure 2.13 O&M Cost Recovery, by Scheme Type



Source: Survey data.

[14]The number of households sharing a handpump in Punjab is nearly the same as that in Tamil Nadu. But there is an important difference. The households in Tamil Nadu use a supplementary source along with a handpump in over 90 percent cases. On the other hand, the handpump users of Punjab are exclusively dependent on it. The problem of over-provisioning is therefore not so serious in the case of handpump users of Punjab.

[15]Rural Water Supply and Sanitation: A status report, Karnataka Rural Water Supply and Sanitation Agency, Rural Development and Panchayati Raj Department, Government of Karnataka, 2004.

compares O&M cost recovery to actual cost incurred and 'good practice (design performance) O&M cost'.

On an average, the O&M cost recovery is 46 percent of the actual O&M expenditure incurred, but only 27 percent of the good practice O&M. State-wise details are presented in Chapter 4.

Huge Direct and Indirect Subsidies

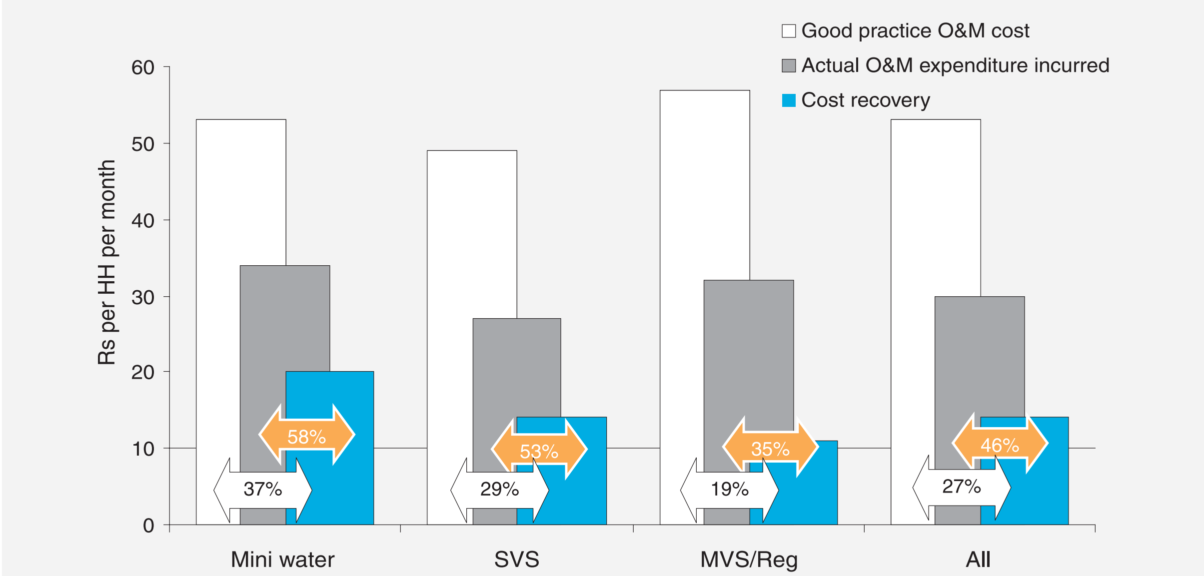
The estimates of subsidy are based on: (i) direct subsidy for rural water infrastructure creation and maintenance, net of revenue collected from households; (ii) indirect power subsidy due to difference in cost of supply, and the power tariff actually charged.

On an average the subsidy is 160 percent of state rural water supply funds,[16] with the amount of subsidy per annum ranging from about Rs 10 billion (US$0.23 billion) in Maharashtra and Rs 8 billion (US$0.18 billion) in Tamil Nadu to about Rs 1.4 billion (US$32 million) in Punjab, about Rs 0.9 billion (US$20 million) in Uttarakhand, and about Rs 0.8 billion (US$18 million) in Orissa. A dominant part of this subsidy relates to the interest and depreciation cost of the investments made for water supply infrastructure, including the associated institutional costs.

The break-up of annual rural water supply subsidy on account of capital cost, O&M cost, and indirect power subsidy is shown in Figure 2.15 for the 10 states surveyed.

The figure shows high subsidies for Maharashtra, Tamil Nadu and Andhra Pradesh, as compared to Orissa, Uttarakhand, Punjab, Karnataka, West Bengal, and Kerala.

Figure 2.14 O&M Cost Recovery in Piped Water Supply Schemes



Source: Survey data for piped water supply schemes, 10 states studied.

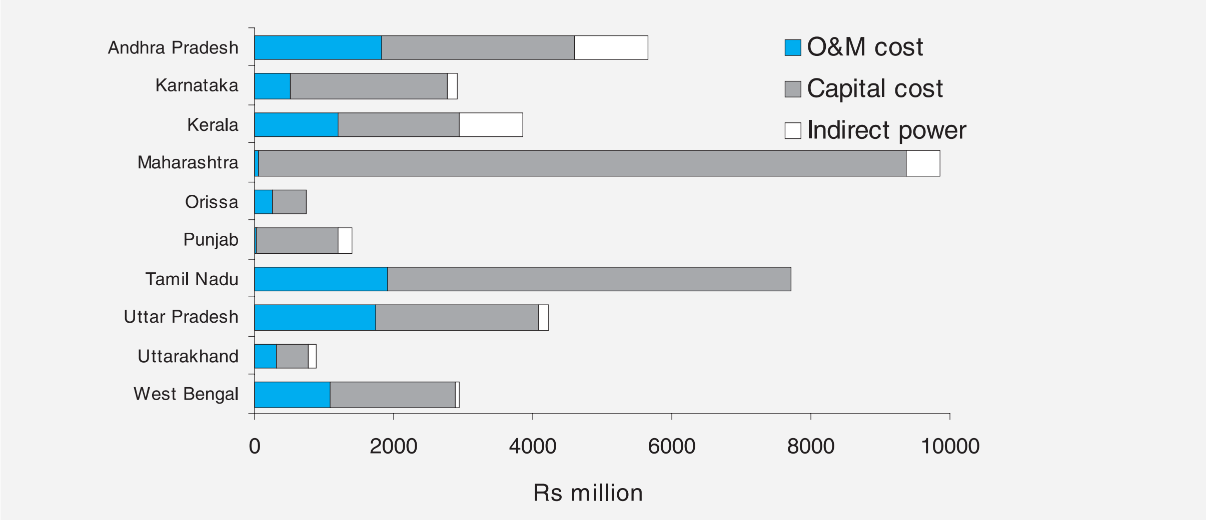
Economic Cost of Water Supply and Scope for Improvement

The total cost of piped water scheme per kilo liter (KL) of water consumed is high. It includes the capital and O&M cost of the main scheme, the capital and O&M cost of supplementary government provided sources, and coping costs such as the opportunity cost of time spent on water collection, expenses incurred on own water source, and the repair of government provided sources.

This works out to an average of about Rs 38 (US$0.9) per KL for supply-driven schemes, compared to an economic

[16] Subsidy exceeds fund flow because of indirect power subsidy and the interest and depreciation cost of the past investment not being recovered from beneficiaries.

Figure 2.15 **Annual Rural Water Supply Subsidy, by State**



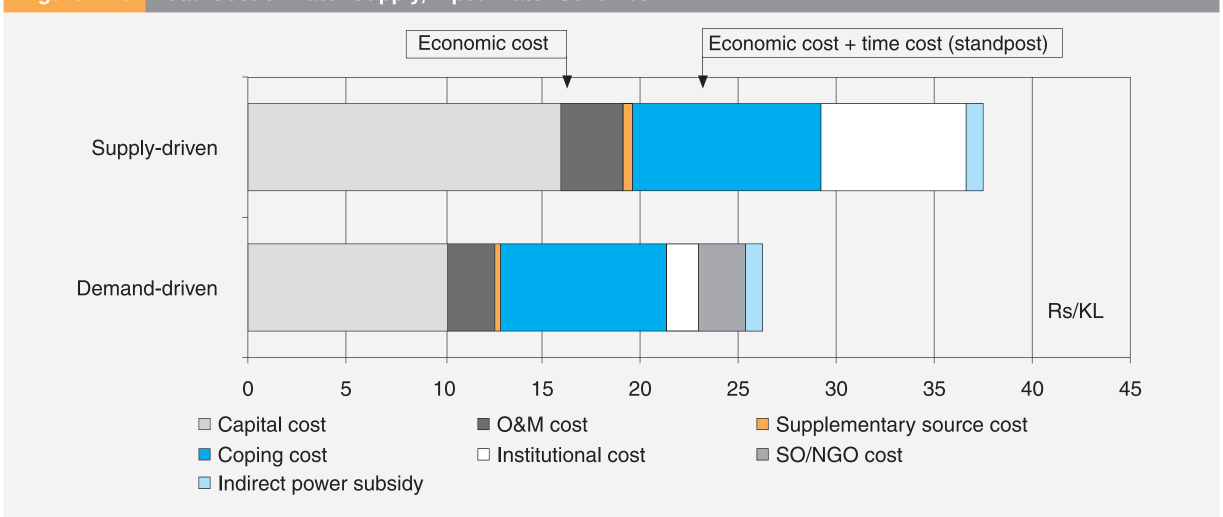
Source: Computed from survey data along with state-level secondary data.

cost[17] of about Rs 16 (US$0.3) per KL for a good performing scheme. The schemes under demand-driven programs have a distinctly lower cost of Rs 26 per KL (US$0.6) of water supply as compared to schemes under supply-driven programs. The overall efficiency of schemes under demand-driven programs is greater than that of schemes under supply-driven programs.

superimposed on the figure to facilitate a comparison of the actual cost with the economic cost (with and without the time cost borne by households accessing standposts).

The marked inefficiency of piped water supply schemes (the total cost of supply far exceeding the economic cost) as shown in Figure 2.16 implies

Figure 2.16 **Total Cost of Water Supply, Piped Water Schemes**



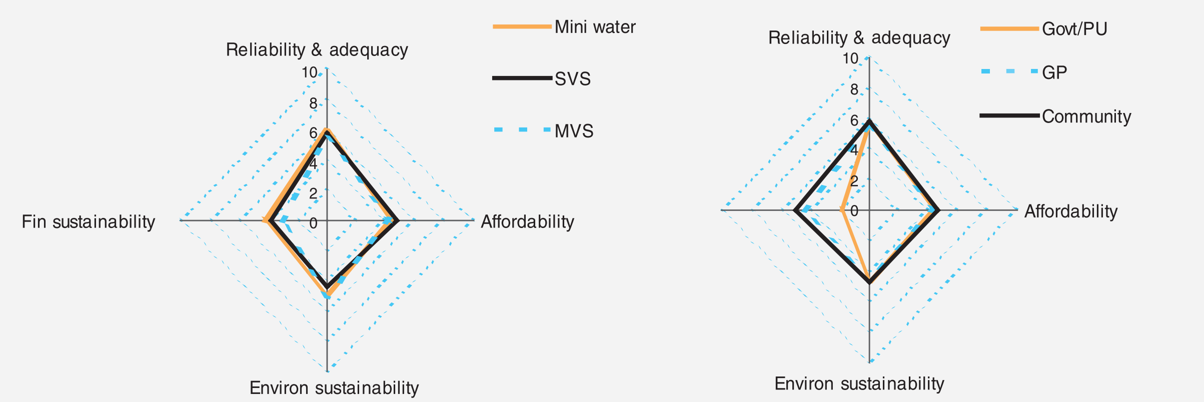
Source: Computed from survey data.

An estimate of the total cost of water supply in demand-driven and supply-driven piped water schemes in the 10 states surveyed is presented in Figure 2.16. The economic cost of water supply is

[17]The economic cost is derived from the cost norms for various states. Efficient institutional cost is taken as 10 percent of the total cost. It is assumed that water could be supplied at 70 lpcd. Assuming that a proportion of households would access standposts and will spend time to collect water (about one hour each day), the cost of water, including the cost of time spent, would be about Rs 23 per KL (US$0.5).

significant wastages of resources. Owing to inefficient functioning of the piped water supply schemes in the 10 states under study, there was a loss of resources of about Rs 50.2 billion per year. To this may be added the resource loss caused by the water supply schemes (handpumps and piped water) getting defunct before the completion of their useful life. This loss is estimated at about Rs 1.9 billion per year for the 10 states. Total loss of resources in the period 1997–98 to 2005–06 was about Rs 470 billion. If water quality, ratio of O&M cost to income of beneficiary households, extent of O&M cost recovery, incidence of source drying up in summer, and so on. With the help of these indicators, four indices of effectiveness have been constructed representing (a) adequacy and reliability, (b) affordability, (c) environmental sustainability, and (d) financial sustainability. The indices take value in the range of 1 to 10. The average values of indices for the schemes studied indicate that the level of the effectiveness of the

Figure 2.17 Indices of Effectiveness, ComparisonAcross Technology and Institutional Arrangement



Source: Computed from survey data; range: Maximum 10, Minimim 1.

these resources were saved and invested in the 10 states, the net state domestic product of the states would increase by 0.9 percent (assuming incremental capital-output ratio of four, which is the average of the incremental capital-output ratio in the Ninth and Tenth Five Year Plans). Thus, from the estimates of resource loss obtained, it seems that the inefficiency of rural water supply schemes caused a loss of about 1 percent in the state domestic product.

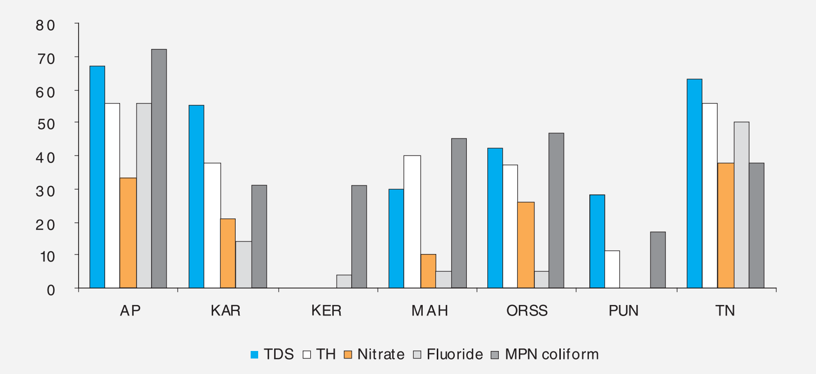
2.3 Effectiveness of Service Delivery

Indices of Effectiveness to Assess the Performance of Schemes

To study effectiveness, 17 important indicators have been developed for piped water supply schemes. These include: liters per capita daily supplied, hours of supply, water pressure, schemes is generally low, or at best moderate. The mean value of the four indices representing adequacy and reliability, affordability, environmental sustainability, and financial sustainability are found to be 5.6, 4.5, 4.8, and 3.6, respectively. The worst performance is found in respect of financial sustainability. With regard to effectiveness of piped water supply schemes, no great differences are found between technologies or between institutional arrangements for management of schemes. However, community-managed schemes are found to be relatively better performing.

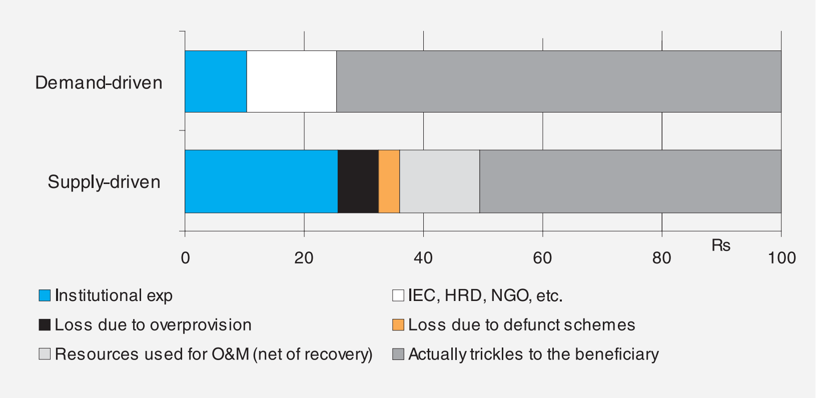
A graphic presentation of the indices of the effectiveness for piped water supply schemes is done in Figure 2.17, showing low performance of schemes, irrespective of the scheme type and institutional arrangements. This analysis uses scheme-level data combined for the 10 states. A state-level analysis is presented in Chapter 5.

Figure 2.18 Water Quality, Rural Water Supply Schemes (Percent of Sample Exceeding Permissible Limit, by Parameter), Source End



Source: Water quality survey.

Figure 2.19 How Rs 100 is Spent in Demand- and Supply-Driven Programs



Source: Computed from survey data.

Quality of Water Supplied by the Schemes

An important dimension of the effectiveness of water supply schemes is the quality of water supplied. In this regard, the performance is found to be not up to standard.[18] The basic purpose of setting up water supply schemes in rural areas is to provide the people access to 'safe' water.

But, tests of water quality at the source end (deep bore handpumps and piped water supply) in the seven states show that in a significant proportion of the samples, several important water quality parameters exceed the permissible limits (Figure 2.18). Comparison across the states reveals that the problem of bacteriological contamination is relatively greater in Andhra Pradesh, Orissa, Maharashtra, and Tamil Nadu, while the problem of fluoride contamination is relatively greater in Andhra Pradesh and Tamil Nadu.

How Much of Infrastructure Expenditure Trickles Down to the Beneficiaries?

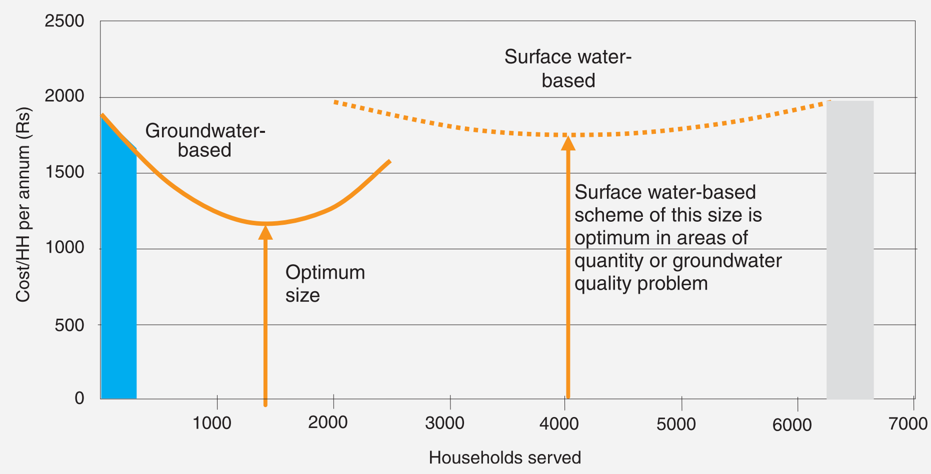
Only a part of the expenditure incurred on rural water supply actually trickles down to the beneficiaries as water supply infrastructure. The leakages take place in the form of institutional costs, resource wastage due to over-provisioning, and defunct schemes and expenditure incurred for the O&M of existing schemes.The leakages are relatively greater for supply-driven programs than for demand-driven programs. Using combined data for the 10 states under study, it is found that out of an expenditure of Rs 100 on rural water supply under demand-driven programs, about Rs 75 trickle down to the beneficiaries. But, under supply-driven programs, which dominate the scene now, only about Rs 50 reach the beneficiaries. This may be seen in Figure 2.19, which shows how an expenditure of Rs 100 gets distributed on various heads for demand-driven and supply-driven programs.[19]

Economies of Scale and Optimum Size of Schemes

An econometric analysis of the cost data of piped water schemes reveals significant economies of scale—as the number of households covered by the scheme goes up, the cost rises less than proportionately. The study of cost variation with the scheme size in terms of the number of households covered shows that for groundwater- based supply, the size classes 500 to 1,000 households and 1,000 to 1,500 households have relatively lower cost compared to smaller or larger piped water supply schemes.

[18]In the water quality study, seven states have been covered; 59 handpumps and 86 piped water supply schemes. The state-wise breakup is given in Annex 1.2.
[19]Over-provisioning has been assessed by comparing the average number of households sharing a public source (standpost/handpump) and the government norm.

Figure 2.20 Scheme Size and Cost of Water Supply (Annualized Capital Cost plus O&M Cost)



Among existing groundwater-based schemes, about one-third are in a size below 200 households. The implication is that in many cases a larger scheme than the existing ones would be able to reap economies of scale and reduce cost. On the other hand, there are a number of surface water-based schemes serving more than 7,000 households, with huge diseconomies in scale.

The implication of this finding on economies of scale is that the figure of Rs 50, estimated to trickle down to beneficiaries, needs to be discounted further. If economies of scale are not reaped due to the inappropriate size of the schemes, the beneficiaries do not get as much benefit from the investments made as would have been possible if the right size was chosen.

The shapes of the cost curves of groundwater-based and surface water-based piped water supply schemes are shown in Figure 2.20. The curves relate to the cost per household (annualized capital cost and O&M cost combined) of a scheme to the number of households served by the scheme. The optimum size at which the cost per household is the least is marked in the figure.

Performance of Multi Village Schemes

A comparative analysis of the performance of multi village and single village schemes shows that the former is less effective. The multi village schemes have a higher cost. On an average, the capital cost per household is about 25 percent higher and the O&M cost is 11 percent higher in a multi village scheme as compared to a single village scheme. For single village schemes, a positive relationship is observed between per household investment and the lpcd level. But no such relationship is found for multi village schemes, thus signifying that higher investments may not be associated with better service delivery in these schemes. Turning to the quality of service provided, the survey data reveal that in terms of a number of parameters such as regularity of supply, hours of supply, lpcd, and so on, the services rendered by the multi village schemes are inferior as compared to the single village schemes.

There are various reasons for the low performance of the multi village schemes. It is well known that a considerable proportion of households at the tail-end of the scheme face problems of inadequate water supply and pressure. Poor performance is also caused by inadequate expenditure on the maintenance of the scheme (0.4 percent of total capital cost as against 1.3 percent in single village schemes), and the problem of inadequate yield from the water source, especially during summer months.

Willingness to Pay for Improved Services and Affordability

There is a strong demand for improved services among rural households covered in the study. The CV method has been applied in this study to assess rural household willingness to pay for improved services. The estimates indicate that the households using private connections are in general willing to pay about Rs 60 (US$1.4) per month, ranging between Rs 30 to Rs 70 per month for improved services.

The households using standposts of piped water schemes are willing to pay about Rs 20 (US$0.5) per month, ranging between Rs 13 to Rs 24 per month towards the O&M cost of improved schemes. The households in Uttar Pradesh, however, are willing to pay only about Rs 7 per month, on average. On the other hand, the standpost users in Maharashtra and Punjab are willing to pay about Rs 30 to 34 per month for improved services.

Among households currently using handpump schemes, the average willingness to pay for better maintenance of the existing public handpumps is about Rs 6 (US$0.1) per month. It ranges from Rs 5 per month in Uttar Pradesh, Orissa, and Tamil Nadu to Rs 8 per month in Kerala and Rs 11 per month in Punjab.

For new handpumps serving 20-25 households, the average household willingness to pay for the maintenance of the handpump, ranges from Rs 6 per month in Uttar Pradesh to Rs 9 per month in Kerala and West Bengal. The average is about Rs 8 (US$0.2) per month. For a handpump serving about 30 households, the maintenance cost per household is expected to be about Rs 5 per month. The estimates of average willingness to pay either exceed or are almost equal to the expected cost of maintenance.

An analysis of affordability reveals that affordable payment for a private connection is Rs 50 to 60 (US$1.1–1.4) per month or higher for a majority of states. As regards standposts (shared connection), the affordable payment level is about Rs 20 to 25 (US$0.4-0.6) per month or higher for a majority of states.

A majority of rural households in Andhra Pradesh, Karnataka, Maharashtra, and Uttar Pradesh would be able to make a one-time capital cost contribution of Rs 900 to 1,000 (US$20-23) for a new piped water scheme. In Kerala and Punjab, the affordable capital cost contribution is higher. In general, the costs of improved water supply in rural areas are within affordable limits.

Almost all households using public handpumps can afford to pay Rs 5 per month to cover the cost of the maintenance of the handpumps. Almost all households using standposts of piped water schemes can afford to pay Rs 10 per month for covering the cost of the proper maintenance of piped water schemes.

As compared to the willingness to pay for water services by rural households, the level of revenue collection is low, leading to low cost recovery. If the households were charged according to their willingness to pay, the O&M cost recovery for piped water schemes would increase to about 90 percent. The same would have been true of handpump schemes for which the cost recovery is virtually nil at present.

For the 10 states studied, this would result in an increase in resource availability of about Rs 4 billion per year (after allowing for the increase in O&M cost that would be required to improve services). These states have spent Rs 30 billion (2005–06 prices) annually on rural water supply infrastructure during the period 1997–98 to 2005–06. The additional resources that would become available by charging households according to their willingness to pay are about 14 percent of the capital expenditures incurred. Hence, through better cost recovery achieved by improving services and charging households according to their willingness to pay, it is possible to expand the water supply coverage by about 14 percent.

Strengths and Weaknesses of Demand-Responsive and Supply-Driven Schemes

In theory, supply-driven schemes have the advantages of sectoral planning leading to an optimal allocation of resources to different regions and appropriate handling of groundwater overexploitation and water quality problems. Demand-responsive schemes have the advantage of being more suited to the local needs and conditions, and more economic in the use of resources. However, in practice, supply-driven schemes may not be able to harness the strengths of planning to satisfactorily meet the water requirements of rural people. Demand-responsive schemes may not be able to achieve high resource use efficiency. Also, as the survey findings of this study clearly show, there is considerable variation in the performance of schemes of the same type. Thus, one demand-responsive scheme may provide an excellent service to the households at a reasonable cost, but another one may not perform well. Nevertheless, the demand-responsive schemes in general have a clear advantage over the supply-driven schemes, as explained below.

Reliability and Adequacy

- On most parameters representing reliability and adequacy of service, the performance of demand-responsive schemes is better than supply-driven schemes. These parameters include the proportion of household water requirement met from the scheme, regularity of supply, and maintenance of adequate supply in summer. The multi village and regional schemes constitute a major part of supply-driven schemes and the survey results clearly show that the performance of such schemes is relatively poor. Further, the multi village and regional schemes spend rather inadequately on repair and maintenance as compared to the demand-responsive schemes.

Financial Sustainability and Affordability

- The extent of O&M cost recovery is higher in demand-responsive schemes than in supply-driven scheme, which renders the demand-responsive scheme greater financial sustainability.
- The cost of infrastructure and related institutional cost is lower in demand-responsive schemes. The total cost of water supply per KL is relatively much lower in demand-responsive schemes, making them not only more efficient but also more affordable for the rural poor.

Environmental Sustainability

- Although a significant portion of supply-driven schemes are based on surface water sources, the shortages in summer months are as widespread among these schemes as among groundwater-based schemes.

  The demand-responsive schemes have a slight edge over supply-driven schemes in that a relatively higher proportion of demand-driven schemes are making investments in source sustainability programs.

  At the same time there are some weaknesses of the existing demand-responsive schemes that need attention: (i) most demand-responsive schemes are very small in size and therefore fail to take advantage of scale economies; (ii) available local water source, in some cases, is inadequate to meet the requirements of the households in summer months; (iii) collection efficiency is low or at best moderate in some of these schemes and may require strict action by village water committees to improve tariff collection from private connection and standpost users.

2.4 Fiscal Implications of Business-as-Usual versus Decentralized Service Delivery Models

The findings of the study indicate that a policy shift towards demand-responsive schemes and the decentralization of service delivery is essential to achieve reliable, sustainable, and affordable services. As an illustration, the fiscal implications of a sector-wide policy reform involving such a policy shift have been studied for Uttarakhand. Three scenarios have been considered: (a) business as usual; (b) decentralized service delivery for single village schemes; and (c) decentralized service delivery for single and multi village schemes.

The second scenario does not allow for a decentralized management of multi village schemes, nor does it allow for the devolution of single village schemes to Gram Panchayats. Thus, this scenario involves only a partial reform of the sector.

The third scenario is based on a sector-wide policy reform with devolution of schemes from the Uttarakhand Jal Nigam and Uttarakhand Jal Sansthan to the Panchayati Raj Institutions (district and village level).

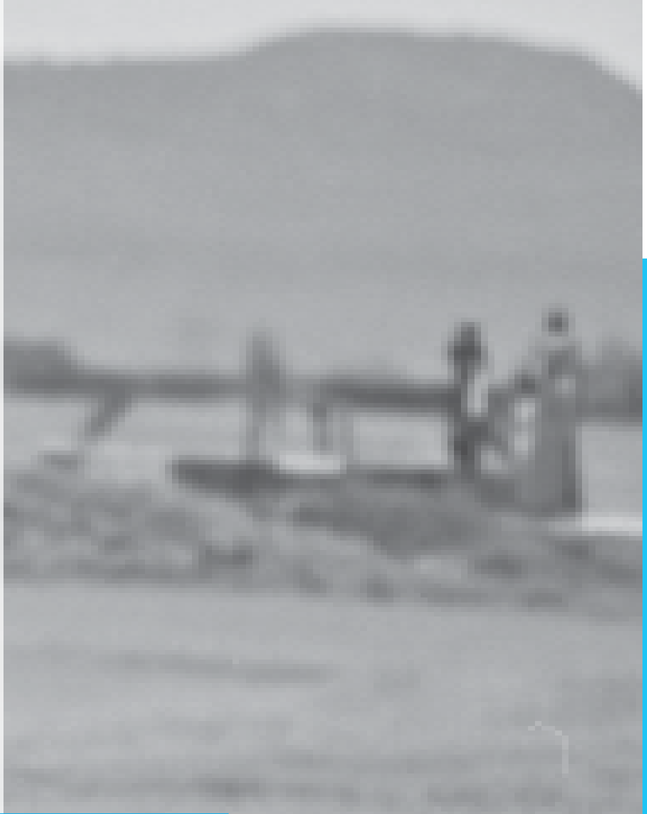
The simulation results show a significant cost saving due to the implementation of sector-wide policies that would primarily arise from reduced slippages from ‘fully covered’ status to ‘partially or not covered’ status and an increased portion of O&M cost being borne by the beneficiary households. In a period of about 15 years, the policy reform will save resources worth Rs 17 billion, or about Rs 1 billion per annum.

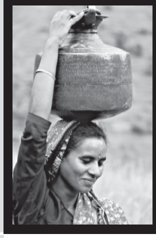
Summing Up

This chapter pulls together the major issues of concern regarding the performance and effectiveness of rural water supply schemes across 10 states. An important point to note is that the rural water schemes are commonly weak in performance and effectiveness is 'low to moderate'. Further details in the context of the concerned states are presented in Chapters 3–7.

CHAPTER 3

The average annual flow of funds for rural water supply during 1997–98 to 2005–06 for the 10 states ranged from Rs 0.8 billion (Punjab) to Rs 8.2 billion (Maharashtra)

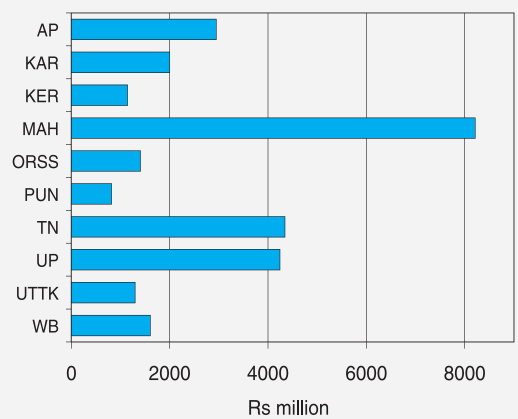




Flow of Funds and Subsidies

The survey findings on the flow of funds under various sector programs and the extent of subsidies are presented in this chapter.
The following aspects are discussed here—the magnitude, structure, and flow of funds; pattern of expenditure on capital, O&M, and institutional cost; and the extent of government subsidies for rural water supply. Section 3.1 covers the magnitude and structure of the flow of funds; Section 3.2 presents the pattern of expenditure; and Section 3.3 presents the type, extent, and distribution impact of subsidies. This chapter is mostly based on secondary data collected from state agencies. Primary data collected in surveys of households and schemes have been used for the estimation of subsidies.

Figure 3.1 **Average Annual Flow of Funds for Rural Water Supply, 1997–98 to 2005–06**



Source: Secondary data on fund flow obtained from states.

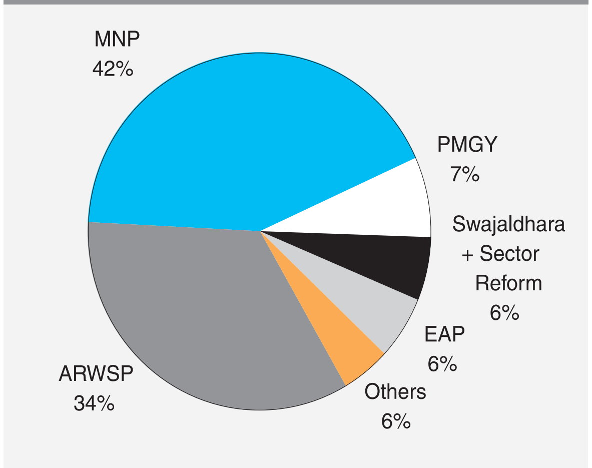
3.1 Magnitude, Structure, and Flow of Funds

The average annual flow of funds for rural water supply during the period 1997–98 to 2005–06 for the 10 states ranged from Rs 0.8 billion (Punjab) to Rs 8.2 billion (Maharashtra). Aggregate average annual flow was Rs 28 billion per annum (US$0.64 billion). Figure 3.1 presents comparative data on the flow of funds in the 10 states studied.

The contribution of certain programs to the aggregate RWS flow of funds far exceeds that of others. The relative share of various RWS programs during the period 1997–98 to 2005–06 was: ARWSP and the MNP contributed the dominant part (34 percent and 42 percent, respectively), while the PMGY was the third largest program, accounting for 7 percent of the flow of funds (Figure 3.2). Swajaldhara and the Sector Reform Project, both demand-driven programs of the central government, accounted for only 6 percent of the flow of funds, while the share of externally aided projects (EAP) was about 6 percent.There are marked inter-state variations in the composition of flow of funds. In Karnataka, Kerala, and Uttarakhand the share of externally aided projects is relatively large (22 percent, 35 percent, and 18 percent, respectively). In Andhra Pradesh, that of Sector Reform/ Swajaldhara is large (15 percent). In Punjab, the National Bank for Agricultural and Rural Development (NABARD), a development finance institution, contributes a large share to the flow of funds for rural water supply (42 percent).

Relating the flow of funds to certain features of the states reveals that the per capita fund flow is not correlated with poverty, that is, per capita fund flow is not greater for poorer states

Figure 3.2 Flow of Funds for RWS Under Different Programs



Source: Secondary data on fund flow obtained from states.
Note: ARWSP = Accelerated Rural Water Supply Program; MNP = Minimum Needs Program; PMGY= Prime Minister's Gramodaya Yojana; EAP = Externally Aided Projects.

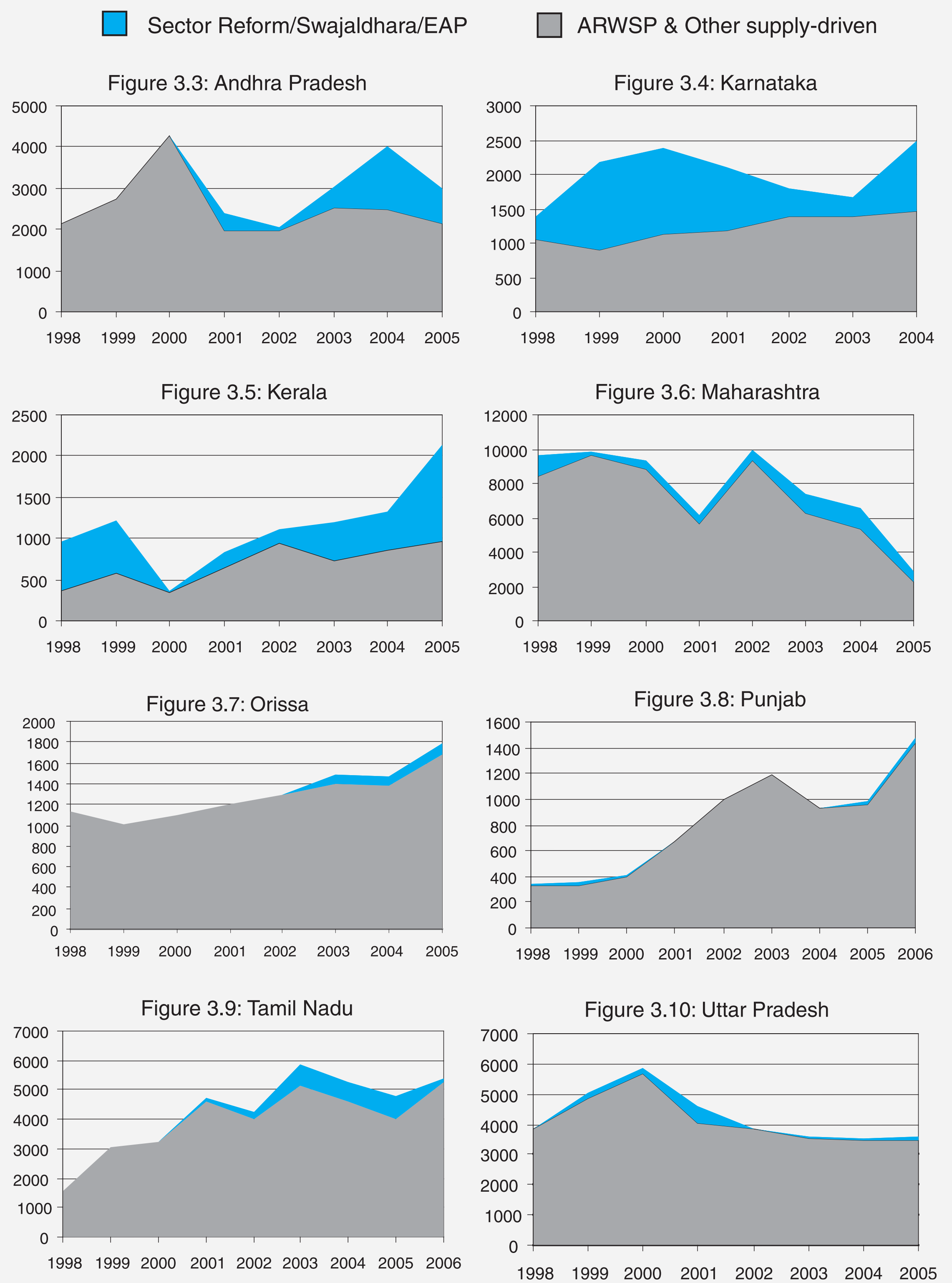
State-wise data reveal that there has been no uniform trend in the flow of funds. In Kerala, during 2000 to 2005, and in Orissa, Punjab, Tamil Nadu, and West Bengal during 1998 to 2006, for example, the flow of funds for rural water supply had an upward trend (Figures 3.5, 3.7, 3.8, 3.9, and 3.12); in Andhra Pradesh, Karnataka, and Uttarakhand the flow of funds has been fluctuating and no clear upward or downward trend is visible (Figures 3.3, 3.4, and 3.11); while in Uttar Pradesh and Maharashtra, there has been a downward trend in the flow of funds since 1999–2000 and 2001–02, respectively (Figures 3.10 and 3.6). Figure 3.13 presents the comparative data on the per capita flow of funds (2005–06 prices) for rural water supply across the 10 states during the period 2001–02 to 2004–05. The per capita fund flow has been the highest in Uttarakhand, followed by Maharashtra and Tamil Nadu. The per capita fund flow has been comparatively low in Uttar Pradesh and West Bengal.

Relating the flow of funds to certain features of the states reveals that the per capita fund flow is not correlated with poverty, that is, per capita fund flow is not greater for poorer states. Among the 10 states considered, the three states with the highest poverty percentage (head count ratio; 2004–05) are Orissa, Uttar Pradesh, and Maharashtra,[20] while the three states with the lowest poverty percentage are Punjab, Kerala, and Andhra Pradesh. Evidently, the ranking of states in terms of poverty does not show any pattern with the flow of funds. On the other hand, a positive correlation is apparent between per capita fund flows and the extent of piped water use (measured by the ratio of the population accessing drinking water from a tap to those accessing it from a tubewell/handpump). The ratio is lowest for Uttar Pradesh, followed by Orissa. It is relatively high for Uttarakhand, Tamil Nadu, and Maharashtra.[21] This matches with the flow of funds.

It seems, therefore, that the per capita flow of funds for rural water supply has been relatively higher in those states in which the rural water supply program had a bigger focus on piped water schemes. Given that the per capita cost of piped water schemes is higher than that of handpump schemes, this is expected.

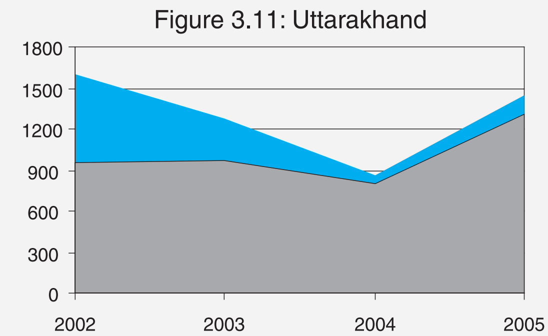
[20] Himanshu, 'Recent Trends in Poverty and Inequality: Some Preliminary Results', *Economic and Political Weekly*, February 10, 2007, pp 497-508.
[21] National Sample Survey Organization, Housing Condition in India, NSS Report No. 489 (58th Round). The estimates are for July–December 2002. This is corroborated by Population Census data for 2001 on the drinking water source of rural households.

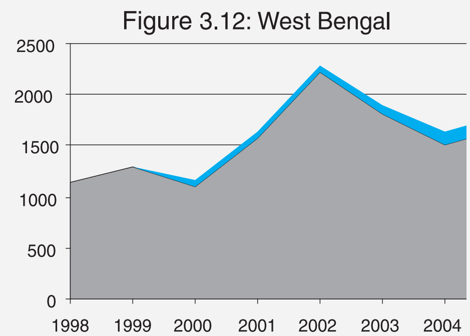
Figures 3.3–3.10 **Fund Flow Under Various Rural Water Supply Programs in Various States (Rs Million)**



Source: Flow of funds data collected from state agencies.

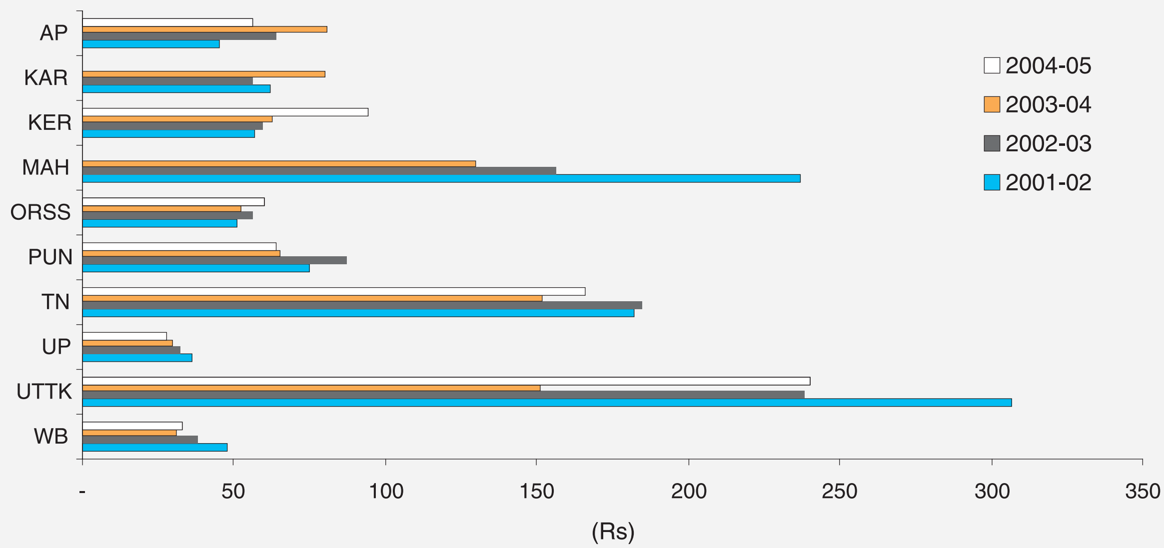
Figures 3.11–3.12 Fund Flow Under Various Rural Water Supply Programs in Various States (Rs. Million)





Source: Flow of funds data collected from states.
Note: Year-wise data on fund flow for demand-driven programs is not available for West Bengal. Year-wise figures have been derived from cumulative totals. For Orissa, fund flow data for demand-driven schemes could not be obtained for years prior to 2002.

Figure 3.13 State-Wise Per Capita Flow of Funds 2001–02 to 2004–05 (2005–06 Prices)



Source: Data on fund flow collected from states.
Note: Per capita fund flows for Maharashtra are not shown for 2004–05, as figures on MJP fund flows for that year are not available.

3.2 Pattern of Expenditure on Capital, O&M, and Institutional Cost

Figure 3.14 presents a break up of state-wise data on expenditure (at 2005–06 prices) incurred on rural water supply programs for the period 1997–98 to 2005-06. As can be seen from the chart, the annual expenditure (at 2005–06 prices) incurred on rural water supply was the highest in Maharashtra, at about Rs 14 billion (US$318 million); followed by Tamil Nadu and Andhra Pradesh, with an annual expenditure of about Rs 7.0 billion (US$159 million) and Rs 5.4 billion (US$ 123 million), respectively. The per capita expenditure at 2005–06 prices was highest in Maharashtra[22] (Rs 258 or US$5.9) followed by Uttarakhand (Rs 252 or US$5.7), and Tamil Nadu (Rs 201 or US$4.6), and was lowest in Orissa (Rs 33 or US$0.7) and Uttar Pradesh (Rs 37 or US$0.8) (Figure 3.15).

Figure 3.16 presents the pattern of expenditure in demand-driven and supply-driven rural water

[22] The decline in fund flow in Maharashtra since 2000 explains the difference in the ranking of Maharashtra in Figures 3.13 and 3.15.

Figure 3.14 State-wise Annual Expenditure on Supply-Driven and Demand-Driven Programs (1998-2006)

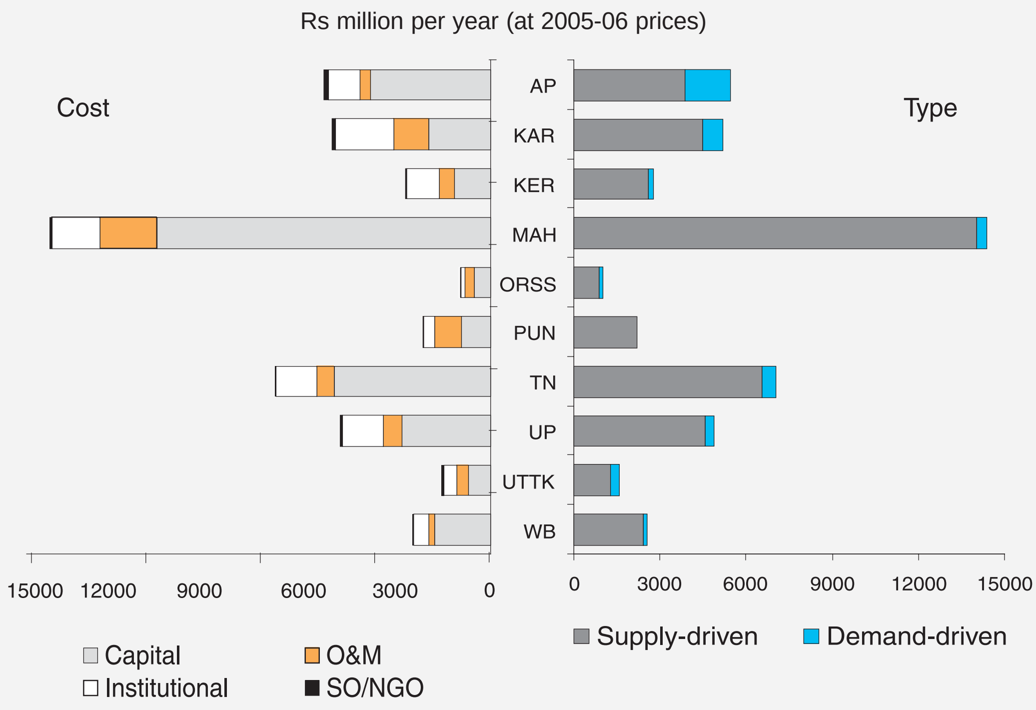
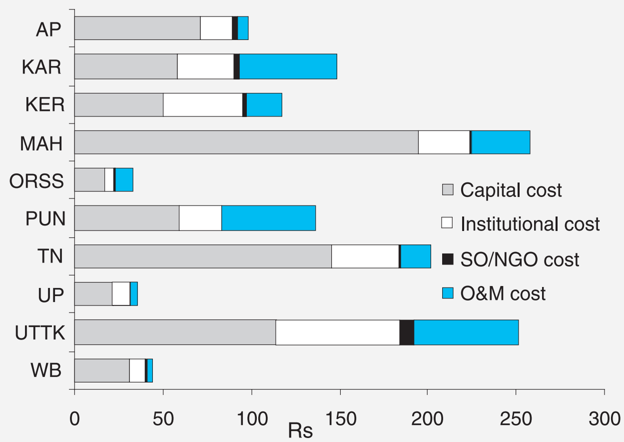


Figure 3.15 State-Wise Annual per Capita Expenditure, Distribution by Cost (1998–2006)



Source (3.14 & 3.15): Data on expenditure collected from the states.

Note: (i) The annual expenditure is estimated as an average across the years for which the expenditure data was available. Uttarakhand was formed in November 2000 and data for earlier years are not available. (ii) Sector Reform, Swajaldhara, Jalnidhi are included under 'demand-driven' programs. ARWSP, MNP, etc, fall under 'supply-driven' programs. (iii) Demand-driven programs have a very small presence in Punjab and cost data for demand-driven programs could not be obtained. The expenditure on SO/NGO has accordingly been treated as negligible.

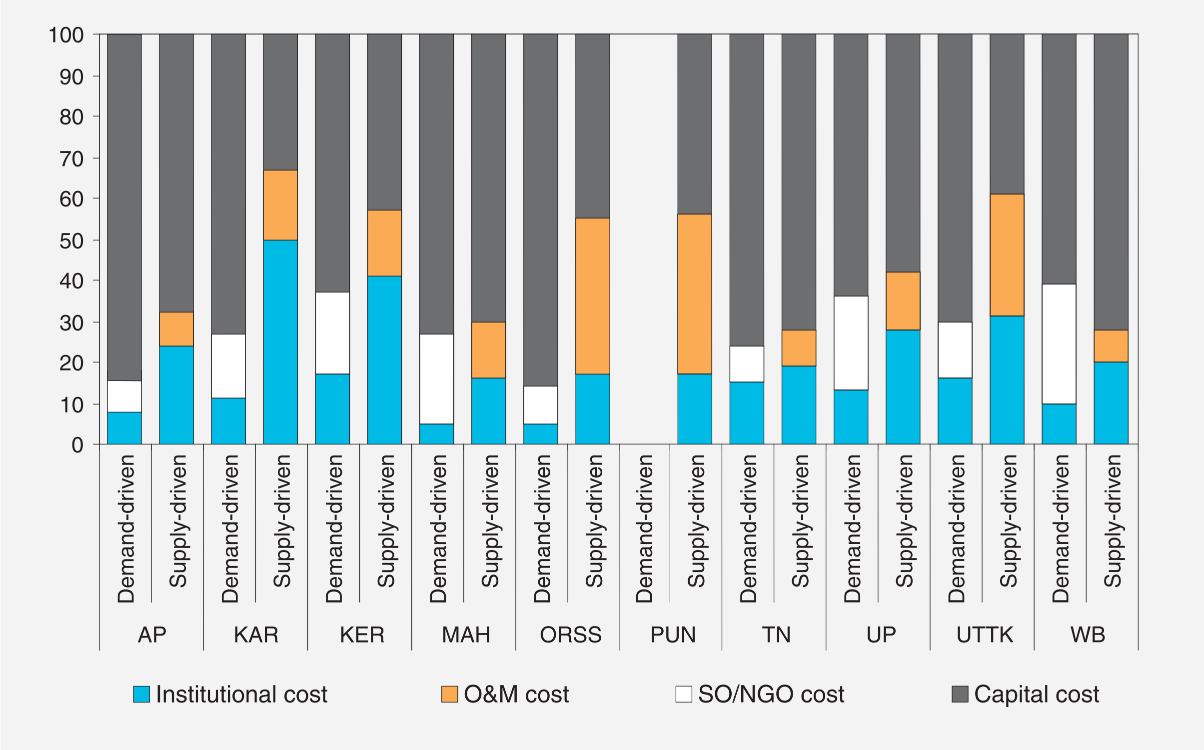
Note: Expenditure data depicted in Figures 3.14 and 3.15 is at 2005–06 prices, and the fund flow data in Figure 3.1 is at current prices.

programs across the 10 states under the heads of institutional,[23] O&M, SO/NGO, and capital cost. From the data it is clear that the institutional cost is relatively higher in supply-driven programs as compared to demand-driven programs.

Even after accounting for the SO/NGO cost that the demand-driven programs have to bear, such programs translate a larger proportion of the expenditure into water supply infrastructure that is reflected by the relatively higher share of the capital cost as compared to supply-driven programs.[24]

[23] The assessment of institutional costs of supply- and demand-driven programs in different states is based on a careful study of the expenditure data of the programs. Details of the items that get included in institutional cost are provided in Annex 3.1.
[24] In West Bengal, the share of institutional cost and SO/NGO cost in total expenditure in demand-driven programs is relatively high at about 40 percent, and the share of capital cost in total expenditure in demand-driven programs is lower than that in supply-driven programs. This is probably explained by the fact that the schemes under the demand-driven programs are new. Over time, the institutional costs are likely to get spread over a larger number of schemes, and the proportion of SO/NGO cost out of the total expenditure is likely to come down. Hence, the share of capital cost in total expenditure is likely to increase over time in demand-driven programs in West Bengal and exceed that in the supply-driven programs.

Figure 3.16 State-Wise Pattern of Expenditure in Supply-Driven and Demand-Driven RWS Programs (%)



Note: For Maharashtra, the institutional cost under supply-driven schemes is underestimated because the costs at the Zilla Parishad level have not been taken into account.

3.3 Government Subsidy for Rural Water Supply Schemes

O&M and Capital Cost Recovery

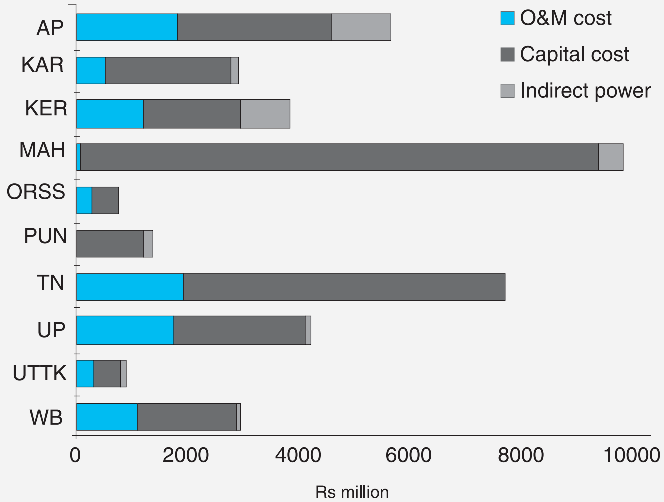
The analysis shows that there is a huge flow of subsidy to rural households for water supply. The extent of O&M cost recovery in piped water schemes is generally low, and is virtually nil in handpump schemes. In terms of capital cost, only a small section of the beneficiary households have contributed to the capital cost of the schemes; and those who did, have contributed only a small part of the per household cost of water supply infrastructure.

Extent of Subsidy

Figure 3.17 presents state-wise estimates of the total amount of subsidy being provided annually for rural water supply by the state and central governments. These estimates are based on various sources, including the survey data on the cost of schemes; survey data on household contribution to O&M and capital cost; and state-level data on financial flows, cost of power supply, power tariff, and so on. The O&M cost subsidy is computed on the basis of the O&M cost of schemes and the O&M cost recovery from households. Capital cost subsidy is obtained as the interest and depreciation cost on the amount of expenditure on rural water supply infrastructure and institutional cost. The indirect power subsidy is computed by estimating the cost of power for piped water schemes, taking into consideration the gap between the actual cost of production of power and the applicable power tariff for rural water supply in each state.

As can be seen from Figure 3.15, the amount of subsidy per annum varies across the states: Rs 8–10 billion (US$182–227 million) in Tamil Nadu and Maharashtra; Rs 3–6 billion (US$68–136 million) in Andhra Pradesh, Karnataka, Kerala, Uttar Pradesh, and West Bengal; Rs 1 billion (US$23 million) or so in Orissa, Punjab, and Uttarakhand. The extent of subsidy per household is highest in Tamil Nadu at about Rs 90 (US$2) per month, and ranges from Rs 60–70 (US$1.4–1.6) per month in

Figure 3.17 **Estimated Annual Subsidy for Rural Water Supply in 10 States, 2005–06**



Subsidy per HH served (Rs/month)	Ratio to state domestic product (%)
43	0.3
33	0.2
65	0.4
71	0.3
10	0.3
37	0.2
88	0.4
17	0.2
63	0.4
21	0.2

Source: Computed from flow of fund data collected from states and field survey data.
Note: (i) Low O&M subsidy in Maharashtra is due to more than 70 percent households paying O&M charges of Rs 30 per month on an average (Rs 40 per month for private connections and Rs 25 per month for standpost). (ii) Low subsidy in Punjab is explained by the relatively high share of rural households having private connections, most of whom are regularly paying about Rs 50 per month towards the O&M cost of piped water schemes.

Kerala, Maharashtra, and Uttarakhand. Subsidies range from Rs 33–43 (US$0.8–1.0) per household per month in Andhra Pradesh, Karnataka, and Punjab. Subsidy is lower at about Rs 20 (US$0.4) per household per month in West Bengal and lowest in Uttar Pradesh and Orissa, at Rs 17 and Rs 10 (US$0.2) per month, respectively. This is mostly explained by the fact that a large proportion of rural households in these states are served by handpump schemes with much lower O&M cost as compared to piped water schemes.

The ratio of rural water supply subsidy to the state domestic product (SDP) is highest in Kerala, Tamil Nadu, and Uttarakhand (0.4 percent), followed by Andhra Pradesh, Maharashtra, and Orissa (0.3 percent), and Karnataka, Punjab, Uttar Pradesh, and West Bengal (0.2 percent).

The annual rural water supply subsidy estimated for the 10 states is about 160 percent of the annual expenditure on rural water supply, for the period 2003–04 to 2005–06. The subsidy is more than the expenditure because the former includes the interest and depreciation cost of past investments in rural infrastructure and indirect power subsidies for piped water supply schemes.

Comparison with Other Rural Subsidies

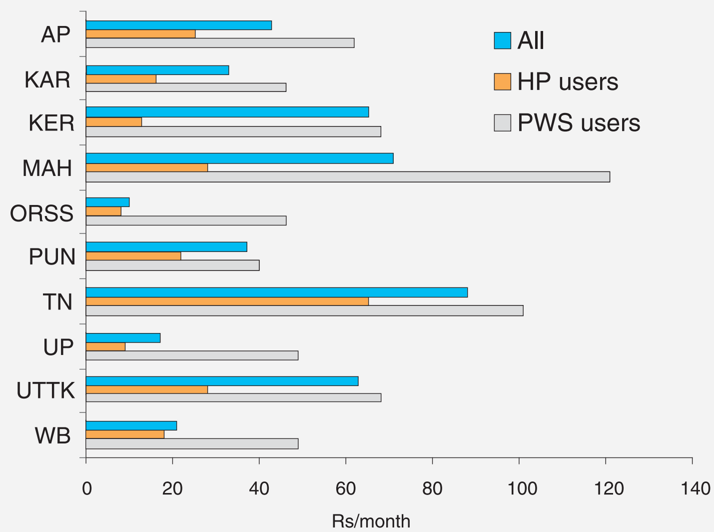
It is interesting to compare the extent of government subsidy being provided to rural water supply with subsidies being given to other sectors, such as rural power supply and rural roads. This will help in assessing how large is the rural water supply subsidy in relation to other subsidies for rural areas. In 2004–05, the total central subsidy as a ratio to the gross domestic product was 1.4 percent (*Economic Survey*, Government of India, 2005–06). An estimate of power subsidy provided to rural areas in different states during 1999 is available from a study undertaken by Gulati and Narayanan.[25] The ratio of power subsidy to SDP has been computed taking Gulati's estimates of power subsidy and the official data on State Domestic Product in 1999–2000. The ratio was 2.5 percent in Andhra Pradesh, and 2.6 percent and 2.9 percent, respectively, in Karnataka and Punjab.

[25] Ashok Gulati and Sudha Narayanan, The Subsidy Syndrome in Indian Agriculture, Oxford University Press, New Delhi, 2003.

The corresponding figure was much lower in Kerala, at about 0.2 percent. In Maharashtra, Punjab, Tamil Nadu, and Uttar Pradesh (including Uttarakhand), the estimated power subsidy as a ratio to SDP was in the range of 1.4–1.8 percent. This may be contrasted to the ratio of rural water supply subsidy to SDP, which is in the range of 0.2 to 0.4 percent. A comparison can also be made with regard to the subsidy for rural roads. According to a study undertaken by the National Institute of Public Finance and Policy (NIPFP), central subsidy on roads and bridges was Rs 63,630 million in 2003–04.[26]

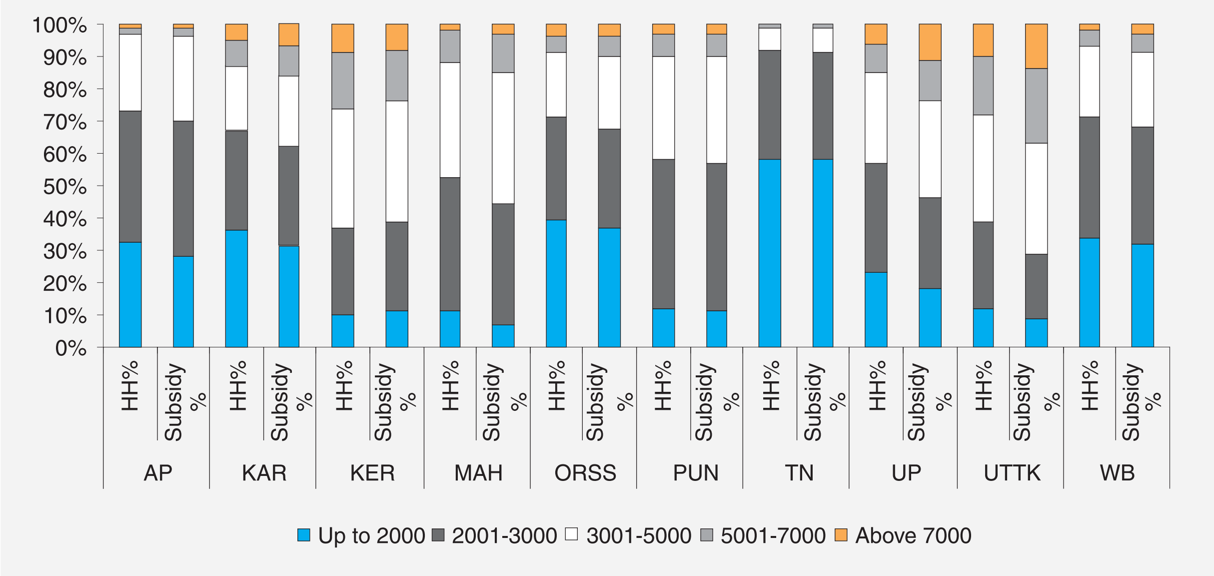
Considering the expenditure incurred by the state government and the central government on roads, the total subsidy on roads is estimated at about Rs 140,000 million per year. Out of this, only one-fifth expenditure is for rural roads, the rest is for other types of roads including highways.[27] Thus, making proportional adjustment, the subsidy on rural roads is about Rs 28,000 million, which is about 0.1 percent of the GDP. Compared to this, the ratio of RWS subsidy to SDP is higher. It is evident that the subsidy provided for rural water supply by state and central government is significant. While it is not quite as large as the

Figure 3.18 Household Subsidy for Handpump and Piped Water Supply Users



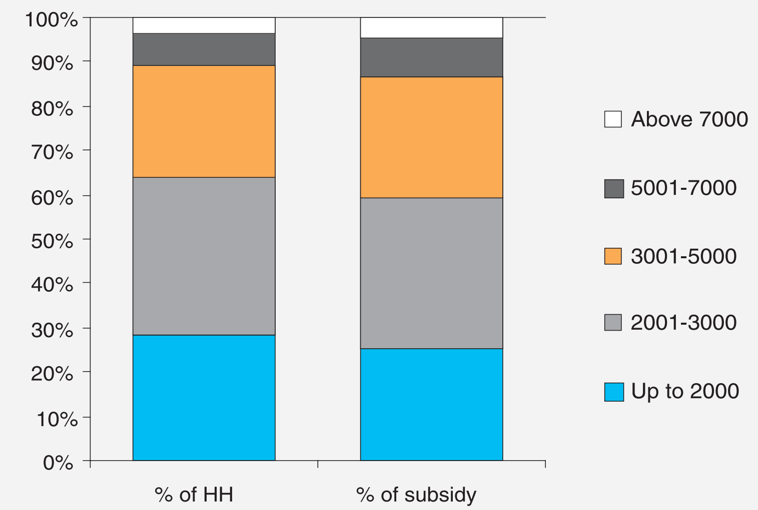
[26] *Central Government Subsidies in India: A Report* (prepared with the assistance of the National Institute of Pubic Finance and Policy), Ministry of Finance, Government of India, December 2004.
[27] Based on expenditure data on rural roads incurred under the Jawahar Rozgar Yojana, disbursement made by NABARD under RIDF (Rural Infrastructure Development Fund), and expenditure on rural roads under Basic Minimum Services (data taken from the website of Indiastat.com).

Figure 3.19 Distribution of Households According to Income Class, and Proportion of Subsidy Accruing to Households Belonging to the Incomes Classes, by State



Source: Flow of fund data and survey data on households and schemes.

Figure 3.20 Distribution of Subsidies Across Income Classes



Source: Flow of fund data and survey data on households and schemes.

subsidy for power in rural areas, it exceeds the level of subsidy for rural roads.

Power Subsidy for Piped Water Schemes in Rural Areas

Power subsidy is an important element of the subsidy that the state government provides for the operation of rural piped water supply schemes. The element of subsidy arises on account of: (a) water supply schemes are charged for power consumed at a rate lower than the cost of supply, (b) water supply agencies do not pay their electricity bills, and the arrears are ultimately written off. The first part is the indirect power subsidy component shown in Figure 3.17. The latter is a part of the O&M cost subsidy in that chart. From the secondary data collected, it is possible to estimate the extent of power subsidy in Kerala and Uttar Pradesh for the period 1997-98 to 2004-05 and 2001-02 to 2004-05, respectively. In Uttar Pradesh the power subsidy per year for rural piped water schemes increased from about Rs 110 million in 2001-02 to about Rs 150 million in 2004-05. The power subsidy as a ratio to total rural water supply expenditure was about 4 percent. In Kerala the power subsidy per year for Kerala Water Authority-managed rural piped water schemes on account of the difference between the cost of power supply and charges imposed on the water supply schemes is estimated at Rs 250 million. To this may be added the annual increment in payment arrears, of about Rs 20 million per annum in recent years (2002-03 to 2004-05). The power subsidy as a ratio to the rural water supply expenditure (Rs 2,500 million per year during 2002-03 to 2004-05) works out to be 11 percent.

Distribution of Subsidy Among Households

Figure 3.18 presents the estimated amount of subsidy per household (per month) for users of piped water supply and handpumps. Figure 3.19 presents a state-wise distribution of subsidy according to the income class of households. As can be seen from Figure 3.18, the level of subsidy per household is fairly high for the users of piped water supply as compared to the level of subsidy for users of handpumps. The subsidy for households using private piped water connections is even higher.

Figure 3.19 shows that the distribution of subsidy among income class is quite similar to the distribution of households according to income class. It appears that both rich and poor households in rural areas are benefiting almost uniformly from the government subsidy program. In Uttarakhand, for instance, 28 percent of households belonging to the income class 'above Rs 5,000 per month', receive an almost proportionate share of the subsidy of about 27 percent. A similar pattern is noted for other states. The distribution of subsidy and households across income classes for the 10 states combined is shown in Figure 3.20, which brings out that the rich and poor receive an almost proportionate share of the subsidy. Households earning up to Rs 2,000 per month account for about 28 percent of the total households and receive about 25 percent of the subsidy. Households earning more than Rs 5,000 per month account for 11 percent of the total households and receive 13 percent of the subsidy.

Summing Up

Supply-driven programs continue to dominate, accounting for over 85 percent of the fund flows. In supply-driven programs, there are large institutional costs, ranging from 15 percent to 50 percent. Also, a substantial part of the funds are utilized for meeting the O&M expenses of schemes. These tend to lower the portion of expenditure that gets translated into water supply infrastructure. Across states, the proportion of expenditure being incurred on capital cost in supply-driven programs ranges mostly from 30 to 70 percent. On average, the proportion is about 50 percent. In demand-driven programs, on the other hand, 70 to 80 percent of the expenditure is on capital cost.

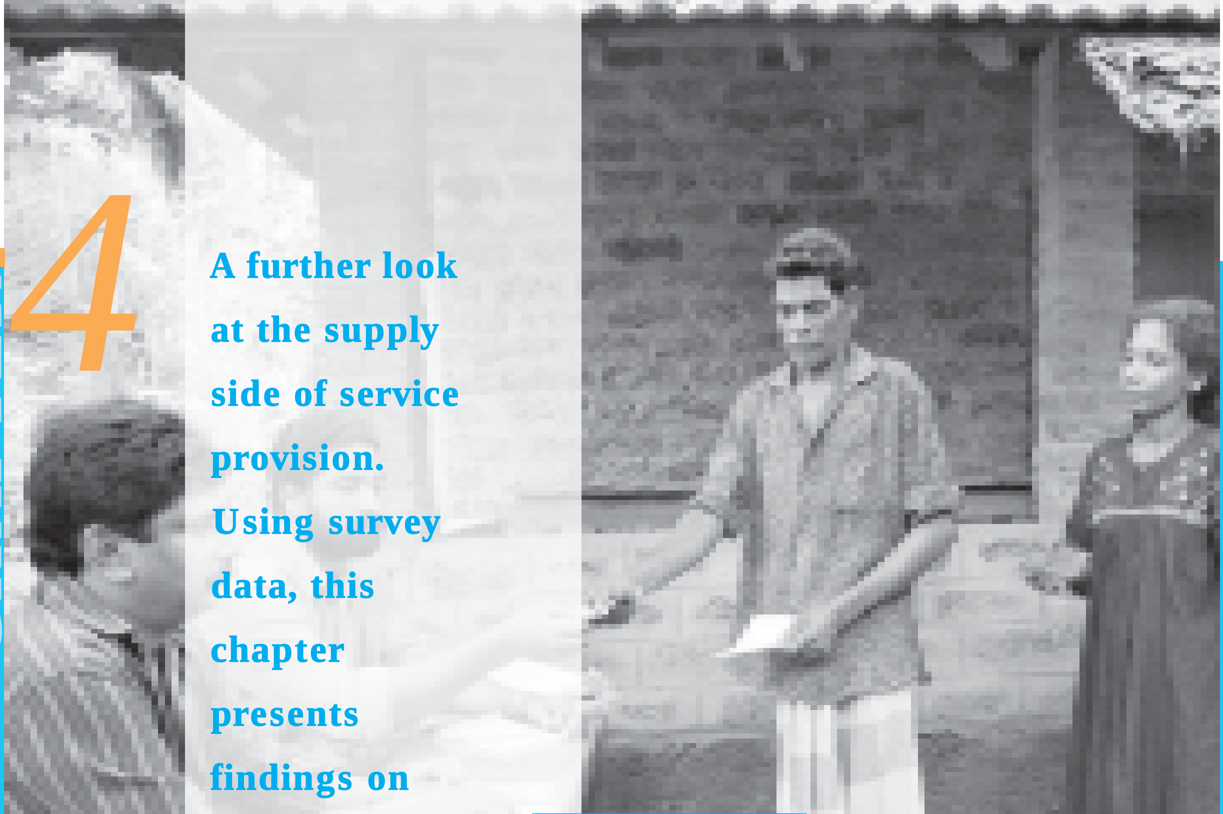
Huge subsidies are being given to rural households for water supply, accounting for 0.2 to 0.4 percent of the state domestic product of the 10 states studied. Subsidy to piped water users is much higher than that for handpumps users. Among piped water users, the per capita consumption of piped water, and hence subsidy per household, is greater for households having a private connection than that for households collecting water from a standpost. An interesting finding of the study is that both the rich and the poor in rural areas gain almost uniformly from the rural water supply subsidies.

To ensure that a greater portion of the government expenditure gets translated into water supply infrastructure and thus benefits the rural people, the institutional costs need to be contained. This calls for a much larger shift to demand-driven programs than at present. Since MVS by its nature tends to be in the supply-driven mode and involves huge institutional costs, independent appraisal and approval of MVS needs to be done. A bias in the technology choice toward MVS that appears to be prevailing at present needs to be checked so that MVS is set up only where it is really needed; this will help reduce institutional costs. For more effective utilization of the government funds, it is also important that the beneficiaries bear an increasing portion of the O&M costs. This calls for transfer of O&M responsibilities to the PRIs and/or user communities.

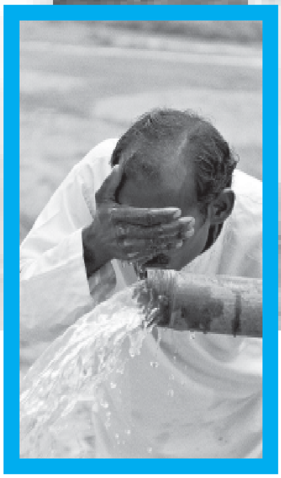
The process of the shifting of O&M responsibility of water supply schemes to the Gram Panchayats is being carried out by the state governments under various programs. The Swajaldhara program has also helped in the decentralization of water supply in rural areas. However, the adoption of sector-wide reform is important to achieve a major boost in decentralization of services. Special incentives could be provided to encourage states to adopt such reforms.

CHAPTER

4



A further look at the supply side of service provision. Using survey data, this chapter presents findings on the cost of service provision and cost recovery



Cost of Service Provision

In the previous chapter, data from state-level agencies were used to estimate the size and structure of the flow of funds and the amount of subsidy being provided for rural water supply in the 10 states under study. Chapter 4 further probes the supply side of service provision. Using survey data, it presents findings on the cost of service provision and cost recovery. The first section covers the capital and O&M cost of piped water schemes, followed by an analysis of handpump schemes; the last section analyzes issues related to cost recovery.

4.1 Cost of Piped Water Schemes

Capital Cost and O&M Cost

The survey covered about 520 piped water schemes including mini water schemes in the 10 states. Out of these, cost data could be collected and analyzed for about 450 schemes. The capital cost (inflation adjusted) of piped water schemes per household served ranges from less than Rs 2,000 (US$45) to over Rs 25,000 (US$568). The average cost of piped water schemes per household is approximately Rs 6,000 (US$136). In about 45 percent of the piped water schemes, the capital cost per household is less than Rs 4,000 (US$91), while in about 4 percent of schemes the capital cost per household exceeds Rs 20,000 (US$455).

The O&M cost of piped water schemes per household ranges from less than Rs 200 (US$4.5) per annum to more than Rs 1,500 (US$34) per annum. This translates into an average O&M cost per household of Rs 360 (US$8.2) per annum, or about Rs 30 (US$0.7) per month, across the schemes surveyed. In about 75 percent of these schemes, the O&M cost per household is less than Rs 400 (US$9) per annum, while in 7 percent schemes, it is more than Rs 1,000 (US$22.7) per annum.

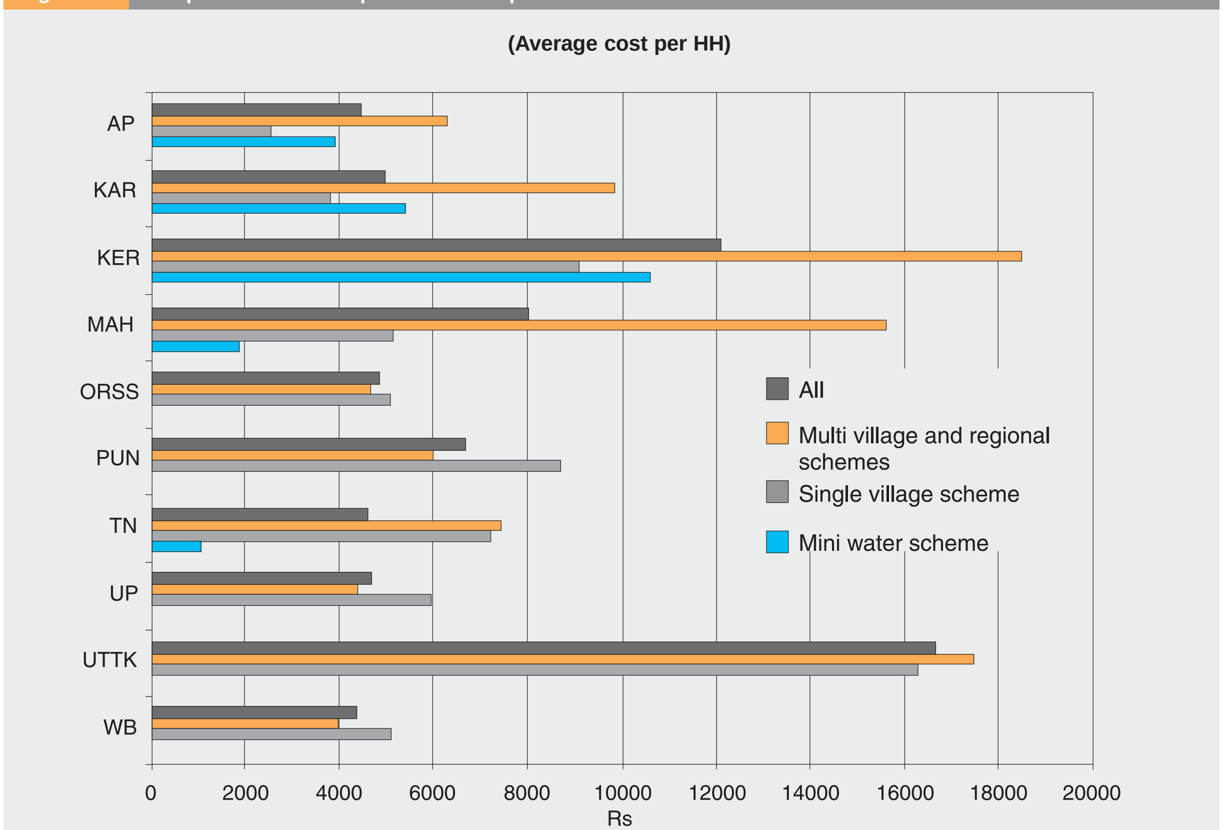
In Maharashtra the capital cost per household is higher than in several other states (for example, Andhra Pradesh, Karnataka, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, and West Bengal), but the O&M cost per household is the lowest

Figures 4.1 and 4.2, respectively, present data on the average capital cost and O&M cost per household for mini water schemes, single village schemes and multi village schemes, including regional schemes, in the 10 states surveyed.

A comparison of the data for the states shows that the capital cost per household for piped water schemes is the highest in Kerala and Uttarakhand, followed by Maharashtra and Punjab. The capital cost per household is comparatively lower in Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, Uttar Pradesh, and West Bengal. The O&M cost per household is relatively high in Kerala, Punjab, and Uttarakhand, as compared to Andhra Pradesh, Maharashtra, and Uttar Pradesh. It is interesting to note that in Maharashtra the capital cost per household is higher than in several other states (for example, Andhra Pradesh, Karnataka, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, and West Bengal), but the O&M cost per household is the lowest among the 10 states.

The explanation for the low O&M cost of Maharashtra schemes is possibly related to a higher subsidy for electricity charges. This is discussed further here.

Figure 4.1 Comparison of the Capital Cost of Piped Water Schemes



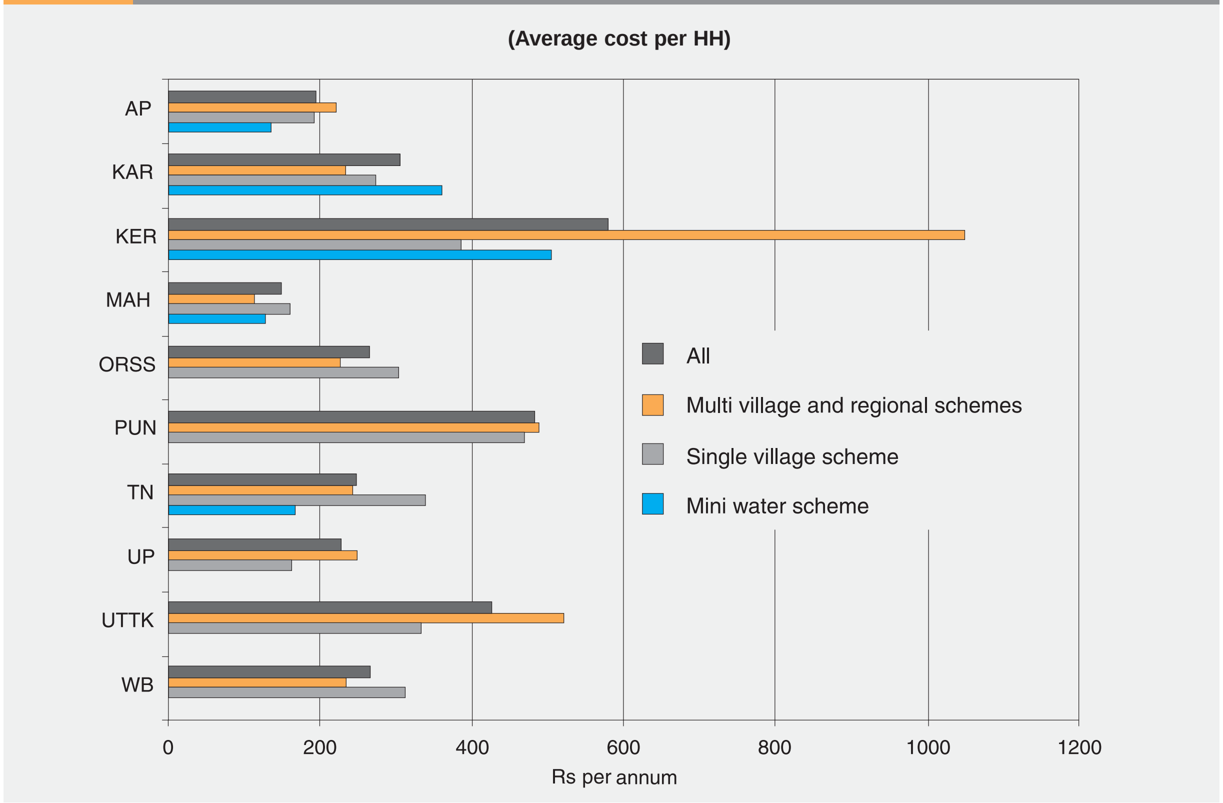
Source: Cost data collected from piped water schemes in the survey.
Note: (i) Capital cost has been adjusted for inflation (2005-06 prices). (ii) No mini water scheme has been covered in Orissa, Punjab, and Uttarakhand. Only two mini water schemes have been covered in Uttar Pradesh and only one in West Bengal, separate cost estimates are, therefore, not shown.

Reasons for State-Wise Differences in the Cost of Schemes

A component-wise break-up of the O&M cost per household for multi village schemes[28] in Maharashtra is presented in Figure 4.3 along with such break-ups for Tamil Nadu and Punjab.

[28] To ensure a comparison across similar types of schemes, a special analysis of multi village schemes has been undertaken for the three states.

Figure 4.2 **Comparison of the O&M Cost of Piped Water Schemes**



Source: Cost data collected from piped water schemes in the survey.
Note: No mini water scheme has been covered in Orissa, Punjab, and Uttarakhand. Only two mini water schemes have been covered in Uttar Pradesh and only one in West Bengal, separate cost estimates, therefore, not shown.

As may be seen from Figure 4.3, there is a large gap between the energy cost of multi village schemes in Maharashtra and that in the other two states. A part of the difference may be explained by differences in hydro-geological conditions across states with implications for varying depths of borewells. On an average, the depth of the borewell of piped water schemes is 85 meters in Tamil Nadu and 114 meters in Punjab, while it is only 37 meters in Maharashtra. This would reduce the energy requirements of multi village schemes in Maharashtra and thus lower the energy cost. But the observed gap in energy cost is too large to be explained by this factor alone. This difference may also be related to the subsidy for electricity in Maharashtra. Till recently, piped water supply schemes in Maharashtra were charged for electricity on the basis of horsepower of pumps, and not on actual power consumption. This might have lowered the payment for electricity charges. Maharashtra has recently changed over to a consumption-based charge for electricity for piped water supply schemes. But, it is possible that many of the schemes have not paid the arrears due to

Figure 4.3 Components of the O&M Cost of Multi Village Schemes

Source: *Cost data collected from piped water schemes in the survey.*

them. The nature and magnitude of this subsidy has not been analyzed, due to a lack of information and has, therefore, not been covered in the analysis of subsidy presented in the previous chapter.

It is interesting to note from Figure 4.3 that the cost of multi village schemes in Punjab is much higher than that of Maharashtra and Tamil Nadu. This is explained by the high cost of staff in the schemes in Punjab and by high overheads, which is included in the cost item, 'others'. Turning to other cases of high cost, the relatively high cost of piped water schemes in Uttarakhand may be partly attributed to the small size of villages and dispersed houses in the hilly areas of the state. Another reason could be that the actual population coverage of schemes is less than the design. The actual population coverage of piped water supply schemes of Uttarakhand is less than the design by about 30 percent in the case of single village schemes and by about 25 percent in the case of multi village schemes.

It should be noted that in Uttarakhand, the cost of pumping schemes is higher than the cost of gravity schemes (see Table 4.1). Within the group of pumping schemes, there are cost differences between low head and high head pumping schemes. High head pumping schemes are particularly known to be costly. This may be reflected in the high costs of piped water schemes in Uttarakhand, as shown in Figures 4.1 and 4.2. In Kerala, there are several reasons for the relatively high cost of piped water schemes. For example, the service level is mostly private tap (similar to Punjab), rather than mostly standpost (for example, in Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, and West Bengal) or a mixture of private tap and standpost. As households are not located contiguously, the expenditure on the distribution system is much higher as the total cost of the system (including the higher cost of distribution) is spread over comparatively fewer households. Consequently, most mini water systems are small in terms of the size of population served. In addition, in most cases, there are fewer households that depend on government schemes due to their preference for backyard well water. There are only a few standposts due to the linear profile of the settlements. Yet, the high cost cannot always be explained by the peculiarities of the situation; there are cases in Kerala and elsewhere in which the capital cost per household is exceptionally high, perhaps signifying a certain degree of inefficiency.

Comparison of the Cost of Piped Water Schemes with the Norm

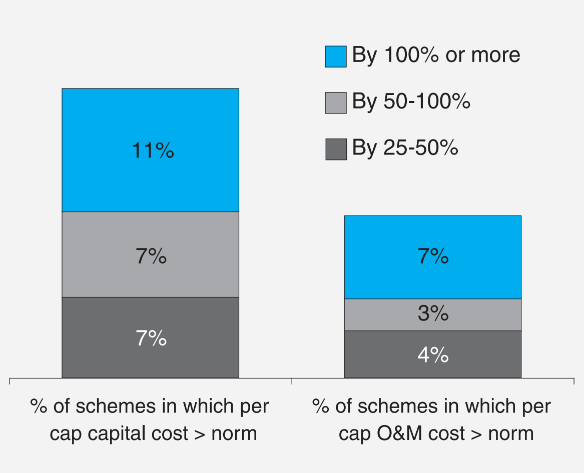
As the normative cost of piped water schemes is not readily available, it is difficult to establish to

Table 4.1 Cost of Schemes per Household in Uttarakhand (Gravity vs Pumping Schemes)

Technology	Capital cost per HH (Rs)	O&M cost per HH (Rs/year)
Gravity schemes	11,670	327
Pumping schemes	25,457	497
All	16,703	424

Source: *Cost data collected from piped water schemes in the survey.*

Figure 4.4 Actual Cost of Piped Water Schemes vs Cost Norm



Source: Computed from scheme-level cost data collected in the survey. Norms have been taken from Economic Evaluation Reports of the World Bank Projects, except UP for which a Sector Assessment Report is used.
Note: The total number of piped water schemes considered in the comparison of actual cost with norm is about 450.

what extent the cost of piped water schemes compare with these norms. For this study, data on the normative capital cost and O&M cost of schemes were derived from the economic evaluation reports of the World Bank rural water supply projects in Karnataka, Kerala, Maharashtra, Punjab, Tamil Nadu, and Uttarakhand (see Annex 4.1). For Uttar Pradesh, the capital cost norms for piped water schemes were obtained from a report prepared by the Project Management Unit, Swajal, Uttar Pradesh.

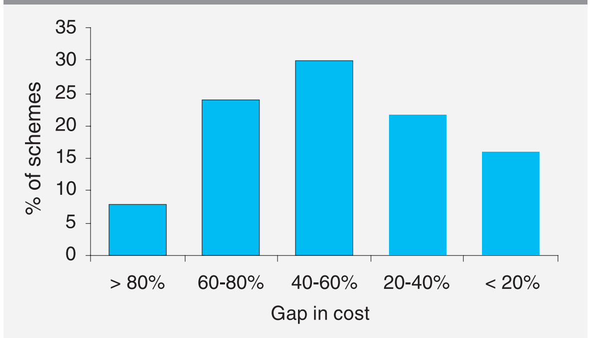
Figure 4.4 presents the proportion of piped water schemes in which the actual cost exceeds the norm. As can be seen from the figure, a number of schemes have exceeded the capital cost norm. In 18 percent of the schemes, the per capita capital cost exceeds the norm by 50 percent or more, and in 11 percent cases, the per capita capital cost exceeds the norm by 100 percent or more. The percentage of schemes in which the O&M cost exceeds the norm has also been assessed.

Findings show that in about 10 percent schemes, the actual O&M cost exceeds the norm by 50 percent or more, and in 7 percent schemes the actual cost exceeds the norm by 100 percent. A significant finding is that in about 60 percent of the schemes, the actual O&M cost was less than half the normative cost of the scheme. This is, however, not a sign of efficiency in O&M schemes, but rather a consequence of inadequate expenses being incurred on O&M.

The study also examined the ratio of actual O&M cost and 'good practice (design performance)' O&M cost (cost of providing water regularly at the design lcpd level and proper maintenance).[29] The ratio varies from less than 20 percent to more than 80 percent. The average ratio is about 50 percent. In other words, the actual cost, on average, is only about half of what the cost would be if the schemes were properly managed and maintained.

As can be seen from Figure 4.5, in 8 percent of the schemes, the actual O&M cost is less than

Figure 4.5 Gap between Actual and Design Performance O&M Cost (Piped Water Schemes)



Source: Computed from cost of scheme data collected from survey.
Note: The range of the gap between actual and design performance cost is indicated on the x-axis. The bars show the % of schemes that fall in a particular range.

one-fifth of the design performance O&M cost. The implication of such low expenditure on O&M is poor quality of services and inadequate maintenance of the infrastructure created.

The ratio of actual to design performance O&M cost varies across states, and across schemes under an alternate institutional arrangement within a state. An indication of the extent of variation across state/institutional arrangement is provided in Table 4.4.

[29] Two adjustments have been made to the cost data to work out the design performance O&M cost. First, an estimate of electricity requirement at the design performance level is worked out taking into account the population to be served, the design lpcd, and the pumping head. The cost of electricity is computed based on the requirement of electricity. The other adjustment relates to maintenance and repair. Annual expenditure required for maintenance and repair for the design performance of schemes is taken as 2.5 percent of the capital cost (inflation adjusted). The actual expenditure on maintenance and repair being made is generally much less than this norm. Wherever the actual expenses on maintenance and repair exceed the norm, the actual figure was used to compute the design performance O&M cost.

Econometric Analysis of Cost

An econometric analysis of cost was undertaken to understand the factors that influence the cost of piped water schemes. The capital cost and O&M cost of schemes were analyzed separately. The econometric model has been specified as:

$$\ln C = f(\ln HH, QL, TECH, WS, LPCD) + u \quad \ldots(4.1)$$

In this equation, C = cost; capital cost or O&M cost; HH = number of households served; QL = dummy variable for quality problem/status; TECH = technology; WS = water source, ground or surface water; LPCD = design or actual lcpd of the scheme; and u = random error term.

The cost functions were estimated using pooled data for about 450 piped water schemes in the survey for which cost data were available. Separate estimation of cost function was carried out for Uttarakhand and the other nine states. In the equations estimated for states other than Uttarakhand, dummy variables representing technology made a distinction between mini water scheme, single village scheme, and multi village and regional schemes. The cost equation for Uttarakhand was specified differently and separately estimated, because the dummy variables representing technology made a distinction among gravity, low head pumping, and high head pumping schemes, as well as between single and multi village schemes.

The analysis confirms the commonly accepted understanding of varying costs across different technology types—the costs are relatively low for mini water schemes compared to single village schemes, and for gravity schemes compared to pumping schemes. In contrast, the costs are relatively high for multi village and regional schemes as compared to single village schemes, and high for high head pumping schemes as compared to low head pumping schemes. Another inference that may be drawn from the econometric results is that the capital cost is higher for surface water schemes than groundwater schemes. Moreover, there are indications from the results that the O&M costs are relatively higher for schemes that are situated in areas with water quality problems.

The results of the econometric analysis reveal significant economies of scale—as the number of households covered by the scheme increases, the capital and O&M cost rises less than proportionately.[30] To examine the issue of optimum scale, a U-shaped cost function for capital and O&M cost was estimated separately for groundwater and surface water schemes. The cost per household was regressed on the scheme size in terms of the number of households served. A quadratic functional form was used. An important finding is that the optimum size of a groundwater-based scheme is 500 to 1,500 households. However, a large number of existing groundwater-based schemes serve 200 households or less, and are therefore not able to reap scale economies. For surface water-based schemes, the optimum size is about 4,000

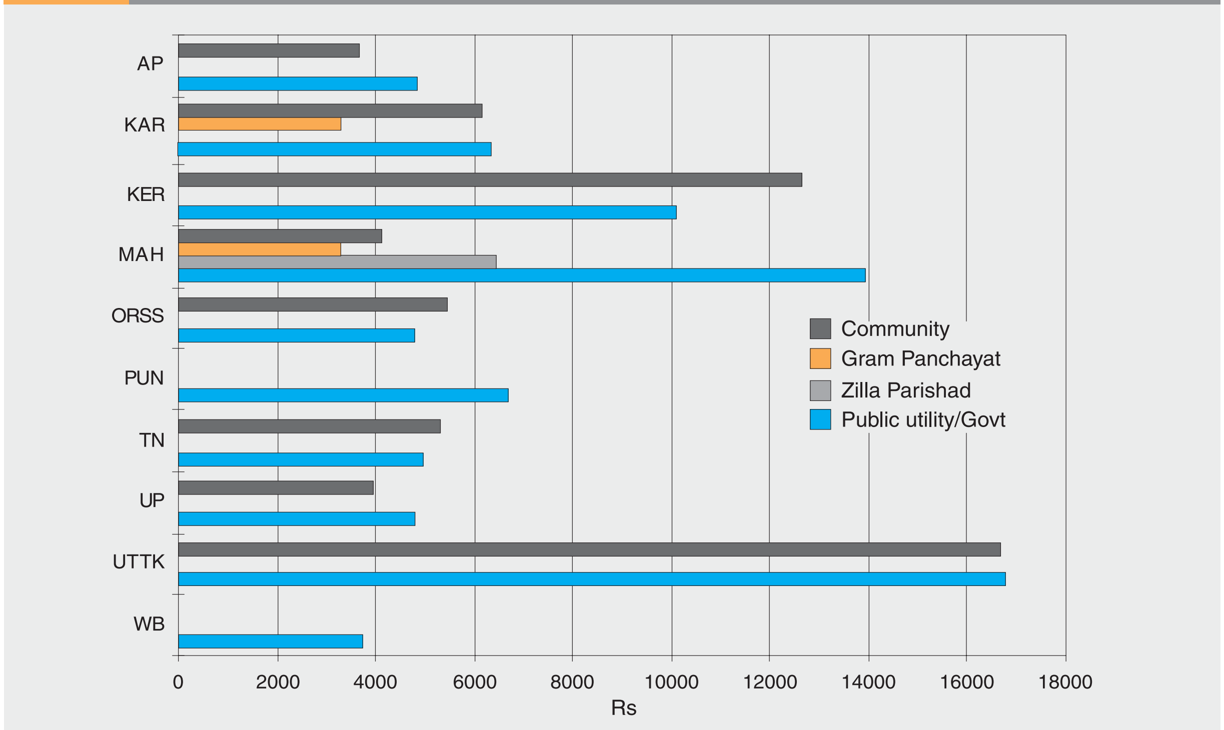
Table 4.2 Cost Comparison among Schemes of Five Sizes

Coverage (HHs)/ water source	Annualized capital cost per HH (Rs/year)	O&M cost per HH (Rs/year)	Economic cost per HH (Rs/year)
50 to 100	1,310	500	1,810
500 to 1,000	960	350	1,310
1,000 to 1,500	830	310	1,140
2,000 to 2,500			
- if based on groundwater	920	430	1,350
- if based on surface water	1,500	330	1,830
6,000 to 7,000			
- surface water-based	1,700	300	2,030

Note: *Annualized value of capital cost has been taken, annualized at the rate of 18 percent. Economic cost is obtained as the sum of annualized capital cost and O&M cost. HH = household.*

[30] The results of econometric analysis are presented and discussed in the Background Report on Ten State Analysis.

Figure 4.6 State-Wise Comparison of the Capital Cost per HH of Piped Water Schemes, by Implementing Agency



Source: Computed from scheme survey data.
Note: For each state, the costs are shown for only some of the categories because for the rest no scheme (or very few schemes) was covered in the survey.

households. Many surface water-based schemes are serving 7,000 households or more, and thus are affected by scale diseconomies. For both categories of schemes mentioned here, that is, groundwater-based schemes serving less than 200 households, and surface water-based schemes serving 7,000 or more households, the cost of water supply could have been lower if the schemes were designed for the optimum size. Based on the cost functions, an estimate of capital cost and O&M cost of schemes of different size and water source is presented in Table 4.2. This brings out clearly that a groundwater-based scheme serving 500 to 1,500 households will be less costly than a groundwater-based scheme serving 50 to 100 households or a surface water-based scheme serving 6,000 to 7,000 households.

State-Wise Comparison of the Cost of Schemes According to Implementation and Management Agency

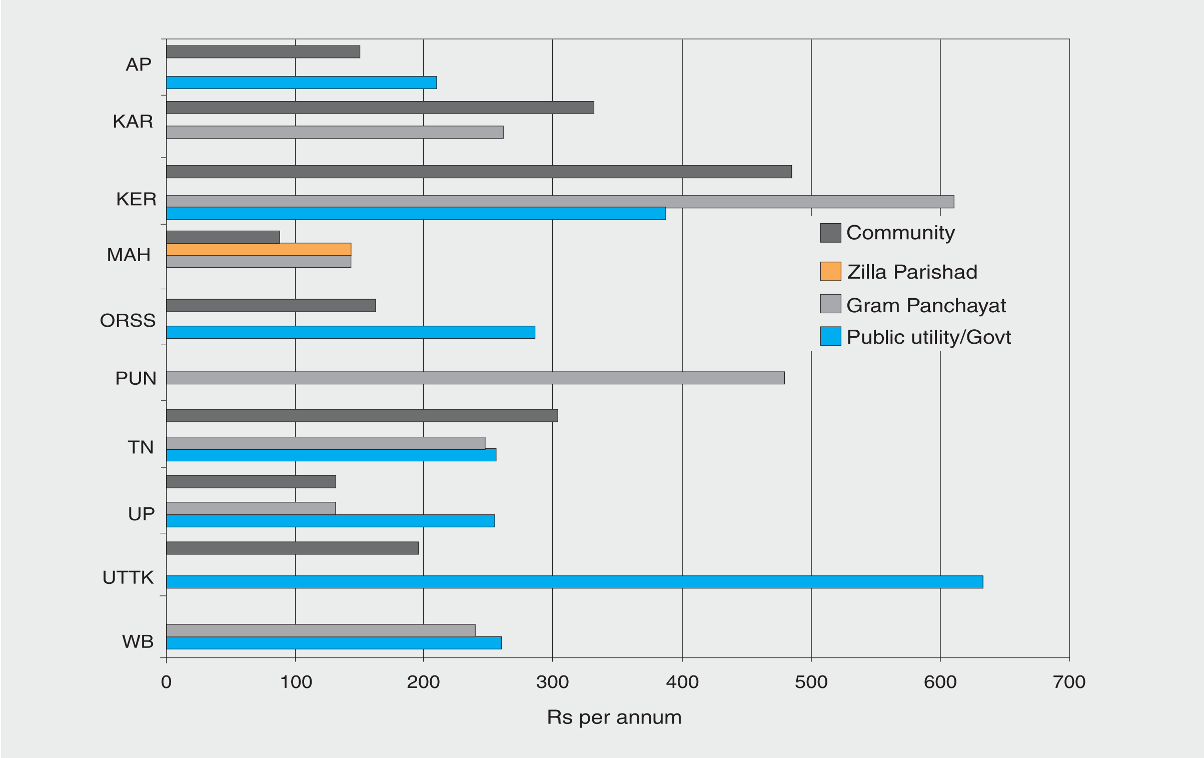
One would expect the institutional arrangement for the implementation and management of schemes to have an important effect. Motivated by this consideration, the study explored the comparative capital and O&M cost of piped water schemes across the 10 states according to the type of implementation/managing agency (Figures 4.6 and 4.7, respectively).

As can be seen from Figure 4.6, in five out of eight states[31] the capital cost per household is relatively lower in community-implemented schemes as compared to those implemented by public utilities or government agencies. However, when a comparison of community-implemented schemes is made with schemes implemented by Gram Panchayats, the cost of community-implemented schemes is higher.[32]

The O&M cost per household is relatively lower in community-managed schemes in five out of eight states.[33] These states are Andhra Pradesh, Maharashtra, Orissa, Uttar Pradesh, and Uttaranchal. But, in Karnataka and Tamil Nadu, the community-managed schemes have relatively higher O&M cost per household.

[31] In two cases, no community-implemented schemes have been covered in the study.
[32] The word 'community' is being used here in a narrow sense to refer to a group of households in a village or habitation who are accessing a water supply scheme and are involved from the planning and construction stage to the management stage of the scheme. A distinction is being made between the schemes that are directly implemented and managed by the community of users and the schemes which are implemented/managed by Gram Panchayats (or Zilla Parishads).
[33] In two cases, no community-managed scheme has been covered in the survey.

Figure 4.7 State-Wise Comparison of the O&M Cost per HH of Piped Water Schemes, by Managing Agency



Source: Computed from scheme survey data.

It is evident from this that no clear pattern emerges regarding the capital cost and O&M cost of schemes per household between the community-implemented/managed schemes and schemes implemented/managed by other agencies. However, in a majority of cases, community-implemented/managed schemes are found to be less costly.

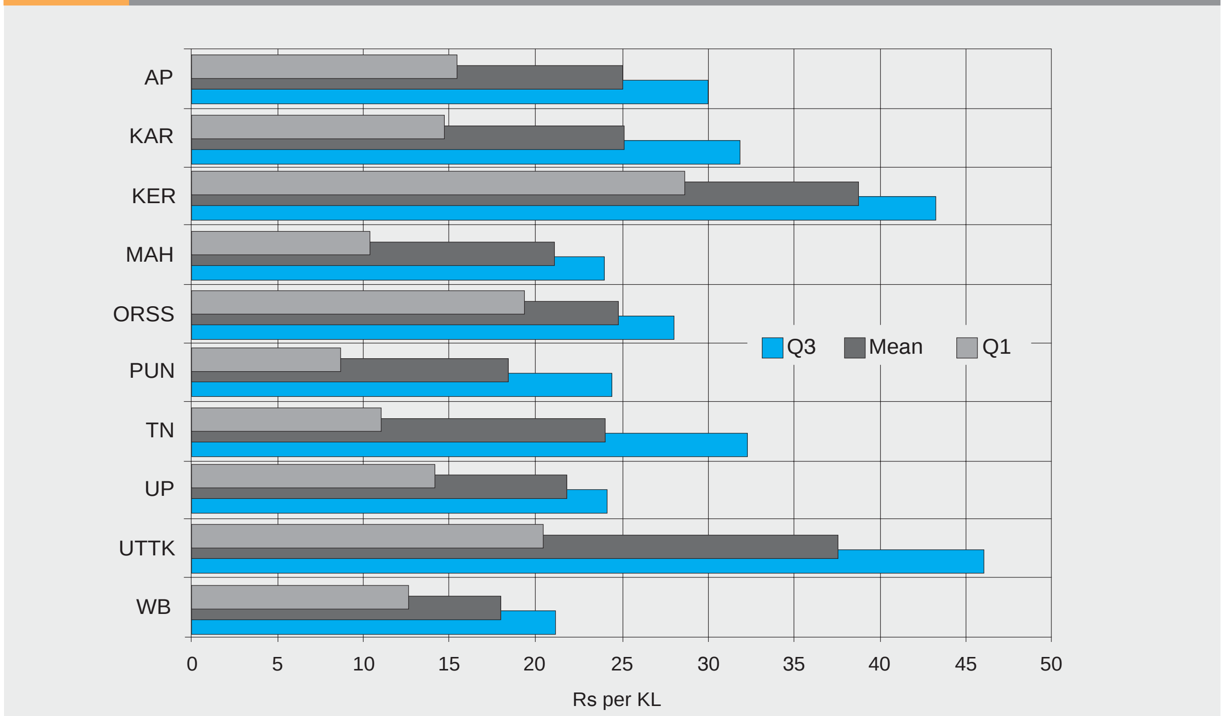
Total Cost of Piped Water Schemes

In addition to the capital and O&M cost of piped water supply schemes (discussed earlier), the supply of water in rural areas involves other costs. These include the capital[34] and O&M cost of supplementary government provided sources, and the coping cost borne by households (which includes the cost of own sources, the expenditure incurred by households for repair of government provided sources, and the opportunity cost of time spent for water collection from public standposts and public handpumps). The aggregate of these costs and the capital and O&M cost of the scheme is hereafter referred to as the total cost of the schemes. To explain the motivation for the analysis of the total cost, a scheme providing a low level of service may appear economic in terms of investments made and the cost of operations, but it may not really be economic in resource use if it imposes a heavy cost on the users. Thus, to judge the overall efficiency of a scheme it is important that the total cost of water supply be studied—the direct costs of the scheme and the indirect costs borne by the households (plus indirect costs of supplementary schemes) due to deficiencies of the service provided. A detailed analysis of coping costs is presented in Chapter 6. The findings from the analysis of the total cost of water supply are briefly discussed here.

The total cost per KL of water consumed has been computed for each of the schemes covered in the survey and the average then computed for each state. The estimates are for 2005-06. Figure 4.8 presents for each state the mean values of the estimated total cost of water supply per KL in various schemes of the state along with the first and third quartiles. The quartiles help in judging the extent of variation in cost across piped water

[34] Capital cost is annualized at the rate of 18 percent.

Figure 4.8 **Total Cost of Water Supply in Piped Water Schemes**



Q_1 = First Quartile; Q_3 = Third Quartile.
Source: Computed from survey data for schemes and households.
Note: (1) Total cost includes the capital and O&M cost of the scheme, the coping cost borne by user households, and the cost of any supplementary scheme.

schemes. In typical piped water supply schemes, the economic cost of water per KL is about Rs 16 (US$0.3).[35] The estimates of the mean total cost of water supply across schemes are above this value in all 10 states. In the case of Kerala, Orissa, and Uttarakhand, even the first quartiles are above this value. Evidently in the majority of schemes the cost of water supply per KL of water is higher than the expected cost of supply.

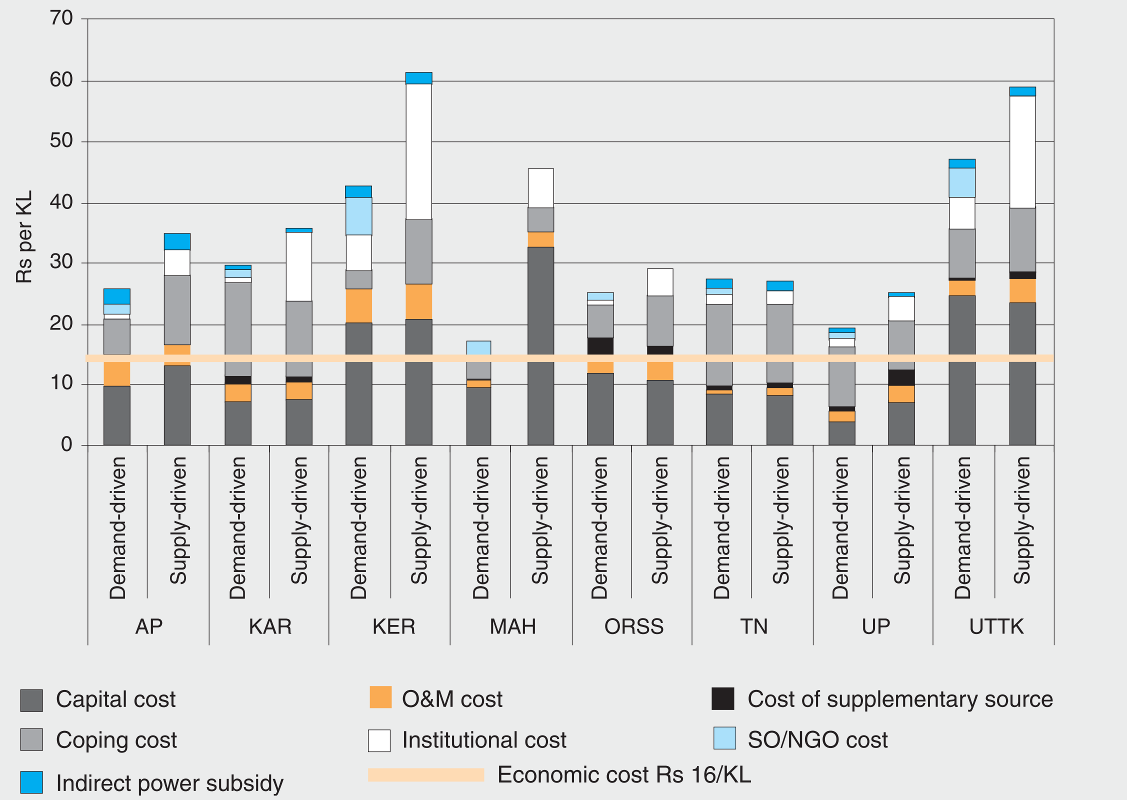
The study also compared the total cost of water supply of piped water schemes (per KL) by type of managing agency. The total cost of water was found to be relatively lower in Gram Panchayat-managed schemes (Rs 21 or US$0.5 per KL) as compared to government/public utility-managed schemes and community-managed schemes (about Rs 28 or US$0.6 per KL in both categories), but more than the cost in Zilla Parishad-managed schemes (Rs 19 or US$0.4 per KL).[36]

One limitation of the estimates of total cost of water supply presented above is that these do not include the institutional cost of schemes, since it is not possible to calculate the institutional cost

[35] Per capita investment in a piped water scheme (single village, groundwater-based) should be approximately Rs 1,400 (going by the weighted average of the cost norms), which translates into a monthly cost of about Rs 21 per month (annualizing capital cost at the rate of 18 percent). The per capita O&M cost in the schemes should be about Rs 10 (taking weighted average of norms). Thus, the total cost per month should be about Rs 31. To this, the efficient institutional cost should be added, which may be taken as 10 percent. Assuming the lpcd level to be about 70, the monthly per capita consumption would be about 2.1 KL. Thus, the cost of water supply should be about Rs 16 per KL.

[36] Costs in Zilla Parishad-managed schemes are found to be lower. But it should be noted that such schemes are present in the sample for only one of the 10 states studied (Maharashtra).

Figure 4.9 Components of Total Cost per KL of Water, Piped Water Supply Schemes



Source: Computed from survey data.
Note: Punjab and West Bengal are not included because a comparison between demand-driven and supply-driven schemes is presented for each state, but in Punjab and West Bengal the survey covered only supply-driven schemes.

separately for each scheme. Indirect power subsidy has not been included because of the difficulties in estimating the indirect power subsidy for each scheme. However, when schemes are split into the two groups, 'demand-driven' and 'supply-driven' schemes, then an estimate of the institutional cost and indirect power subsidy at the group level has been possible.

Figure 4.9 presents estimates of the total cost of water, including the institutional cost and indirect power subsidy, and compares schemes set up under demand-driven and supply-driven programs. As can be seen, the total cost of water supply is comparatively high in Kerala and Uttarakhand (Rs 42 or US$0.95 per KL in demand-driven schemes and Rs 61or US$1.4 per KL in supply-driven schemes in Kerala; Rs 47 or US$1.1 per KL and Rs 59 or US$1.3 per KL, respectively, in Uttarakhand). This may be traced mainly to the relatively high capital cost and O&M cost of piped water schemes in these states as noted above (refer to Figures 4.1 and 4.2). In general, the total cost of water supply is higher in supply-driven schemes as compared to demand-driven schemes; however, in the case of Tamil Nadu, the difference is not significant. Except for Maharashtra, other states do not compare well, with the estimated economic cost of Rs 16 per KL.

It would be noticed from Figure 4.9 that the coping cost forms an important element of the total cost of water supply, particularly in Andhra Pradesh, Karnataka, Tamil Nadu, and Uttar Pradesh. The figure also brings out that the direct costs of water supply are relatively low in Karnataka, Tamil Nadu, and Uttar Pradesh. But, once the coping cost and institutional cost are included, the sum total of cost goes up significantly. A dominant component of the coping cost is the opportunity cost of time spent for water collection from standposts.

4.2 Cost of Handpump Schemes

A state-wise comparison of the cost of handpump schemes is presented in Table 4.3. As can be seen, the average capital cost of deep-bore public handpumps is highest in West Bengal (Rs 73,000 or US$1,659), followed by Karnataka (about Rs 65,000 or US$1,477) and then by Maharashtra, Andhra Pradesh, Tamil Nadu, and Orissa, (Rs 40,000, Rs 43,000, Rs 47,000, and Rs 48,000, respectively). It is comparatively lower in Uttar Pradesh and Uttarakhand (about Rs 23,000 and Rs 34,000, respectively).

The main reason for the relatively high cost of public handpumps in Karnataka is the high cost of boreholes and pipes. However, the cost per household served is lowest in Karnataka as compared to the other states; this is because the number of households sharing a handpump is highest in Karnataka (66 households share a handpump on average as compared to 12 in Uttar Pradesh, and 18–26 households in Andhra Pradesh, Maharashtra, Punjab, Tamil Nadu, and Uttarakhand). The relatively high cost of handpump schemes in West Bengal is attributable to the relatively higher cost of pipes and engineering supervision and to the cost of water treatment equipment.

As can be noted from Table 4.3, the average annual O&M cost of handpumps is highest in Tamil Nadu (Rs 5,812 or US$132), followed by Andhra Pradesh (Rs 3,100 or US$70), West Bengal (Rs 1,867 or US$42), Uttarakhand (Rs 1,627 or US$37) and Punjab, Maharashtra, Orissa, Uttar Pradesh, and Karnataka (Rs 700–1,100 or US$16-25). The O&M cost per household per annum is about Rs 63 (US$1.4) in Uttarakhand and Rs 70 (US$1.6) in Uttar Pradesh, which works out to about Rs 5–6 per month.

The monthly cost per household is far less in Karnataka, Maharashtra, Orissa, and Punjab (Re 1 in the first and Rs 3 in the latter three states). It is slightly higher in West Bengal, at about Rs 3.7 per household per month. Among the states surveyed, the O&M cost per household is highest in Tamil Nadu (Rs 27 or US$0.6 per month), followed by Andhra Pradesh (Rs 10 or US$0.2 per month).

The O&M costs are comparatively higher in Tamil Nadu as compared to the other states because large parts of the state are acutely affected by groundwater exploitation, and the lowering of the water table adversely impacts the performance and maintenance of schemes due to frequent source failures. It should also be noted in this context that the dependence per handpump is low as the yield per source is limited and cannot sustain a large population, especially in summer.

Table 4.3 Cost of Deep-Bore Handpump Schemes

	Capital cost per handpump (Rs)	O&M cost per handpump (Rs per annum)	No of HHs served	Capital cost per HH (Rs)	O&M cost per HH (Rs per annum)
Andhra Pradesh	43,407	3,100	26	1,670	119.2
Karnataka	65,000	764	66	985	11.6
Maharashtra	40,226	923	25	1,609	36.9
Orissa	48,206	1,070	31	1,555	34.5
Punjab	35,312	714	20	1,766	35.7
Tamil Nadu	47,040	5,812	18	2,613	322.9
Uttar Pradesh	22,900	839	12	1,908	69.9
Uttarakhand	34,471	1,627	26	1,326	62.6
West Bengal	73,328	1,867	42	1,746	44.5

Information on cost norms for deep-bore handpumps is quite sketchy. However, going by the available information, the capital cost of deep-bore handpumps should be in the range of Rs 40,000 to Rs 60,000 in the Bundelkhand area of Uttar Pradesh, hilly areas of Uttarakhand, north Karnataka, Maharashtra, and Tamil Nadu. The cost should be Rs 20,000 to Rs 30,000 in the plains of Uttar Pradesh, Kerala, and most part of Karnataka (excluding north Karnataka). The capital cost of the handpump schemes surveyed is more or less within the norms. However, as noted above, the handpumps are shared by much fewer households than the norm (50 households per handpump) and, therefore, in per capita terms the cost of handpumps is excessive, except in the case of handpumps in Karnataka.

As regards the O&M cost, the available information indicates a norm of Rs 1,600 to Rs 3,000 per handpump per year, or higher, depending on the local condition. It would be noticed from Table 4.3 that the average expenditure being incurred is commonly well below this range, thus indicating that adequate maintenance of the handpump is not being done.

4.3 Cost Recovery

An important dimension of the effectiveness of schemes is cost recovery, particularly O&M cost recovery, since this is at the heart of financial sustainability. The study explored cost recovery in various schemes, including piped water schemes, handpump schemes, and schemes managed by different agencies.[37]

Piped water schemes are only making a partial recovery of the O&M cost. In piped water schemes (including mini water supply schemes), the extent of O&M cost recovery is about 1 percent in West Bengal, 6 percent in Tamil Nadu, 19 percent in Orissa, 21 percent in Andhra Pradesh, 30 percent in Uttarakhand, 36 percent in Uttar Pradesh, 47 percent in Karnataka, 60 percent in Kerala, 61 percent in Maharashtra, and 86 percent in Punjab (Table 4.4). In Tamil Nadu and Andhra Pradesh, most rural households access water supply through a standpost (or mini water tank). About 80 percent of such households in Tamil Nadu and about 90 percent of such households in Andhra Pradesh are not charged for water. The consequence is obviously a low recovery of O&M cost.

The situation is similar in West Bengal and Orissa. Piped water is accessed predominantly through standposts rather than private connections. About 80 percent of standpost users in Orissa and more than 95 percent of standpost users in West Bengal are not charged. In contrast, most households in Punjab have a private connection and are required to pay regularly. This explains the high level of cost recovery in Punjab, despite the cost being relatively high. The relatively superior cost recovery performance of piped water schemes in Maharashtra is attributable to the following factors—the cost is low due to heavy subsidies for energy; the proportion of standpost users is relatively less as compared with Andhra Pradesh, Orissa, Tamil Nadu, and West Bengal; the standpost users are generally charged; and most of the standpost and private connection users are paying the water charges.

[37] Cost recovery is assessed on the basis of payments received from users. There are cases where the Gram Panchayat or other such institutions may be directly paying for the electricity cost of piped water schemes. This is not considered as cost recovery, since the focus is on recovery from users.

Table 4.4 O&M Cost Recovery and the Ratio of Actual to 'Design Performance' O&M Cost in Piped Water Supply Scheme, by State and Institutional Arrangement

Scheme implemented by...managed by	O&M cost recovery (%)										Ratio of actual to 'design performance' O&M cost (%)									
	AP	KAR	KER	MAH	ORSS	PUN	TN	UP	UTTK	WB	AP	KAR	KER	MAH	ORSS	PUN	TN	UP	UTTK	WB
Community Community	10	51	95	80	67		43	83	89		45	52	48	33	56		50	25	40	
Gram Panchayat Community		39	94									68								
Public utility Community			62										76							
Gram Panchayat Gram Panchayat		53	74	60						3		60	100	55						39
Government Gram Panchayat		45				86						58				52				
Government Government	25				9					1	52				57					57
Public utility Gram Panchayat							1	70						15			67	38		
Public utility Zilla Parishad				51										24						
Public utility Public utility			13				6	29	11				94				59	47	63	
Zilla Parishad Zilla Parishad				56										46						
All/average	**21**	**47**	**60**	**61**	**19**	**86**	**6**	**36**	**30**	**1**	**50**	**57**	**67**	**38**	**57**	**52**	**62**	**43**	**53**	**56**

Source: *Computed from household and scheme survey data.*
Note: *Design performance O&M cost is the cost of providing a regular supply of water at design lpcd and undertaking proper maintenance. Some cells are empty because schemes of that type have not been covered in the survey of the state.*

As can be seen from Table 4.4, the performance of community-implemented and managed schemes is relatively better than schemes implemented and managed by public utilities or the government, which are recovering only a small portion of the O&M cost. Andhra Pradesh is an exception in this regard, since even community-constructed and managed schemes are recovering only about 10 percent of the O&M cost. The households using a standpost (or a mini water tank) in demand-driven schemes in Andhra Pradesh are mostly not charged (in about 90 percent cases). Since such households form the dominant portion of the users, the cost recovery is very low.

It is interesting to note that the community-managed schemes are spending about 25 to 56 percent of the cost that is needed to run the scheme at design performance level (see Table 4.4). In contrast, the proportion of actual cost to good practice 'design performance' O&M cost is relatively higher in schemes being managed by public utilities and government agencies.

Cost recovery in handpump schemes is very low. In the household survey, 3,207 handpump users were covered in Uttar Pradesh, 840 in Orissa, 760 in West Bengal, 524 in Uttarakhand, 520 in Andhra Pradesh, 440 in Maharashtra, 400 in Tamil Nadu, 397 in Karnataka, 358 in Punjab, and 239 in Kerala. In most cases, users are not contributing to the cost of repair and maintenance of handpumps. In Karnataka, 15 percent of handpump users reported that they regularly pay the charges for the repair/maintenance of handpumps. The corresponding percentage for Uttarakhand is about 10 percent. Most of these households are using handpumps in demand-driven schemes. In Orissa, about 6 percent of handpump users report that they regularly pay the charges for the repair/maintenance of handpumps. In contrast, in Andhra Pradesh, Kerala, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh, and West Bengal, almost no household reported that they were regularly paying any charges for the repair/maintenance of handpumps. The handpump users covered in the survey of these states are mostly using supply-driven schemes.

Although in almost all cases, households using handpump schemes in Uttar Pradesh are not paying any charges for the maintenance of handpumps, about half (48 percent) are incurring expenses on a personal basis for the repair of the public handpumps; a typical household pays about Rs 70–80 per year. In Orissa, about 40 percent of the households using handpumps spend on a personal basis for the repair of public handpumps. A typical household spends about Rs 50 in a year. To some extent, this is true of Uttarakhand and West Bengal as well, where about 20 percent and 12 percent of households, respectively, using handpump schemes spend on a personal basis for the repair of handpumps. A typical household in Uttarakhand spends about Rs 50 a year and in West Bengal about Rs 60–70 a year. Of the handpump users in Karnataka and Kerala, about 5 percent and 4 percent, respectively, spend on the repair of public handpumps. This proportion is almost nil in Andhra Pradesh, Kerala, Maharashtra, Punjab, and Tamil Nadu; in these states, most households are neither paying maintenance charges for handpumps, nor incurring personal expenses for the repair of public handpumps.

Summing Up

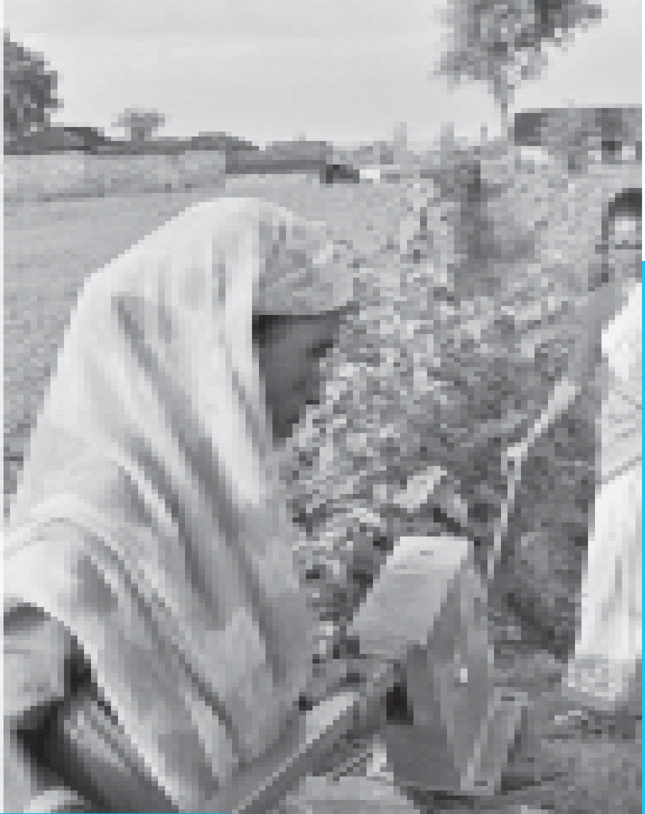
The two main findings of the analysis of the cost of schemes are that a section of piped water schemes have excessive capital cost and most piped water schemes and handpump schemes are not spending adequately for O&M. The total cost of water supply is high, well above the expected cost per KL of a well performing scheme. The demand-driven schemes have a distinctly lower total cost of water supply than supply-driven schemes, reflecting the efficiency advantages of demand-driven programs. There are indications of significant economies of scale with respect to the size of schemes (number of households covered), and unless these economies are reaped, the cost of piped water schemes will be more than what these ought to be. Cost recovery is found to be low. But, the community-managed schemes, that is, the demand-driven schemes, have a much better performance in this regard as compared to government/public utility-managed schemes.

The relatively low cost and higher cost recovery of community-managed schemes point towards the need for a major push in the direction of demand-driven schemes. To ensure that least cost options are implemented, the demand for schemes from the bottom will have to be reconciled with the top-down planning. Such planning could be at the district level. The plans will take into account the demand for schemes arising from the bottom (that is, user communities) and the advantages of having larger schemes, especially in areas marked by groundwater over-exploitation and water quality problems. The setting up of multi village schemes does not necessarily imply that decentralization of delivery will have to be given up. In such schemes, the bulk water supply and water distribution could be unbundled. Bulk supply could be managed by a professional public or private operator, who could enter into an enforceable contract with the GP and/or user committee that is responsible for the distribution at the local level.

Going by the considerations of economies of scale, schemes of 500 to 1,000 households or 1,000 to 1,500 households would be economic. Multi village schemes are commonly much larger in size and hence suffer from some degree of scale diseconomies. It would be beneficial to break up multi village and regional schemes into smaller schemes at the village level and hand over the responsibility to the village community/GP with contractual agreements and performance improvement targets between the user groups and the bulk water providers.

CHAPTER 5

Comprehensive analysis of the effectiveness of piped water schemes is based on indices of effectiveness compared across technologies and service delivery agencies



Performance of Schemes

As mentioned in Chapter 1, the main objective of this study is to assess the effectiveness of rural water supply schemes in providing access to safe water to households. Performance is judged on the basis of the following four parameters: reliability and adequacy of water supply; affordability; environmental sustainability; and financial sustainability of services.

A comprehensive analysis of the effectiveness of piped water schemes is undertaken based on indices of effectiveness compared across technologies and service delivery agencies. A similar analysis is presented for the performance of handpump schemes.

Issues related to the sharing of public water supply sources, water shortages, and breakdowns are subsequently discussed.

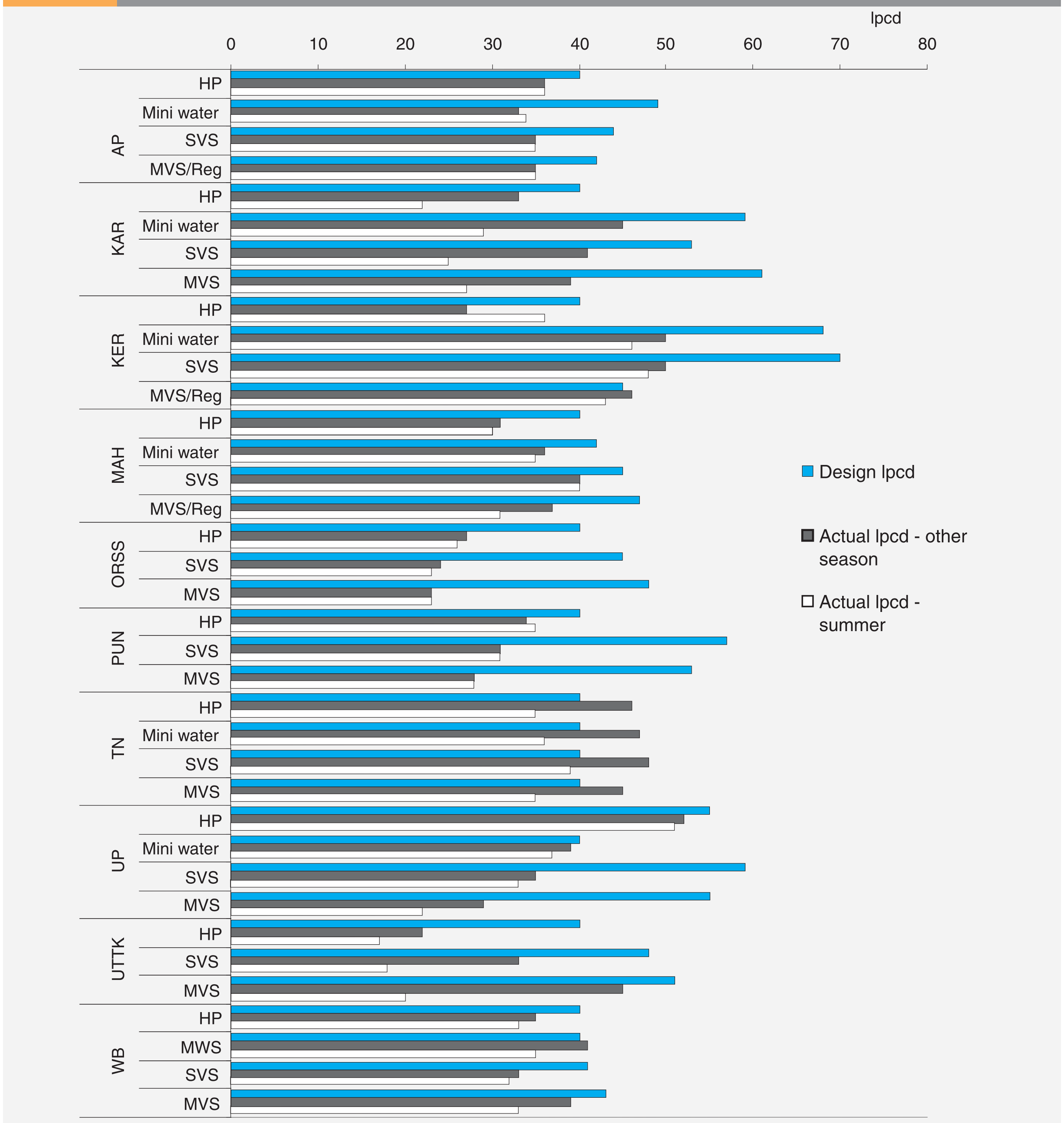
5.1 Limitations in Service Provision

The study findings reveal that actual services provided by piped water supply schemes fall short of design in several respects. For example, in the 10 states surveyed, the actual supply of water is often lower (more so in summer) than the quantity of water the schemes were designed to supply. The design norm generally ranges from 40 to 70 lpcd, and in some cases goes up to 90 lpcd or

The study findings reveal that actual services provided by piped water supply schemes fall short of design in several respects

more (Figure 5.1). Among multi village schemes in Uttar Pradesh, the design lpcd is 55 on an average while the actual lpcd in summer is 22 on an average. Similarly, the design lpcd of single village schemes in Karnataka, Punjab, and Uttarakhand is 53, 57, and 48, respectively, while the actual lpcd in summer is 25, 31, and 18, respectively.[38] The water supplied by the schemes is often

Figure 5.1 **Design and Actual LPCD**

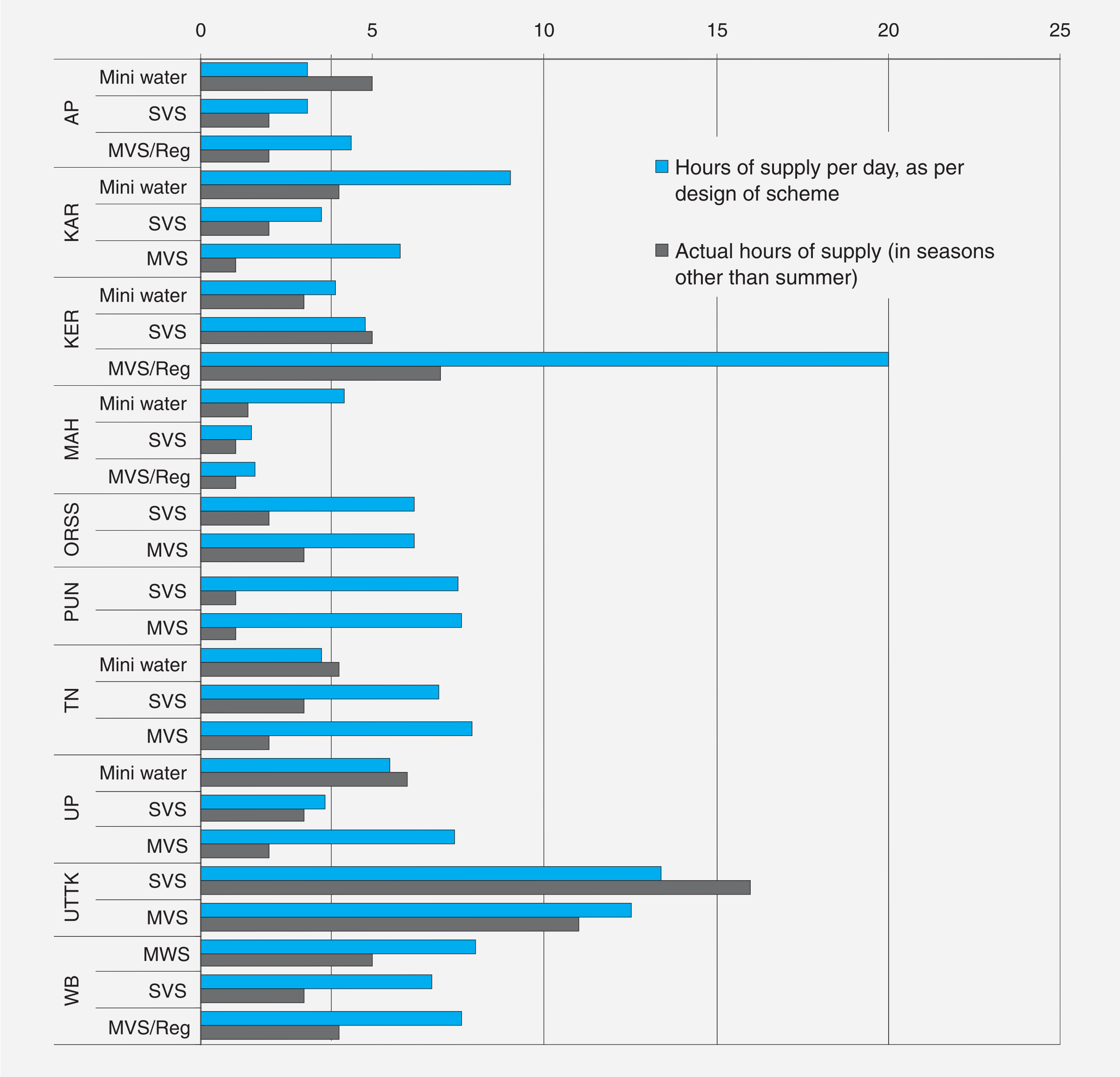


Source: Survey data for households and schemes.

Note: The summer season in different parts of the country is generally two to three months, say, May to July.

[38] Tamil Nadu is an exception among the 10 states surveyed. Household data indicate that the lpcd level in non-summer months is more than the design lpcd average of surveyed schemes. It should be noted, however, that in summer the lpcd level falls short of the design.

Figure 5.2 Hours of Piped Water Supply per Day



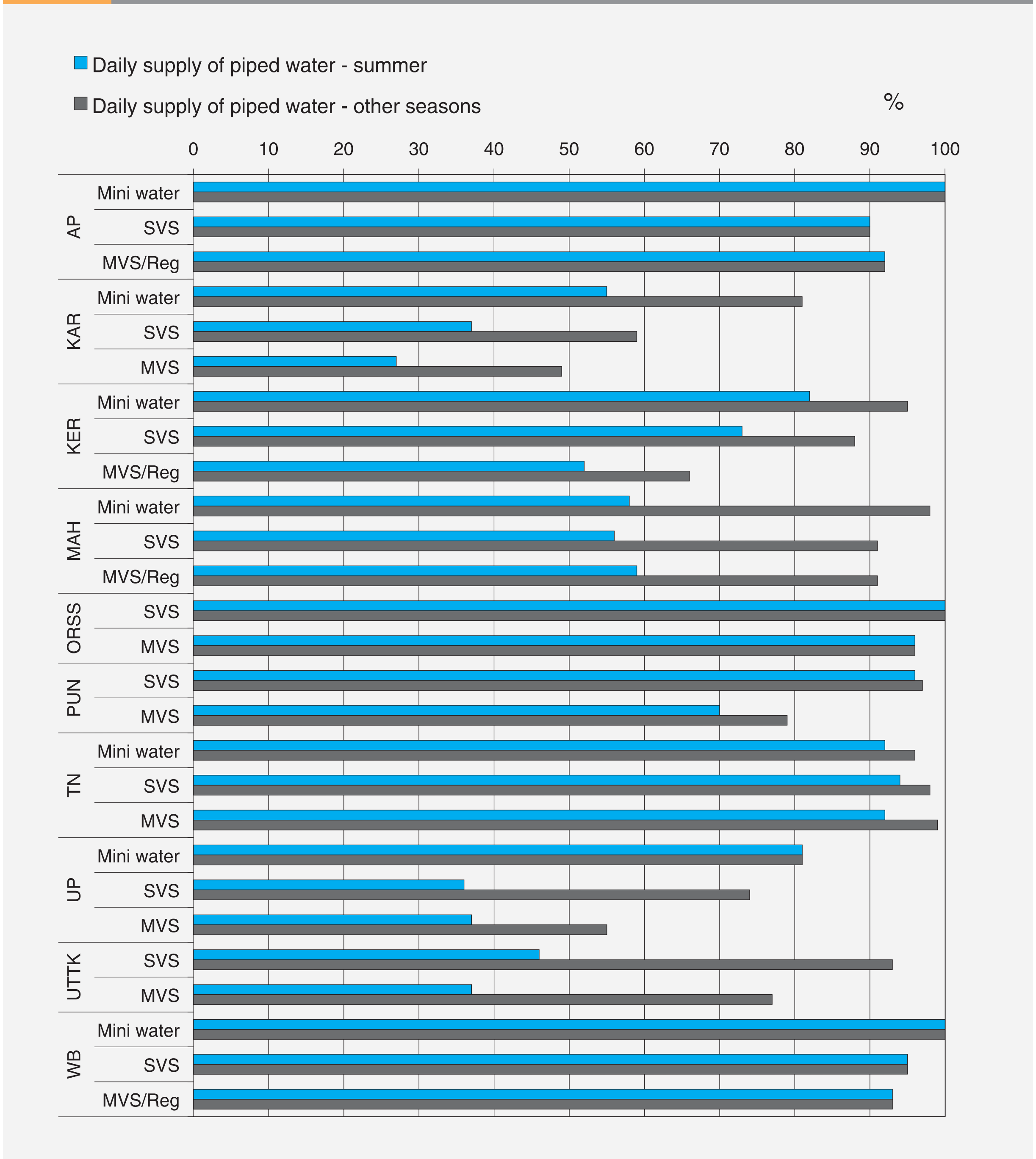
Source: Survey data for households and piped water supply schemes.
Note: (i) The summer season in different parts of the country is generally two to three months, say, May to July. (ii) Design hours reported by multi village schemes in Kerala are exceptionally high. It should be noted that this is based on the information provided by only two schemes out of the eight multi village/regional schemes covered in the study. (iii) Design hours are hours of water supply as per scheme design, not hours of pumping.

inadequate, and does not fully meet the water requirements of the households,[39] particularly in summer. For example, the majority of households in Uttarakhand and Karnataka (80 percent and 55 percent, respectively), and a significant proportion in West Bengal (50 percent), Orissa (45 percent), Kerala and Punjab (30 percent), Tamil Nadu (23 percent), and Uttar Pradesh (20 percent) could meet less than half of their water requirement in summer from the main water supply scheme accessed by them.

Similarly, the actual hours of water supply are generally less than the design hours (Figure 5.2). For example, for piped water schemes in Punjab, the design hours of supply in a day are about seven, while the actual hours is about one. For single and multi village schemes of Tamil Nadu, the design hours are seven to eight and actual hours of supply are two to three, respectively.

[39] This finding, based on water consumption reported by households, is corroborated by the water consumption study undertaken for about 200 households in seven states. See Annex 5.3.

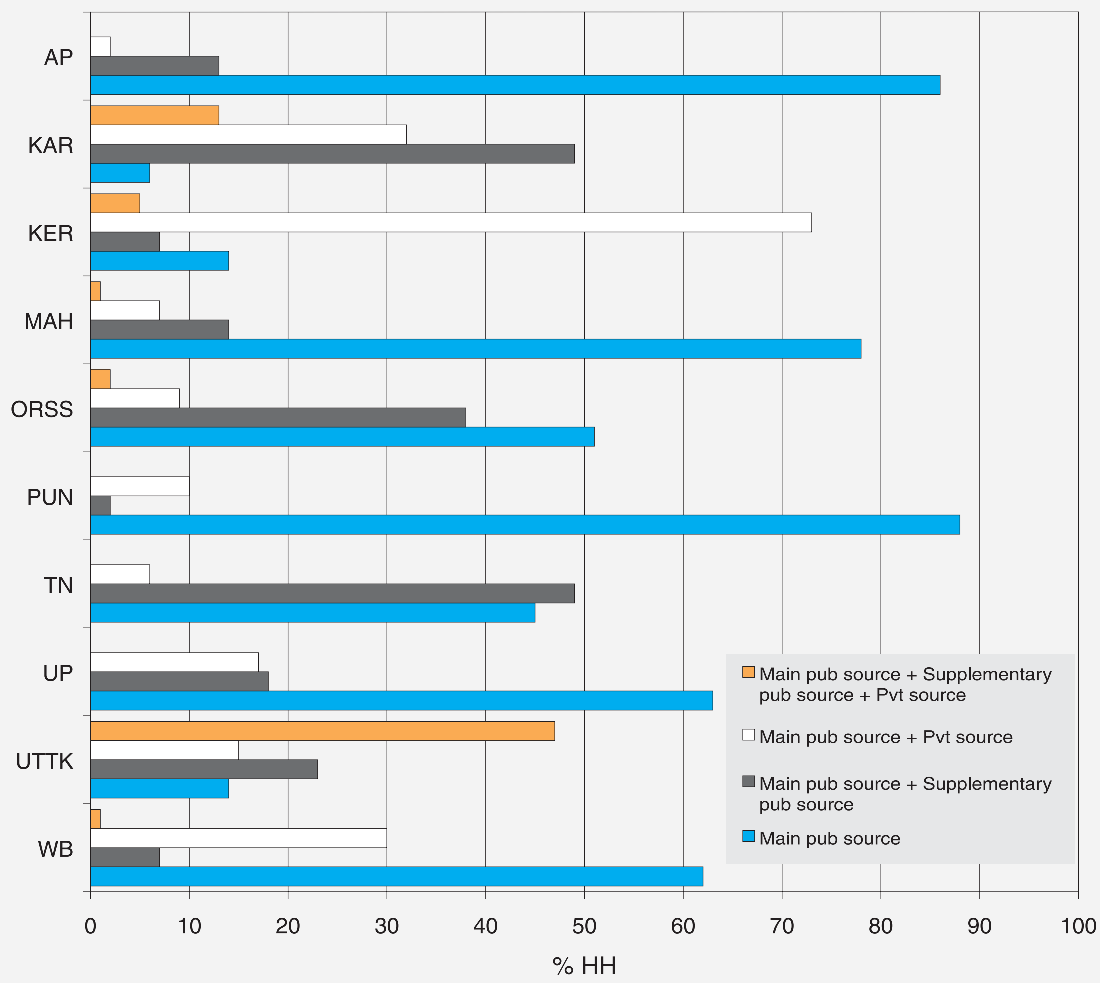
Figure 5.3 Percentage of Households Reporting a Daily Supply of Piped Water



Source: Computed from household survey data.

Across states, the actual hours of water supply are found to be relatively low in Karnataka, Maharashtra, and Punjab than in the other states. It should be noted that a significant proportion of households do not get a daily supply of water, particularly in summer (Figure 5.3). In Karnataka, Uttar Pradesh, and Uttarakhand, the majority of households using single and multi village schemes do not get daily supply in summer. Among them, the households of Karnataka have a further difficulty that they are provided with only limited hours of supply on the days water is supplied. Due to these limitations in service provision and to meet their

Figure 5.4 Dependence on Multiple Sources



Source: Survey data for households.

water requirements, rural households typically have to depend on multiple water sources (Figure 5.4). About 50 percent households combine the main public water supply source with a supplementary public source, or a private source, or both. Across the states, dependence on multiple water sources is relatively higher in Karnataka, Kerala, and Uttarakhand, followed by Tamil Nadu, than in the other states.[40] There are no significant differences in regard to the level of dependence on multiple water sources across schemes under alternate service delivery institutions. In community-managed schemes, dependence on multiple sources is found to be as high as in schemes managed by Gram Panchayats and public utilities.

5.2 Performance of Piped Water Schemes

Four indices of effectiveness have been constructed to assess the performance of piped water schemes, presented below.

Indices of Effectiveness

The indices relate to reliability and adequacy; affordability; environmental sustainability; and

[40] Multiple dependence arises because the main scheme is not able to adequately meet the water supply requirements of the households. This involves a loss to the society in terms of resources deployed for water supply. Multiple dependence is not inevitable in rural areas, and this is brought out by the inter-state variation in the extent of multiple dependence. If a scheme provides sufficient water regularly so that the households do not have to use other sources, credit has to be given to the scheme for its effectiveness.

Table 5.1 List of Indicators and Method of Scoring

Indicator	Score = 1	Score = 2	Score = 3	Score = 4
Reliability and adequacy				
Lpcd (from the piped water scheme) in summer	< 20	20–39	40–69	> 70
Lpcd (from the piped water scheme) in other seasons	< 20	20–39	40–69	> 70
Proportion of household requirement of water met by water from the scheme in summer	< 25%	25–75%	75–85%	> 85%
Proportion of household requirement of water met by water from the scheme in other seasons	< 25%	25–75%	75–85%	> 85%
Number of days of water supply each week in summer	< = 3 days	Alt days	> alt days	Daily
Number of days of water supply each week (other seasons)	< = 3 days	Alt days	> alt days	Daily
Hours of supply each week other than in summer	< 7	7–20	21–99	> 100
Time taken to fill a 10 liter bucket	> 4 minutes	3–4 minutes	2–3 minutes	< 2 minutes
Time spent on water collection each day in summer	> 6 hours	2–6 hours	30 minutes–2 hrs	30 minutes or less
Time spent on water collection each day in other seasons	> 6 hours	2–6 hours	30 minutes–2 hrs	30 minutes or less
Incidence of supply system getting affected by frequent breakdowns	Scores assigned to schemes based on households reporting such a problem, along with scheme-level data			
Household assessment of water quality based on the following criteria:				
1. % households that consider the supplied water to be bacteriologically contaminated	> 20	10–20	1–10	Nil
2. % households that consider the supplied water to have chemical problems such as salinity, excessive iron, etc	> 20	10–20	1–10	Nil
Affordability				
O&M cost per household served as a ratio to the average income of private connection users	> 2.5%	1–2.5%	0.5–1%	< 0.5%
O&M cost per household served as a ratio to the average income of standpost users	> 2.5%	1–2.5%	0.5–1%	< 0.5%
Environmental Sustainability				
Incidence of source drying out during summer	Scores to be assigned to schemes based on (a) whether the scheme is in 'dark/gray' zone signifying high groundwater exploitation; (b) measures taken by schemes for source sustainability; (c) number of days the scheme did not function in the previous year due to source drying out; (d) the proportion of beneficiary households (using the scheme in question) that have reported the water supply to be unreliable because the source dries out in summer; and (e) whether water sources for piped water supply were re-bored before their design life was over.			
Financial Sustainability				
Extent of O&M cost recovery (O&M contribution made by beneficiary households divided by O&M cost)	< 30%	30–70%	> 70%, but not full recovery	Full recovery of O&M cost
Proportion of private connection users regularly paying water charges	< 50%	50–90%	91–99%	100%

Note: (1) In 'dark' zones/blocks more than 85 percent of the available groundwater is exploited; in 'gray' zones/blocks, groundwater exploitation is between 65 percent and 85 percent of available resources. (2) Assessment of affordability is based on design performance O&M cost, not actual O&M cost. Design performance O&M cost has been taken as the basis for affordability indicators for the reason that if, instead, actual O&M is taken as the basis then a scheme that spends far less on O&M than required (and hence provides a low quality service, imposing costs on the households) will appear to have greater affordability.

financial sustainability. The indices are based on 17 key indicators of water supply service. Of these, 12 indicators have been used to gauge the reliability and adequacy of water supply, and of the remaining five indicators, two relate to affordability, one to environmental sustainability and two to financial sustainability. Four values have been assigned to each indicator (1, 2, 3 or 4), the same as the score in Table 5.1, depending on whether the performance in respect of the indicator was negligible, low, medium or high. All the indicators have then been summed into an index, which has been rescaled so that the index takes a value in the range of 1 to 10. Since some of the indicators are not relevant for handpumps, the performance of handpump schemes is discussed separately in Section 5.3. The list of indicators and the method of scoring are shown in Table 5.1. As liberal criteria are used to assign the top score for the various indicators, it is expected that the value of indices for the schemes would be high (8 or higher). However, the actual values of the indices are found to be generally lower than expected.

Comparison of the Mean Value of Indices of Effectiveness

The mean value of the four indices for reliability and adequacy, affordability, environmental sustainability, and financial sustainability, computed for piped water supply schemes, are compared across states, technologies, and service delivery agencies in Table 5.2 and Figures 5.5 and 5.6. As can be seen, the mean value of the index for the reliability and adequacy of schemes shows relatively little variation across the 10 states. Based on 12 key indicators of reliability and adequacy, the performance of Karnataka, Punjab, and Uttar Pradesh is relatively poor,[41] though the gap in the mean value of the index (across schemes) is

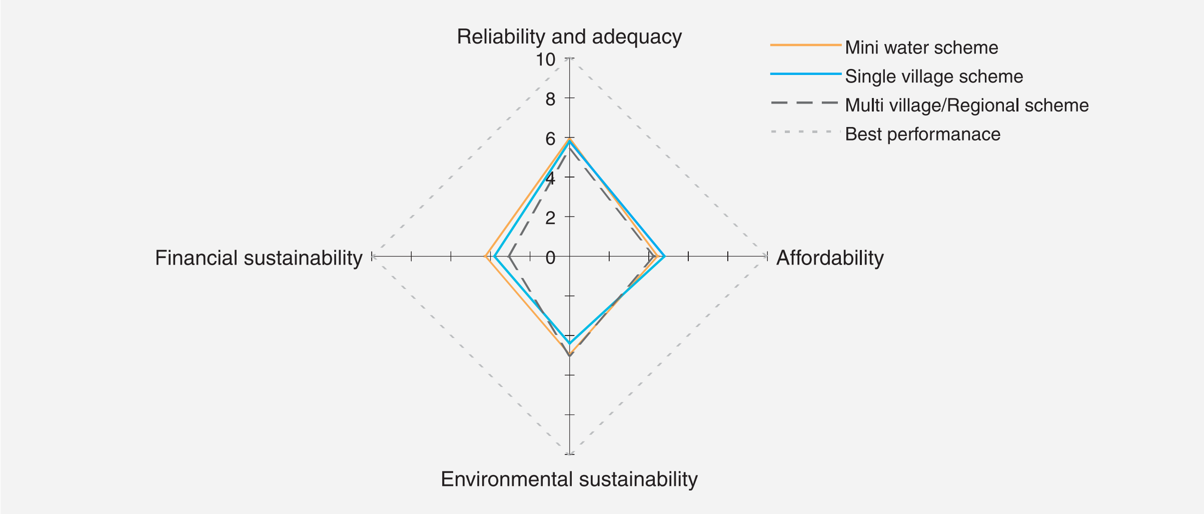
Table 5.2 Mean Value of Indices of Effectiveness, Comparison across States, Technology, and Service Delivery Agency

State/technology/service delivery agency	Indices*			
	Reliability and adequacy	Affordability	Environmental sustainability	Financial sustainability
Andhra Pradesh	6.5	5.6	3.4	2.4
Karnataka	5.2	4.5	4.2	3.4
Kerala	5.9	4.1	5.3	5.3
Maharashtra	6.1	5.8	6.1	6.5
Orissa	5.7	5.2	4.1	2.0
Punjab	5.2	3.3	4.1	7.7
Tamil Nadu	5.6	4.4	3.5	2.9
Uttar Pradesh	4.9	4.8	7.1	2.4
Uttarakhand	5.8	2.8	4.5	2.6
West Bengal	5.8	6.1	4.6	1.1
Mini water scheme	5.9	4.5	4.9	4.3
Single village scheme	5.8	4.8	4.4	3.8
Multi village/regional scheme	5.4	4.3	5.0	3.1
Government/public utility-managed	5.6	4.5	4.6	1.9
Gram Panchayat-managed	5.4	4.4	4.5	4.4
Community-managed	5.8	4.6	4.7	5.0
Zilla Parishad-managed (one state only, Maharashtra)	6.0	5.3	6.2	5.8
All	**5.6**	**4.5**	**4.8**	**3.6**

Source: Computed from household and scheme survey data.
* Minimum score = 1, maximum score = 10.
Note: The indices shown in the table are for piped water supply schemes only.

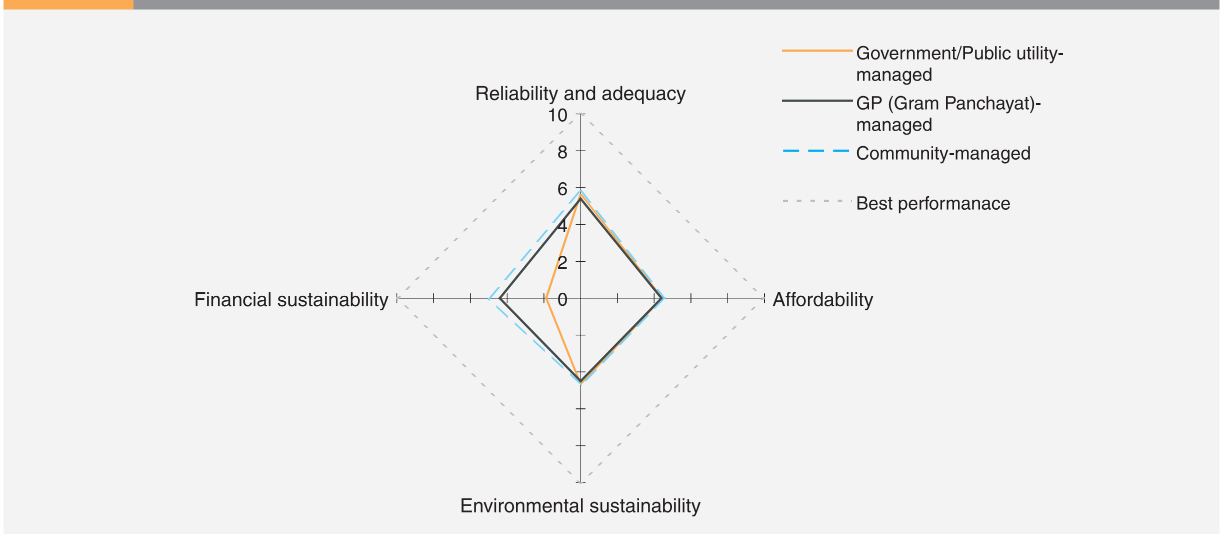
[41] The mean value of the index of reliability and adequacy for piped water supply schemes is found to be the lowest in Uttar Pradesh. It should be noted that public handpumps are providing a good service in Uttar Pradesh. If handpumps and piped water supply schemes are considered together, the performance of water supply schemes in Uttar Pradesh would be far better. However, it has not been possible to include both handpumps and piped water schemes in the performance analysis presented here, because some of the selected indicators are not relevant for handpumps. The performance of handpump schemes is analyzed in detail in Section 5.3, and the results show that the mean value of the index of reliability and adequacy of water supply schemes in Uttar Pradesh improves considerably when handpump schemes are included in the analysis, based on a smaller set of performance indicators.

Figure 5.5 Performance Indicators of Rural Piped Water Supply Scheme, by Technology



Note: Data for 10 states have been combined.

Figure 5.6 Performance indicators of Rural Piped Water Supply Scheme, by Management Agency



Note: Data for 10 states have been combined.

not large. In contrast, significant state-wise differences are evident in the index for affordability and for financial and environmental sustainability. For example, in terms of affordability the performance of Kerala, Punjab, and Uttarakhand is relatively poor as compared to other states; in terms of environmental sustainability, the performance of Andhra Pradesh, Karnataka, Orissa, Punjab, Tamil Nadu, Uttarakhand, and West Bengal is relatively poor; and in terms of financial sustainability the performance of Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal is relatively poor. Comparisons based on type of technology reveal that the performance of mini water schemes is better than multi village/regional schemes in respect of three indices—adequacy and reliability, financial sustainability, and affordability. The mean value of the index for environmental sustainability for multi village/regional schemes is higher than that for mini water and single village schemes. However, it would not be right to infer on that basis that multi-village schemes are performing better in terms of environmental sustainability. This is so because the state-wise distribution of multi village schemes surveyed is different from that of single village and mini water schemes. A relatively larger proportion of multi village/regional schemes surveyed are in Uttar Pradesh where the problem of water source drying out in summer is less (the index for Uttar Pradesh is 7.1, much ahead of other states).

Thus, to make a proper assessment, a technology-wise comparison of the index of environmental sustainability needs to done for each state. When such a comparison is done, in 7 of the 10 states surveyed, the index of environmental sustainability for multi village/regional schemes is found to be lower than that for mini water schemes or single village schemes or both. Accordingly, it may be inferred that the performance of multi village schemes is inferior to that of single village and mini water schemes.

When comparisons are made across service delivery agencies, the performance of community-managed schemes is found to be relatively better than public utility-managed schemes in terms of reliability and adequacy of water supply and financial sustainability. The mean value of the index for affordability and for environmental sustainability is found to be marginally higher for community-managed schemes than that for public utility-managed schemes. When a comparison of the indices for affordability and environmental sustainability is made separately for the states, the performance of community-managed schemes is found to be better than that of government/public utility-managed schemes in several states. Overall, the performance of community-managed schemes is found to be somewhat better than that of government/public utility-managed schemes in terms of affordability and environmental sustainability.

Schemes managed by Gram Panchayats have a score higher than government/public utility-managed schemes in terms of financial sustainability, but have a lower score in respect of the index of reliability and adequacy of water supply. With respect to affordability and environmental sustainability, the mean value of the index for public utility-managed schemes is relatively higher. However, the difference is marginal and the advantage of public utility-managed schemes disappears when comparisons are made for the different states separately.

As evident from Figure 5.6, community-managed schemes have an edge over Gram Panchyat-managed schemes in respect of all the four indices. However, the gap in the value of the indices is not large. On the other hand, the public utility-managed schemes have a clear disadvantage vis-à-vis the community-managed and Gram Panchayat-managed schemes in respect of financial sustainability.

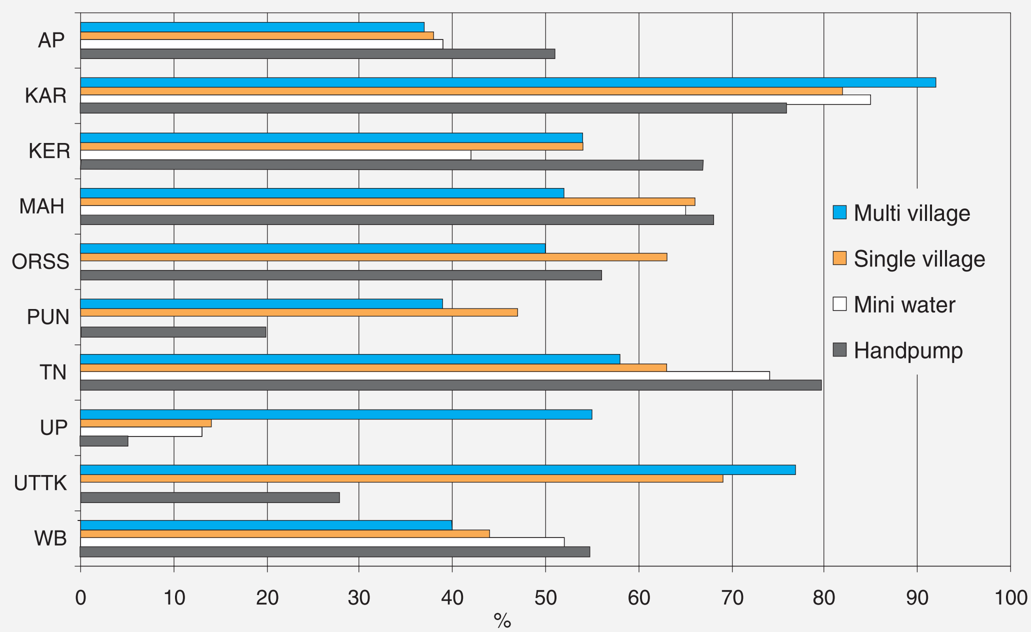
5.3 Performance of Handpump Schemes

The performance of handpump schemes varies from state to state, which arguably has much to do with the height of the groundwater table, variation in groundwater availability across different seasons of the year, and other features of the local hydro-geological condition. In certain respects, the performance of handpump schemes (or deep-bore public handpumps, to be more precise)[42] in Uttar Pradesh is better than piped water schemes. As seen from the findings of the household survey, about 87 percent of the users of handpump schemes in the state regarded handpumps as their main source of water supply, whereas only about 50 percent of the households using single and multi village schemes regarded piped water supply as their main source of water. In other words, the handpump users could rely more on the source available to them than the piped water users, presumably because the performance of handpumps in meeting the requirement of users was better than that of the piped water schemes.

Somewhat similar conclusions are reached by examining the proportion of households that reported water shortage in some months of the year, commonly summer (Figure 5.7), and the proportion of their water requirement met from the main public water source accessed

[42] Among the 10 states surveyed, the handpump scheme received particular attention in the survey of Uttar Pradesh, since a high proportion of households in Uttar Pradesh depend on handpumps (according to Census data for 2001, 16 percent rural households of Uttar Pradesh accessed drinking water from taps while 69 percent accessed drinking water from handpumps). Over 600 handpumps were covered in the study. Therefore, in analyzing the performance of handpump schemes, a greater focus has been on the situation in Uttar Pradesh. It may be mentioned here that while deep-bore handpumps (India Mark II/III) occupy a dominant position, a small section of households use public shallow handpumps. Such handpumps are excluded from the analysis of the performance of handpump schemes.

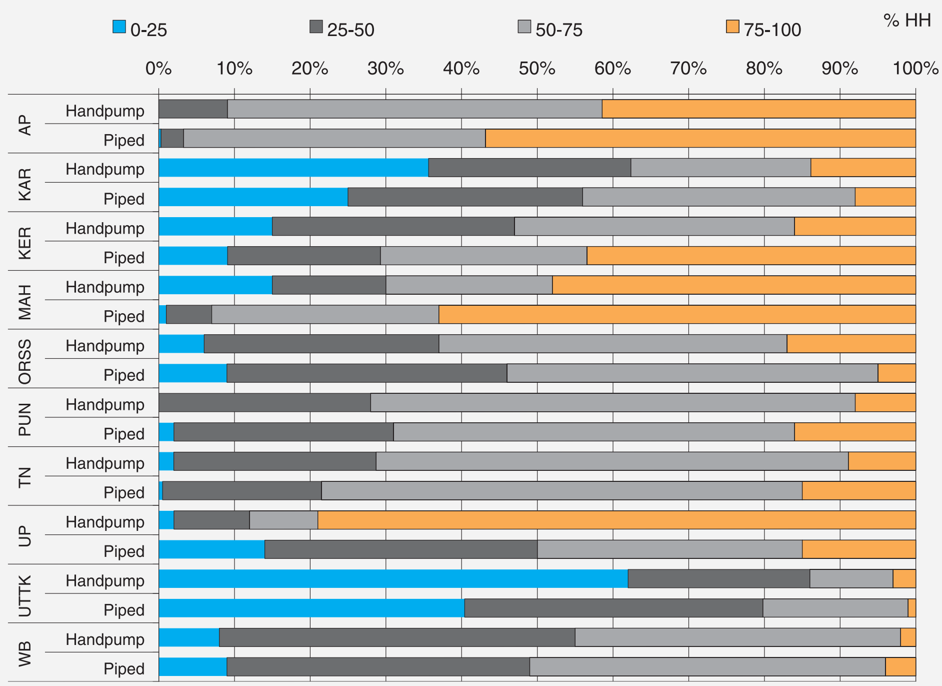
Figure 5.7 % Households Reporting Water Shortage in Some Months of the Year, by Technology and State



Source: *Household survey data.*

Note: (1) In most cases, the reporting of shortage is for summer. However, the survey also took into account cases where the shortages were experienced in some other months. For Punjab, the households reporting seasonal shortage as well as households reporting somewhat regular shortage have been combined since the latter category is substantial. (2) No mini water schemes were covered in the surveys conducted in Orissa, Punjab and Uttarakhand.

Figure 5.8 Proportion of Water Requirement Met from Main Public Source



Source: *Computed from household survey data.*

Note: Each bar shows how the households of the relevant category are distributed in terms of adequacy of water source in meeting their requirement. The last bar, for instance, is for piped water users in West Bengal. These households have been divided into four groups according to the proportion of their requirement they are able to meet from the piped water scheme: 0-25%, 25-50%, 50-75% or 75-100%. The bar has four parts and shows the proportion of the households in each group.

(Figure 5.8). In Uttar Pradesh households that use handpump do not report any significant water shortage in summer and most households are able to get the bulk of their water requirement from handpumps.

On the other hand, users of piped water schemes complain about seasonal water shortage, and most households have to supplement piped water supply with other sources of water.

This may be compared with the situation in Tamil Nadu, where about 80 percent of households using handpumps reported a water shortage in summer and only 8 percent reported that the bulk of their water requirement is met by handpumps. Evidently, as noted at the beginning of the section, the performance of handpump schemes varies across states.

Since a large proportion of the rural households of Uttar Pradesh depend on public handpumps and the performance of handpumps is better than piped water schemes, a proper analysis of the performance of water supply schemes in Uttar Pradesh requires that the handpumps be considered together with the piped water supply schemes.

Figure 5.9 reflects the mean value of indices of effectiveness for Uttar Pradesh, when handpumps are taken into account along with piped water schemes, and compared with the mean values of indices based on piped water schemes only. As can be seen, the inclusion of handpumps leads to a marked increase in the mean value of the indices of reliability and adequacy, and affordability; the index for environmental sustainability also improves; but the index for financial sustainability goes down significantly because the cost recovery from handpump schemes is virtually nil.

The index of adequacy and reliability presented in Table 5.2 for different states indicated that in terms of the adequacy and reliability of the water source the performance of Uttar Pradesh is worst. However, the index presented in Table 5.2 related only to piped water schemes.

As noted above, the performance of handpump schemes is far better than piped water schemes in Uttar Pradesh. Thus, the inclusion of handpumps in the index improves Uttar Pradesh's rank substantially.

5.4 Sharing Public Water Sources

The government-stipulated norm for the sharing of public sources in rural water supply schemes is that a public source such as an India Mark II/III handpump or a standpost or a mini water tank (which is a spot source) should be shared by 250 persons (50 households). The study finds that this norm is rarely met and commonly violated among the schemes currently functioning.

Figure 5.9 **Performance Indicators of Rural Piped Water Supply Scheme, Uttar Pradesh**

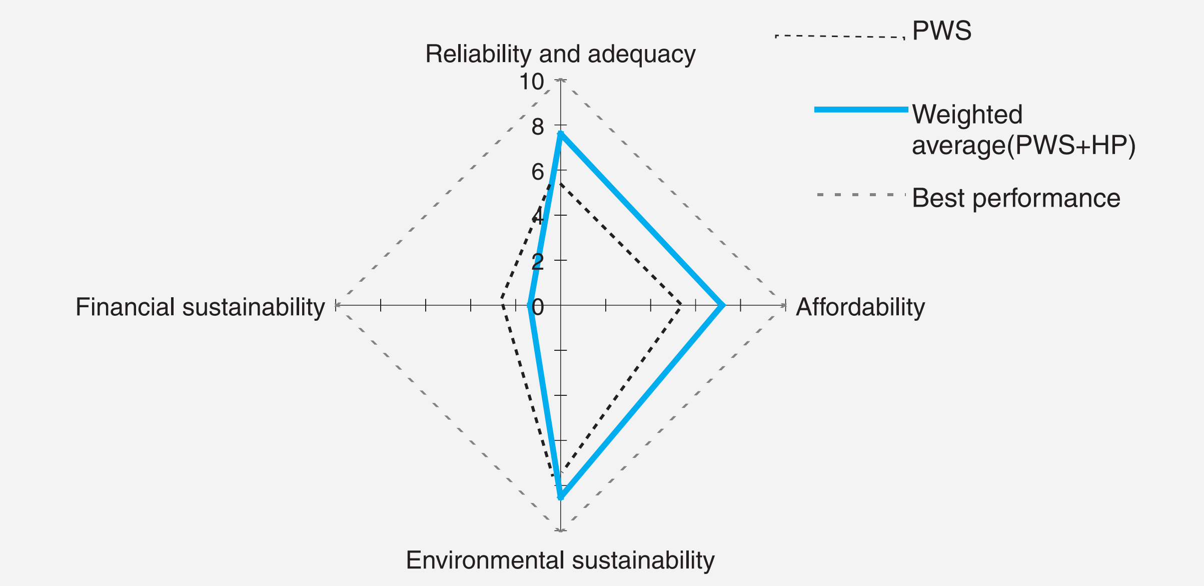
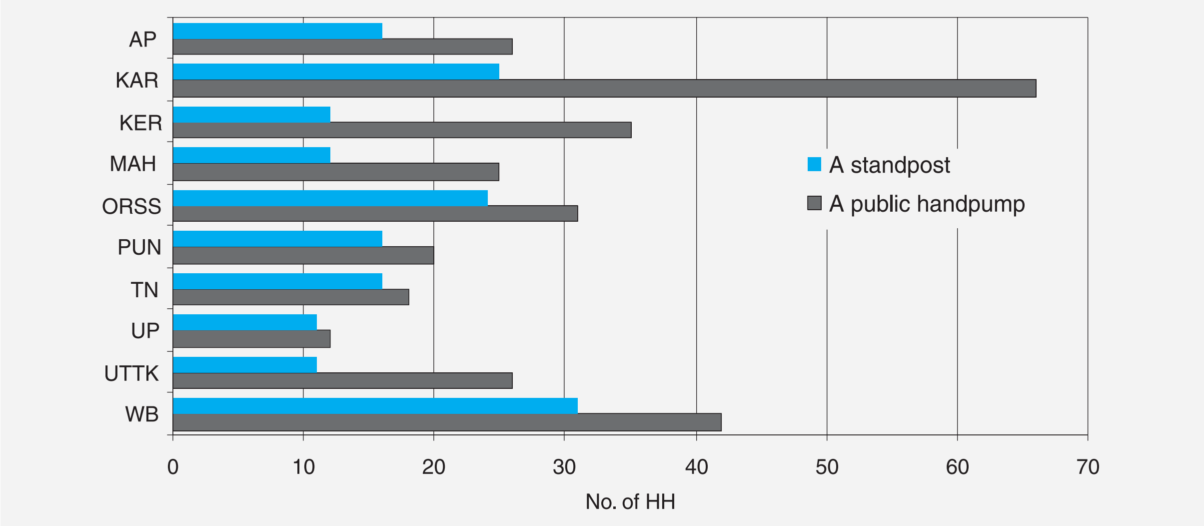


Figure 5.10 presents state-wise data on the number of households sharing a public water source. As can be seen, in most cases, the number of households sharing a public source is much less than 50. Particularly, it may be noted that there is a significant difference between Karnataka and Uttar Pradesh in terms of the number of households sharing a public water source. In Uttar Pradesh, on an average only 11 to 12 households share a handpump or a standpost; indeed, in some cases (10 percent), 4 or less households share a handpump. In contrast, in Karnataka, on an average 66 households share a handpump (obviously causing considerable inconvenience), while on an average 25 households share a standpost. In Kerala and Uttarakhand, 35 households and 26 households, respectively, share a handpump. The corresponding figures are lower for Andhra Pradesh, Maharashtra, Punjab, and Tamil Nadu (26, 25, 20, and 18 households per handpump, respectively).

Figure 5.10 Average Number of Households Sharing a Handpump or a Standpost



The number of households sharing a standpost in Maharashtra, Kerala, and Uttarakhand is about the same as in Uttar Pradesh. In Andhra Pradesh, Punjab, and Tamil Nadu the average is higher, though far lower than the number of households sharing a standpost in Karnataka.

It is evident from the discussion above that Karnataka is an exception in the matter of the sharing of public handpumps. This helps in reducing the per household cost of handpump schemes. However, this has serious repercussions on the quantity of water each household is able to access from the source, which is reflected in the fact that a higher proportion of households using handpumps complain of inadequate water availability.

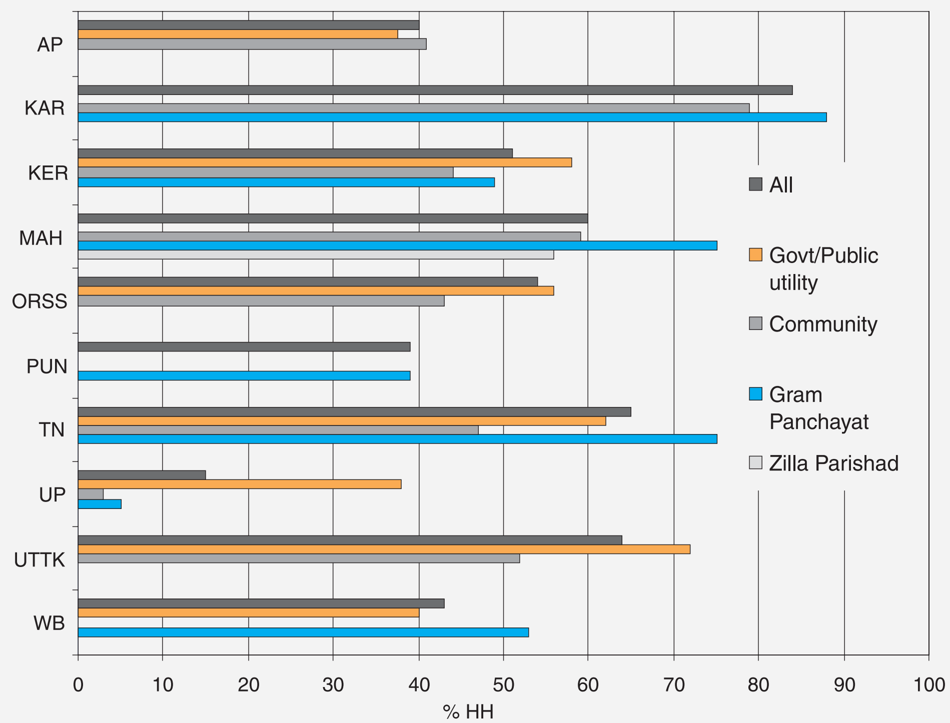
5.5 Water Shortages and Breakdowns

Water shortages and breakdowns have a more telling effect on consumer satisfaction with the water supply schemes, and a discussion on these two aspects in the context of scheme performance is presented below.

The study reveals that the problem of water shortage in some months of the year (summer mainly) is common, though it is more acute and pervasive in some states than others. It was also found that a section of consumers have been experiencing prolonged and frequent breakdowns of schemes. These two aspects are discussed further.

Karnataka has the highest proportion of households reporting a shortage of water in some months of the year, while Uttar Pradesh has the lowest proportion reporting such shortages (Figure 5.11), 84 percent as against 15 percent. Notably, in Uttar Pradesh, schemes managed by the public utility had a relatively larger proportion of users who said that there were months when

Figure 5.11 Proportion of Households Reporting a Water Shortage in Some Months of the Year, by State and Managing Agency



Source: Computed from household survey data. Both handpump schemes and piped water schemes are considered.
Note: Some cells are empty because no scheme of the particular category was surveyed. For Punjab, the households reporting seasonal shortage as well as households reporting a somewhat regular shortage have been combined since the latter category is substantial.

there is water shortage, while in community-managed schemes (mainly handpumps covered, also four piped water schemes) in Uttar Pradesh, almost no users reported periods of water shortage.

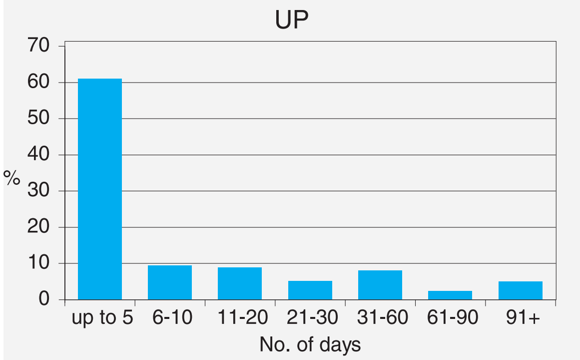
In Uttarakhand, nearly two-thirds of the households reported water shortage during certain months of the year. The problem of water shortage was far greater for households using schemes managed by public utilities than those accessing community-managed schemes.

In Kerala, Orissa, Maharashtra, and Tamil Nadu, 51, 54, 60, and 65 percent households, respectively, reported water shortage in certain months of the year. This proportion was relatively lower for households using community-managed schemes than those using government/public utility-managed schemes or Gram Panchayat-managed schemes in all these states. Considering the trend across states, it may be inferred that households using government, public utility or Gram Panchayat-managed schemes face greater/more acute water shortage in summer than households using community-managed schemes. The relative position of government/public utility-managed schemes and Gram Panchayat-managed schemes is not clear; as in some states government/public utility-managed schemes are doing better, while in others, Gram Panchayat-managed schemes are performing better.

Shifting now from the issue of shortage to the issue of breakdowns, an important question about the performance of water supply schemes is whether they provide services throughout the year, or almost throughout the year. Or, do schemes remain non-functional for several days in a year? The data collected in the survey as well as other secondary data available clearly bring out the limitations of water supply schemes on these aspects.

The survey clearly shows that in many states piped water schemes experienced frequent breakdowns/interrupted water supply. On an average, piped water schemes did not function

Figure 5.12 Number of Days Handpump was Not Functional in the Last Six Months: Uttar Pradesh

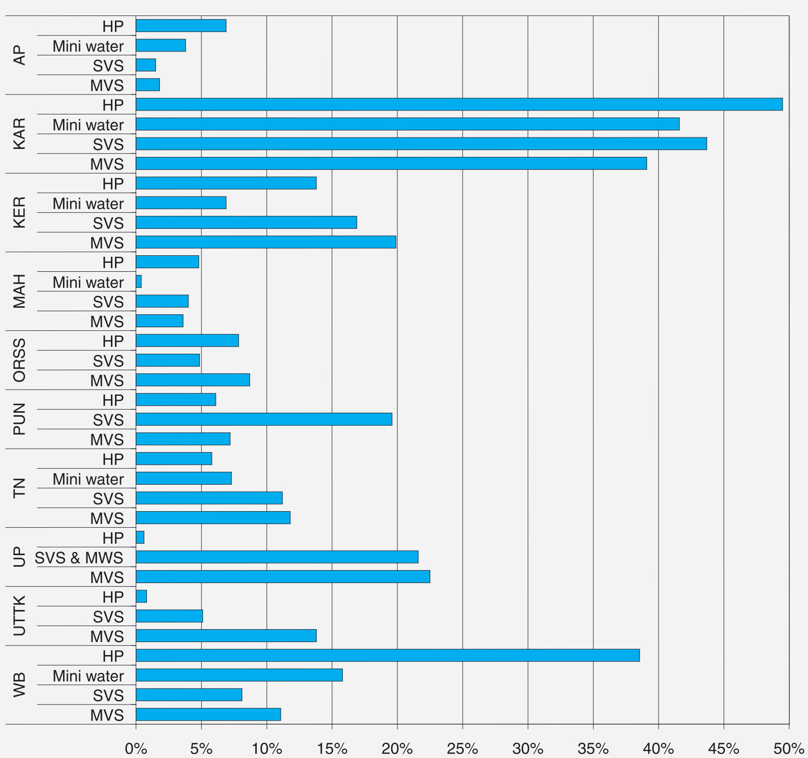


for 36 days in the year preceding the survey in Uttar Pradesh, for 23 days in Karnataka. In some cases, schemes did not function for more than three months.[43] Piped water supply schemes did not function for a significant number of days also in Orissa and West Bengal. On an average, piped water schemes did not function for 24 days in the year preceding the survey in West Bengal and 15 days in Orissa.[44]

According to the information furnished by the staff managing the schemes in Punjab, Maharashtra, Andhra Pradesh, and Tamil Nadu, schemes did not function for fewer days in the same period (eight, six, four and four days, respectively).

In Uttar Pradesh, the Gram Panchayats and user households were interviewed to collect data on handpump schemes. Information was collected on whether the handpump had not functioned in the six months preceding the survey. The Gram Panchayat/user households reported that on an average handpumps had not functioned for about nine days in the previous six months

Figure 5.13 Problems of Frequent Breakdowns Reported by Households (% HH Reporting)



[43] These data are based on the information supplied by schemes. The households were also asked questions relating to breakdowns, particularly whether they find their scheme unreliable because of frequent breakdowns.
[44] A fairly large part of this is due to power problems. Hardware failure or other such reasons account for about one-third of the number of days the piped water schemes did not function. It may be pointed out further that the number of days of the non-functioning of the schemes in a year was greater among multi village schemes than among single village schemes. For instance, in West Bengal, multi village schemes did not function for 26 days in a year on an average, while the single village schemes did not function for 19 days on an average.

(that is, about 18 days in a year); however, in some cases it was reported that the handpump had not functioned for more than two months in the previous six months (Figure 5.12).

It is difficult to make a comparison of the functioning of handpumps across states because the study covered only a small number of handpumps in other states and adequate scheme-level information is not available. However, data availability on the breakdown of handpumps is better for Orissa and West Bengal. The available information indicates that in Orissa handpump schemes on an average did not function for about 12 days in the year preceding the survey. The corresponding figure for West Bengal is 15 days. Thus, the problem of water supply disruption due to the breakdown of handpumps in Orissa and West Bengal is almost as serious as that in Uttar Pradesh. The information on breakdowns is also available from the household survey. Going by the number of households reporting a breakdown, the problem seems to be relatively more serious in Karnataka, West Bengal, Uttar Pradesh, Kerala, and Tamil Nadu (Figure 5.13).

Summing Up

This study clearly brings out that the effectiveness of the schemes is moderate to low. The actual performance is often less than the design and the expectations of consumers. The performance of community-managed schemes is found to be somewhat better than the public utility-managed schemes. The number of households sharing a handpump or a standpost is well below the government norm. The survey results indicate that a high proportion of consumers face water shortage in summer, and a section of consumers face problems caused by the prolonged and frequent breakdowns of water supply schemes. The inadequate maintenance of schemes seems to be a major cause of the poor performance of schemes, particularly the multi village schemes. This reinforces the earlier argument that the multi village and regional schemes need to be broken up into smaller schemes and handed over to the GPs.

The finding that the number of households sharing a handpump or a standpost is well below the government norm raises the issue of appropriateness of the government norm of 50 households sharing a standpost or a handpump. There are indications from the survey results that the rural households desire and are willing to pay for a much higher level of service than the norm of 40 lpcd within a 1.6 km distance and 100 m elevation, which is governing the provision of water supply in rural areas. A more flexible norm, therefore, needs to be adopted for service delivery. And, the rural communities should be offered a higher level of service, subject to the availability of water and the willingness to contribute through user charges that recover O&M and partial capital costs.

CHAPTER 6

Strategies adopted and the costs borne by rural households to cope with the deficiencies of the service provided by the water supply schemes

Coping Strategies and Costs

This chapter discusses the strategies adopted and the costs borne by rural households to cope with the deficiencies of the service provided by the water supply schemes, particularly shortfalls in the requirement for water during the summer season.

The coping cost, or the cost incurred to cope with inadequacies of service provision, can be categorized into distinct groups:

- **Time cost** covering value of time taken to travel to the nearest water source and the value of time in queuing up to get water;
- **Storage cost** covering expenses for storing water in household containers;
- Cost of **water purification** covering expenditure incurred to purify water;
- Expenditure incurred on the **repair** of public water sources; and
- Expenditure incurred for the **maintenance** of household equipment for private water supply arrangements.

Estimates of coping cost are presented in terms of different technologies and institutional arrangements. These costs constitute a component of the total cost of water discussed in Chapter 4.

A large proportion of rural households do not take any measures to treat the water supplied by rural water schemes before drinking even though many households in rural areas are not sure of the quality of water supplied

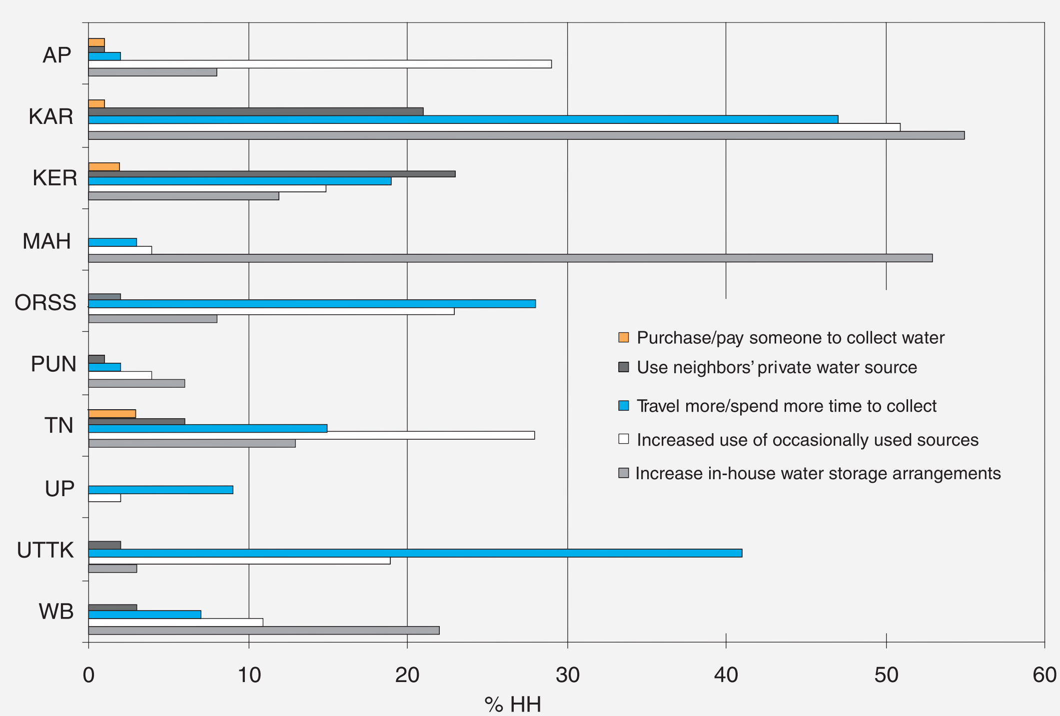
6.1 Coping Strategies

Households have adopted several strategies to cope with the inadequate water supply. These include purifying water by boiling or filtering, storing water, maintaining a private water source, using a neighbor's water source, arranging and paying for the repair of public water sources when a breakdown occurs, bringing into use an occasionally used source when the need arises, and purchasing water for domestic use or paying someone to collect water. Many households are also required to travel a considerable distance and stand in long queues to collect water.

The strategies adopted by households to cope with water shortage vary across states (Figure 6.1). In Karnataka, a large proportion of households have adopted the following three strategies during periods of water shortage—increase arrangements for water storage inside the house; increase their use of sources that are only occasionally used; and travel longer distances and spend more time to collect water. A smaller number of households use their neighbor's water source. Similar strategies are also adopted by households in Tamil Nadu, though the proportion of households is relatively lower. The situation in Kerala is similar to Tamil Nadu, except that the use of a neighbor's source is the most important strategy in Kerala, but this is relatively less important in Tamil Nadu.

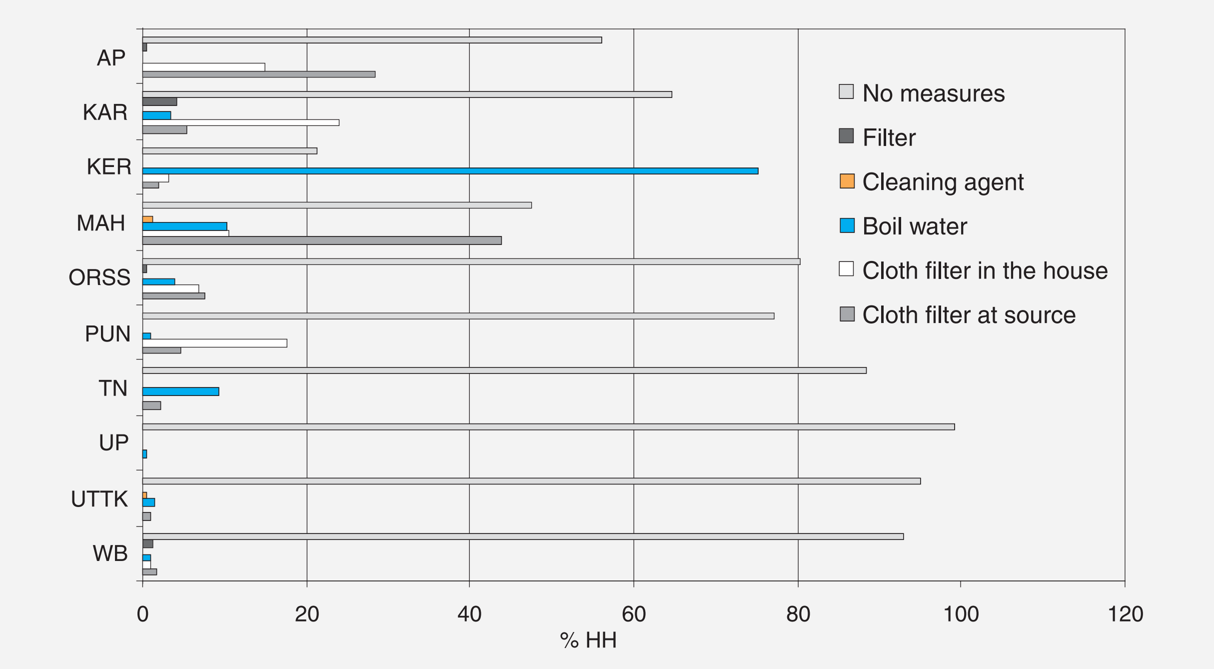
In Andhra Pradesh, the main strategy adopted by households to cope with water shortage in summer is to increase their dependence on 'occasionally' used sources. In Maharashtra, households increase water storage arrangements inside the house, which is the main strategy also for households in West Bengal. In Uttarakhand, household members travel a longer distance and spend more time collecting water during periods of water shortage. The next important strategy adopted by households of Uttarakhand is to increase their dependence on sources occasionally used. The situation in Orissa is

Figure 6.1 Coping Strategies in Water Shortage Months by Type of Water Supply Technology, by State



Source: Household survey data for both handpump and piped water schemes.
Note: Some households adopt multiple strategies and hence are included at more than one place.

Figure 6.2 Water Purifying Strategies Adopted in Different States



Source: Household survey data, handpump, and piped water schemes.

similar to that in Uttarakhand in that the two main coping strategies are the same. As compared to the other states, only a small proportion of rural households in Uttar Pradesh and Punjab has to adopt a strategy to cope with summer shortages, presumably because only a small proportion of households face a problem of summer shortage (see Chapter 5).[45]

Water Purification

A large proportion of rural households do not take any measures to treat the water supplied by rural water schemes before drinking (Figure 6.2) even though many households in rural areas are not sure of the quality of water supplied (there are state-wise variations, as discussed below). Indeed, a significant proportion of rural households, particularly in Andhra Pradesh, Maharashtra, Punjab, and Tamil Nadu are of the view that the water supplied is not free from germs or has chemical problems (such as iron, fluoride, arsenic, and salinity/TDS).

Kerala is an exception where about 75 percent of households boil water so as to make it safe to drink. In Maharashtra and Tamil Nadu, about 10 percent of the households boil water before drinking. In Maharashtra the strategy more commonly adopted (almost 55 percent of households) is to use a cloth filter at the source or at home. Similarly, about 43 percent of the households in Andhra Pradesh, 29 percent in Karnataka, 22 percent in Punjab, and 14 percent in Orissa use the same strategy. In contrast, 99 percent of the households in Uttar Pradesh, 95 percent in Uttarakhand, and 93 percent in West Bengal do not take any measures to purify water. Probably, the households do not perceive it to be a problem.

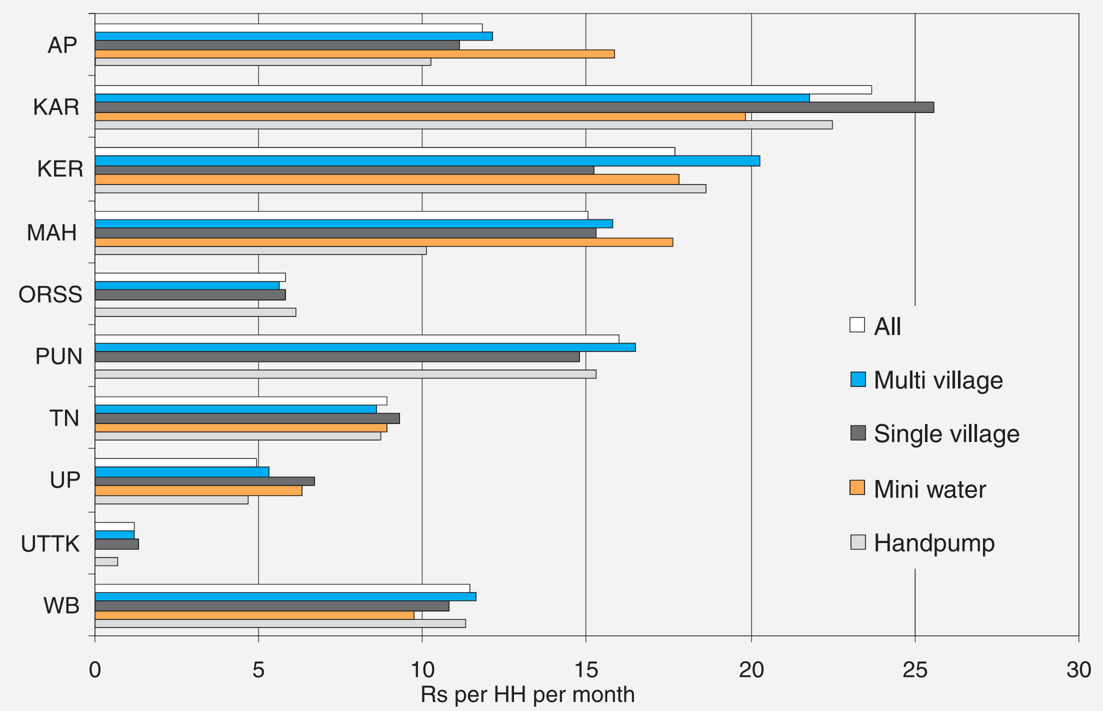
Water Storage

Approximately 90 percent of the households in Karnataka and Kerala reported that they made arrangements for water storage in the house. This proportion is almost 100 percent in Maharashtra and Tamil Nadu, and in the range of 93 percent to 98 percent in Andhra Pradesh, Orissa, Punjab, and West Bengal.

In contrast, water storage is relatively less common in Uttarakhand. Approximately 48 percent of households using handpump schemes, 38 percent using single village schemes, and 58 percent using multi village schemes

[45] About 15 percent households in Punjab report summer shortages. But, another 25 percent households report a somewhat regular water shortage.

Figure 6.3 Storage Cost by State and Scheme Type



Source: Household survey data, handpump, and piped water schemes.
Note: No mini water schemes covered in Orissa, Punjab, and Uttarakhand. The averages include all households. The cost is taken as zero for the households who have not invested; this explains the relatively low cost in Uttar Pradesh and Uttarakhand.

reported that they have invested in water storage in the house. The fact that piped water is supplied for much longer hours in Uttarakhand (more than 10 hours a day) compared to other states may explain the low investment in storage. The situation in Uttar Pradesh is similar, that is, a relatively smaller proportion of households have invested in storage. The hours of piped water supply in Uttar Pradesh is much smaller than that in Uttarakhand. But, piped water users have abundant access to public handpumps (often shared by only a small number of households), making it unnecessary for them to invest in storage.

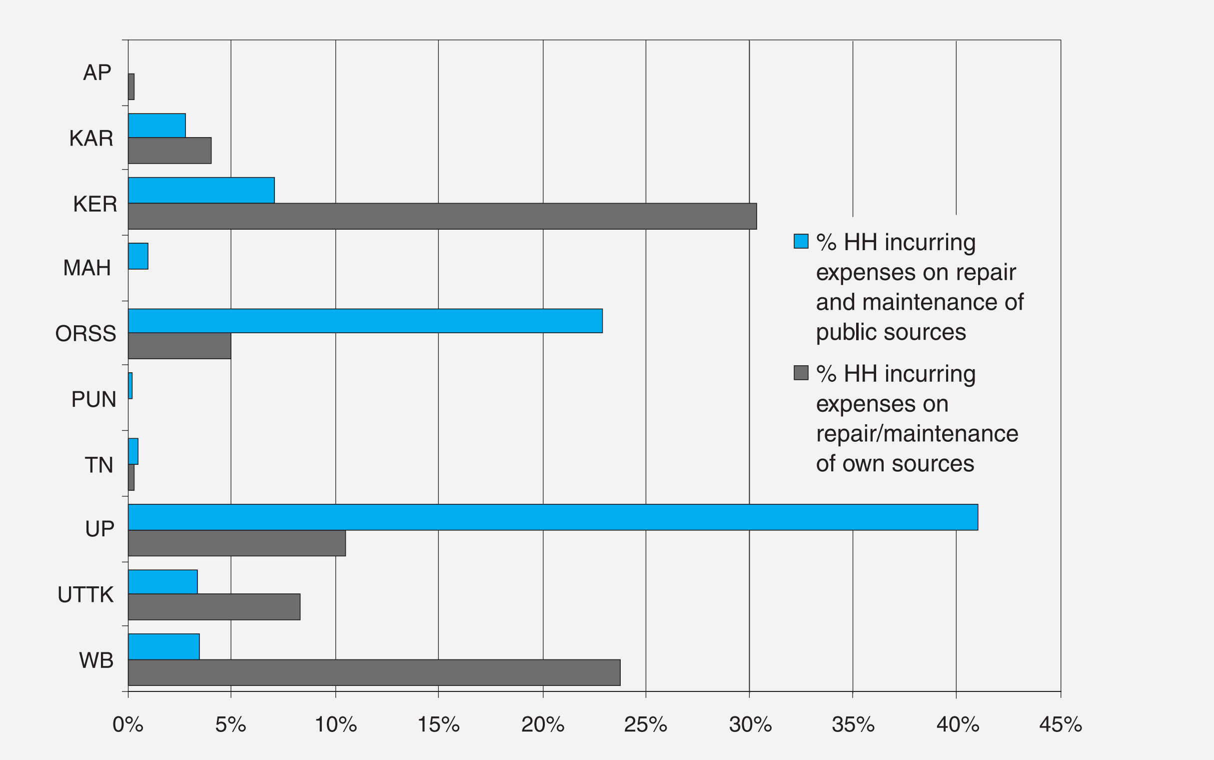
For a typical household, the cost of storage (annualized cost of investment) is highest in Karnataka (around Rs 24 per month), followed by Kerala (Rs 18 per month) and Punjab, Maharashtra, Andhra Pradesh, West Bengal, and Tamil Nadu (about Rs 16, 15, 12, 11, and 9 per month, respectively). The cost of storage is relatively low in Uttarakhand, Uttar Pradesh, and Orissa (about Re 1, Rs 5, and Rs 6 per month, respectively). Figure 6.3 compares the estimates of the average cost incurred on storage by rural households in the 10 states, across different types of schemes. No marked difference across technologies is apparent across states.

Expenditure on Repair and Maintenance

As mentioned earlier, two strategies that households of the states surveyed have adopted in varying degree to cope with the inadequacies of the services provided by the water supply schemes are—to have an own water source (say, a handpump or a well); and to get the public source repaired at one's own expenses when the need arises. Both entail costs to be incurred by the households. The study finds that these strategies and associated costs are far more important in Uttar Pradesh and Kerala than other states. This is discussed further.

In Uttar Pradesh, about 41 percent of households are incurring expenditure on the repair and maintenance of public water sources

Figure 6.4 Proportion of Households Incurring Expenditure on the Repair and Maintenance of Own Sources or Public Source



Source: *Household survey data for handpump and piped water schemes.*

(for instance, community handpumps). Another state in which a significant proportion of rural households is incurring expenditure on the repair and maintenance of public water sources is Orissa, where about 23 percent households are incurring such expenses. In Karnataka, Kerala, Uttarakhand, and West Bengal, relatively fewer households (3–7 percent) are spending on repair and maintenance, while in Andhra Pradesh, Maharashtra, and Tamil Nadu the proportion is less than 1 percent. This expenditure is over and above the O&M charges that schemes are collecting from beneficiary households.

As regards the expenditure incurred by households related to their own water sources, the proportion of households that incur such expenditure is 30 percent in Kerala, 24 percent in West Begal, 11 percent in Uttar Pradesh, and 8 percent in Uttarakhand. The corresponding proportion is even lower in other states, and in some cases virtually nil. While in both Uttar Pradesh and Kerala several households incur expenditure on the repair and maintenance of their own water sources, in Uttar Pradesh, the private source is commonly a shallow-bore handpump, while in Kerala it is commonly a well. The expenses incurred by households in Kerala on the maintenance of one's own water source is relatively higher at about Rs 14 per month[46] (on an average), while it is about Rs 2 per month in Uttar Pradesh.

Figure 6.4 reflects the proportion of households in each of the 10 states that incur expenses on the repair and maintenance of their own sources or on public sources of water supply.

Time Spent on Water Collection

Members of a household, both adult and children, have to spend time collecting water from public sources (handpumps, standposts of piped water schemes, mini water tanks). The amount of time spent is dependent on the distance traveled and the time spent waiting in queues. During the day, members may have to make several trips to the water source and spend

[46] This is the average for all households. For households not having their own source, the cost is taken as zero.

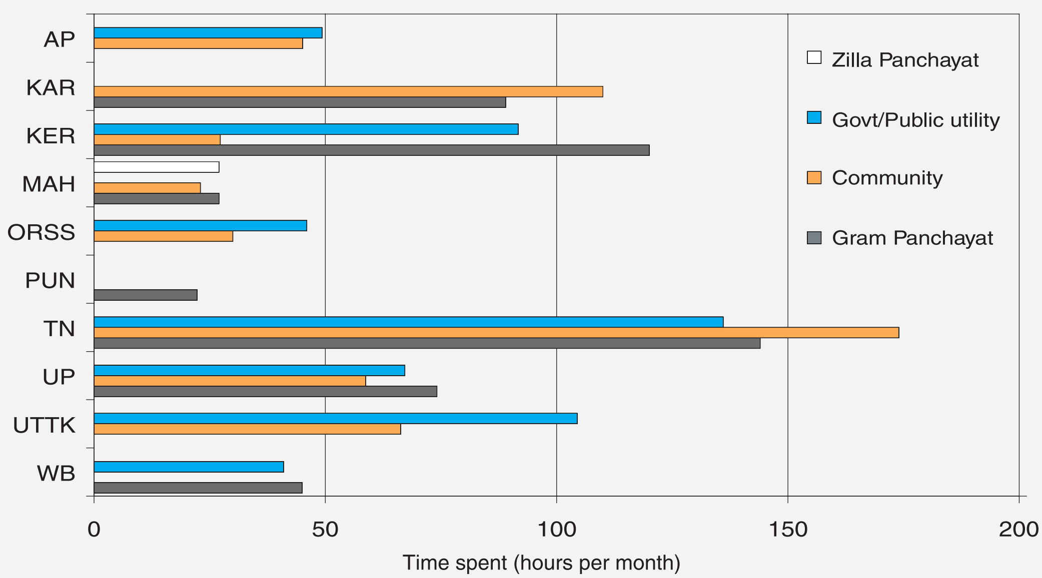
a fair amount of time collecting water. The time that households spend to collect water would be lower if the water source was closer or if a private water connection was available inside the house. Table 6.1 gives an estimate of the total time spent on water collection during months of shortage with respect to households that collect water from standposts, mini water tanks or public handpumps. As noted above, the time spent includes both the extra time spent traveling longer distances and more time in collecting water. A comparison across states indicates that the time spent on water collection is relatively high in Tamil Nadu and Karnataka. In Karnataka, a large number of households share a public source (as noted in the previous chapter), and this probably explains why a lot of time is needed to collect water. In Tamil Nadu, the households make a larger number of trips to collect water, and this increases the time spent.

Table 6.1 Time Spent on Water Collection (per Month per Household)

State	Average time spent per trip (in minutes)	Average number of trips per day	Total hours spent per month in collecting water
Andhra Pradesh	12	9	49
Karnataka	27	9	100
Kerala	15	9	61
Maharashtra	8	7	27
Orissa	7	12	45
Punjab	8	6	25
Tamil Nadu	20	14	141
Uttar Pradesh	16	8	60
Uttarakhand	30	7	81
West Bengal	12	8	45

Source: *Household survey data.*
Note: *Time spent includes the extra time spent traveling longer distances and more time in collecting water in summer.*

Figure 6.5 Time Spent for Water Collection, by State and Management Agency

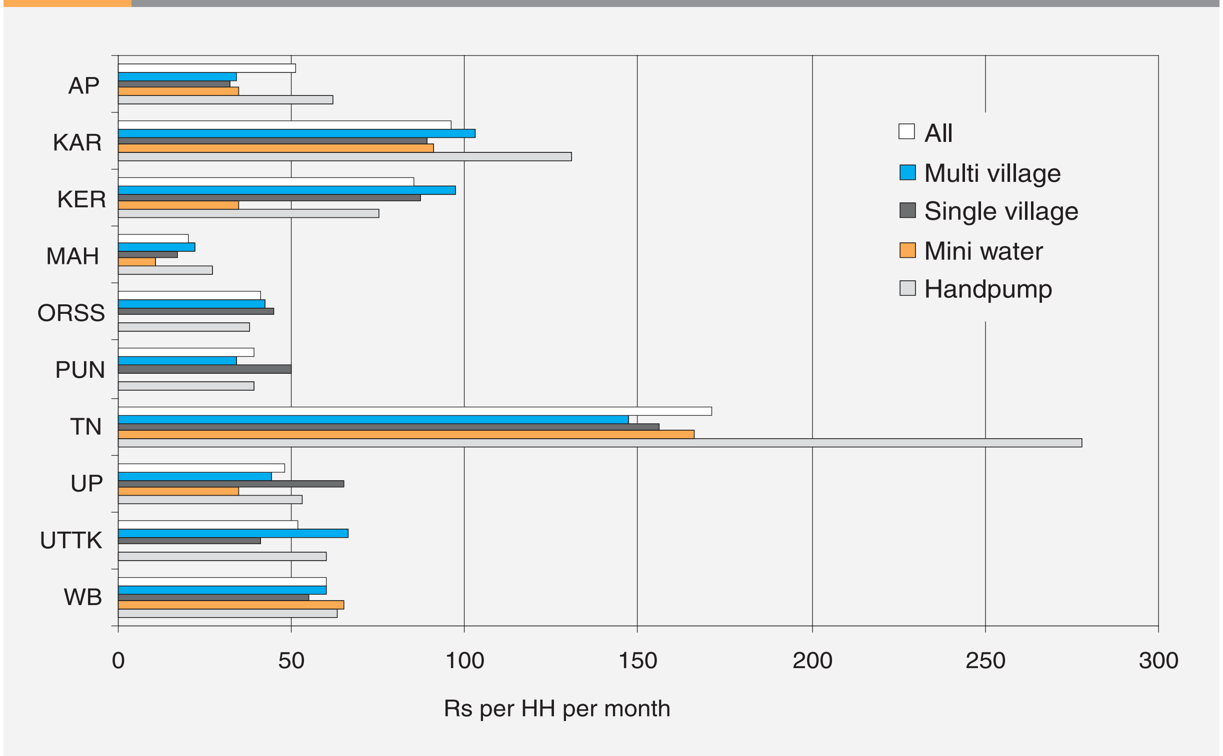


Source: *Household survey data.*

Figure 6.5 presents data on the time spent for water collection compared across managing agencies of the water supply schemes. Interestingly, in Tamil Nadu, households using schemes managed by public utilities spend less time for water collection than the households using schemes managed by GPs and communities. A general pattern observed is that the time spent for water collection is less in schemes managed by communities than those by government/public utilities, which is in turn less than the time spent for water collection in schemes managed by GPs.

To compute the opportunity cost of time, the work participation rates of adult male and female household members have been taken into account, along with the average daily wage rate and the number of days in a year an adult male or female may expect to find work.[47] The opportunity cost of children's time is taken as zero. The opportunity cost of time is reduced by 50 percent, if the time taken per trip is less than 30 minutes.[48]

Figure 6.6 Opportunity Cost of Time Spent for Water Collection, by State and Type of Scheme



An estimate of the average opportunity cost of time is presented in Figure 6.6 for the 10 states and for different types of schemes. A wide variation in the cost of time spent collecting water is reflected; the range is from Rs 20 per month in Maharashtra (average across schemes) to Rs 171 per month in Tamil Nadu.

6.2 Estimates of Coping Cost

The following costs are considered to estimate the coping cost borne by households:

- Storage (interest and depreciation of the amount invested)
- Maintenance of own water sources
- Repair of public water sources (incurred by the households)
- The opportunity cost of time spent on water collection

[47] Work participation rate is taken from a paper by G.K. Chadha (Rural Employment in India: Current Situation, Challenges, and Potential for Expansion, Issues in Employment and Poverty, Discussion Paper # 7, ILO, February 2003). Wage rates for Andhra Pradesh, Maharashtra, Punjab, and Tamil Nadu have been taken from National Sample Survey Report on Employment for 2004-05. Wage rates for the other states are taken from diverse sources. For Uttarakhand, the labor force participation rates in rural areas could not be found, and are assumed to be the same as that in Uttar Pradesh. Days per year of usually employed workers have been assumed to be 327 for rural males and 246 for rural females, for all the states.

[48] Here, the assumption is that if the trips do not take much time, the adult members could have collected water without much income loss.

Coping Costs by Technology

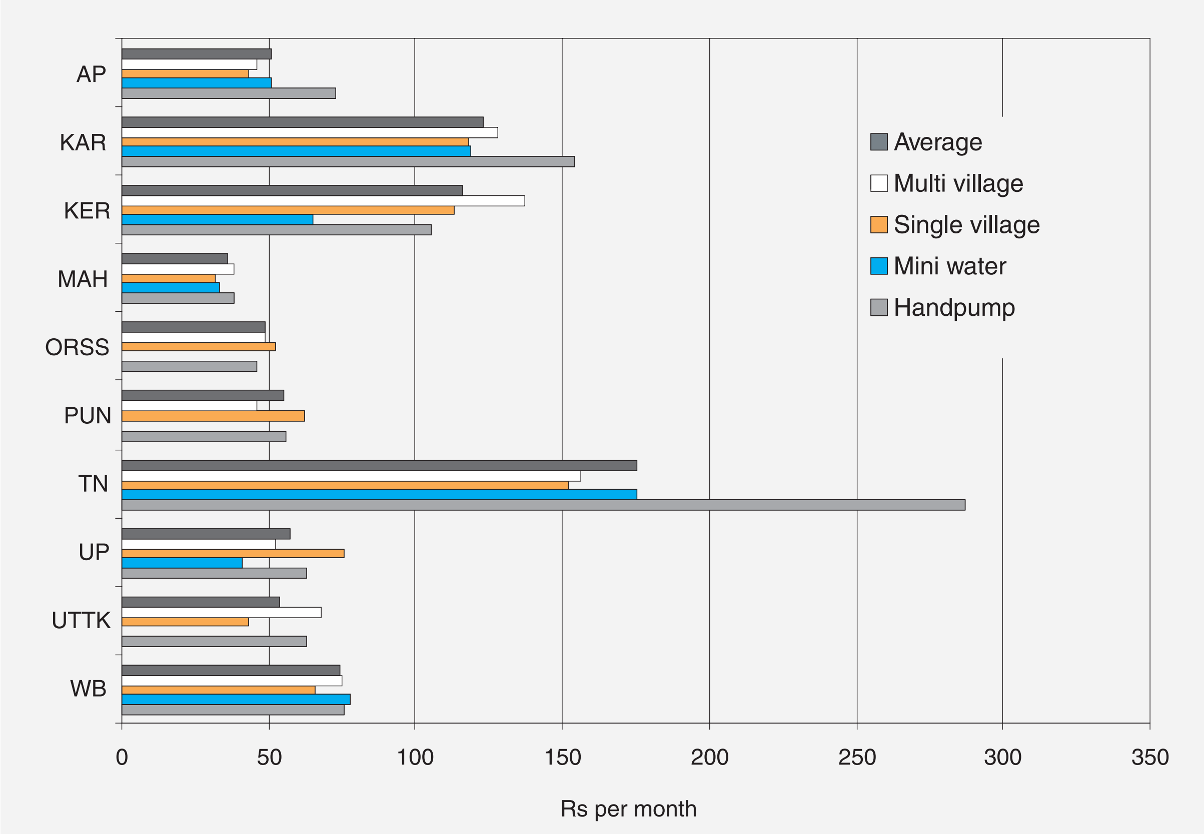
As reflected in Figure 6.7, the overall average coping cost per household ranges between Rs 32 and Rs 287 per month. There is no clear pattern; however, coping costs are found to be relatively higher for households dependent on handpumps or on multi village schemes. In several states, the coping costs borne by users of the multi village scheme exceed that of handpump users or single village scheme users or both groups of users.

Nadu, and is relatively much lower in Andhra Pradesh, leading to relatively lower coping cost.

Coping Costs by Institutional Arrangement

A comparison of coping costs borne by rural households in the 10 states is also carried out according to the institutional arrangements for water supply. The estimates of costs show a wide variation, with the average ranging from Rs 32 to Rs 224 per month (Figure 6.8). No clear pattern emerges from the table with regard to this

Figure 6.7 Coping Costs Borne by Rural Households, by Technology

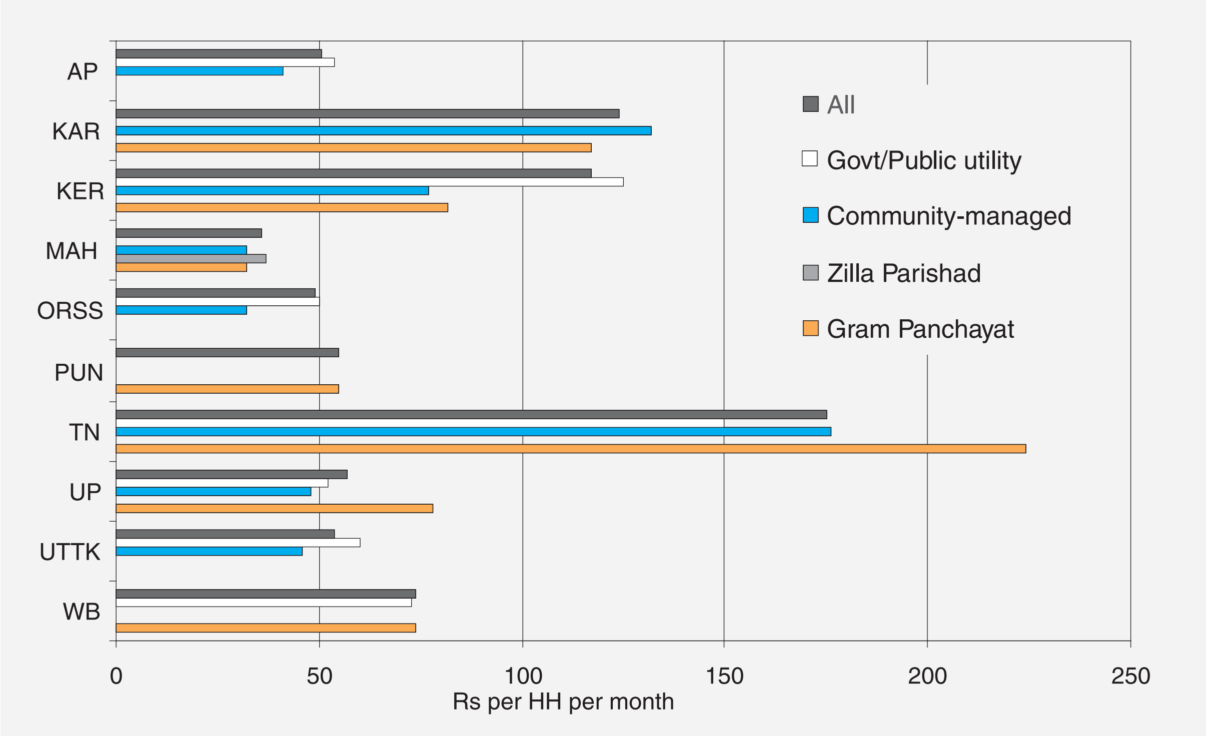


Source: Computed from household survey data.

In Tamil Nadu, Karnataka, and Kerala the coping costs are relatively high as compared with other states. The high cost in Tamil Nadu is due to the greater amount of time spent by households for collecting water. Tamil Nadu and Andhra Pradesh present an interesting contrast. In both states, a high proportion of rural households are dependent on standposts as a source of water supply. However, the time spent for water collection is high in Tamil

variation. In Karnataka, households using community-managed schemes bear higher coping costs than households using Gram Panchayat-managed schemes. In Uttar Pradesh and Tamil Nadu, on the other hand, the coping costs are relatively lower for households using community-managed schemes. The coping costs of households using Gram Panchayat-managed schemes in these two states are found to be relatively higher than that of public

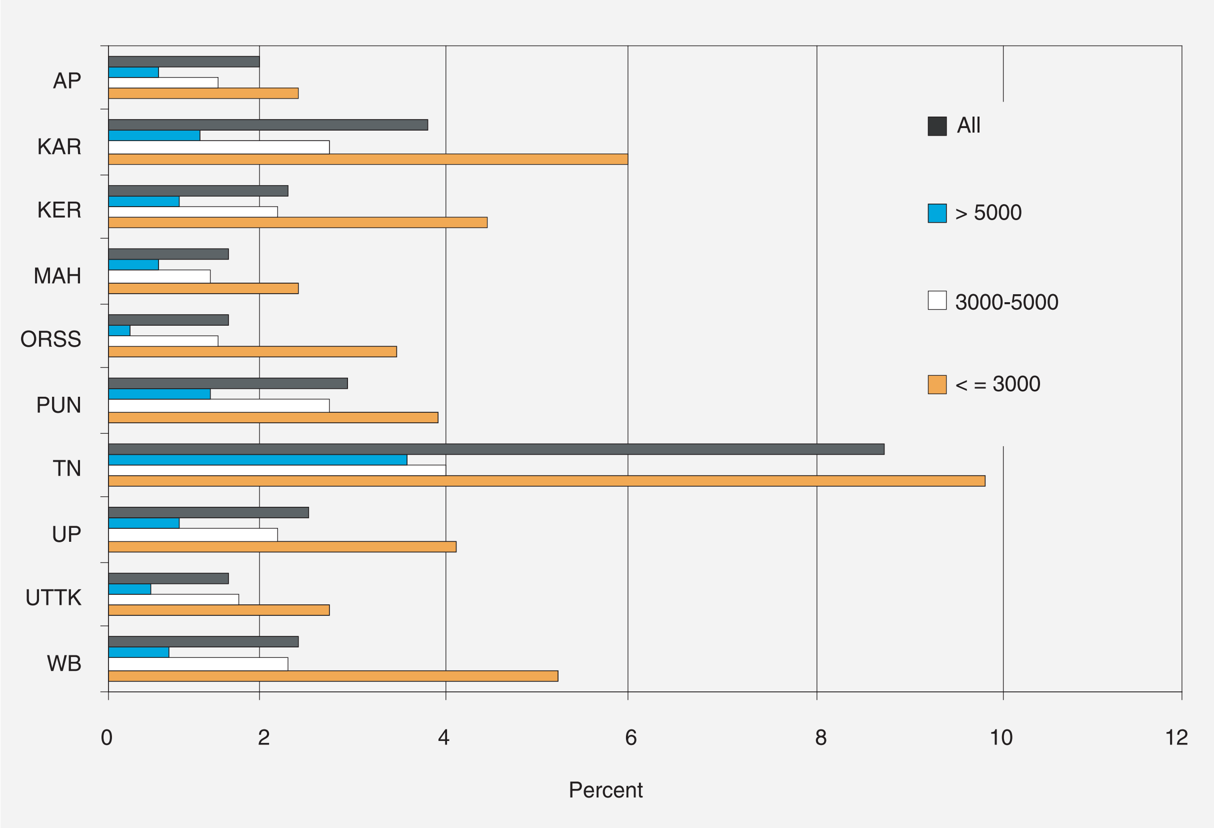
Figure 6.8 Total Coping Costs by Institutional Arrangements



Source: *Computed from household survey data.*
Note: *For each state, some of the categories are missing in the chart because schemes of the relevant category were not covered in the survey.*

utility-managed schemes. In contrast, in Kerala and Uttarakhand, the coping cost borne by households is relatively high for schemes managed by public utilities. In Andhra Pradesh, Kerala, Orissa, Uttar Pradesh, and Uttarakhand, the coping costs borne by households using community-managed schemes are lower than that borne by households using schemes managed by public utilities or government agencies. However, in Tamil Nadu, the costs are relatively lower in government/public utility-managed schemes.

Figure 6.9 Coping Cost and Water Charges Paid as a Percentage of Income, by State and Income Class



Source: Computed from household survey data.
Note: Three levels of monthly income have been considered, up to Rs 3,000, Rs 3,001 to 5,000, and above Rs 5,000.

Total Cost of Water to Households as a Proportion of Household Income

The total cost of water supply to households includes the coping cost borne by households, together with the payment for water supply. How high is the total water cost as a proportion of household income? Does this ratio vary across income classes, and if so, in which direction? These are the questions taken up next.

The proportion of the total cost of water to household income is shown in Figure 6.9 for different income classes and also as an aggregate. The proportion of the total cost of water to a household's income as aggregate is found to be highest in Tamil Nadu (8.8 percent) followed by Karnataka (3.8 percent). In the remaining states the percentage was 2.5 percent or less. From the results, one may infer that rural households in the 10 states surveyed are incurring a loss of about 2 percent to 9 percent of their income due to deficiencies of the water supply schemes.

It may be pointed out here that the absolute amount of cost borne by higher income classes is not much higher than that borne by low income households. In consequence, the ratio of total water cost to income falls with the level of income.

It would be noticed from Figure 6.9 that the ratio of total water cost to income is distinctly lower in the income class 'above Rs 5,000 per month' as compared to the income class, 'below Rs 3,000 per month'.

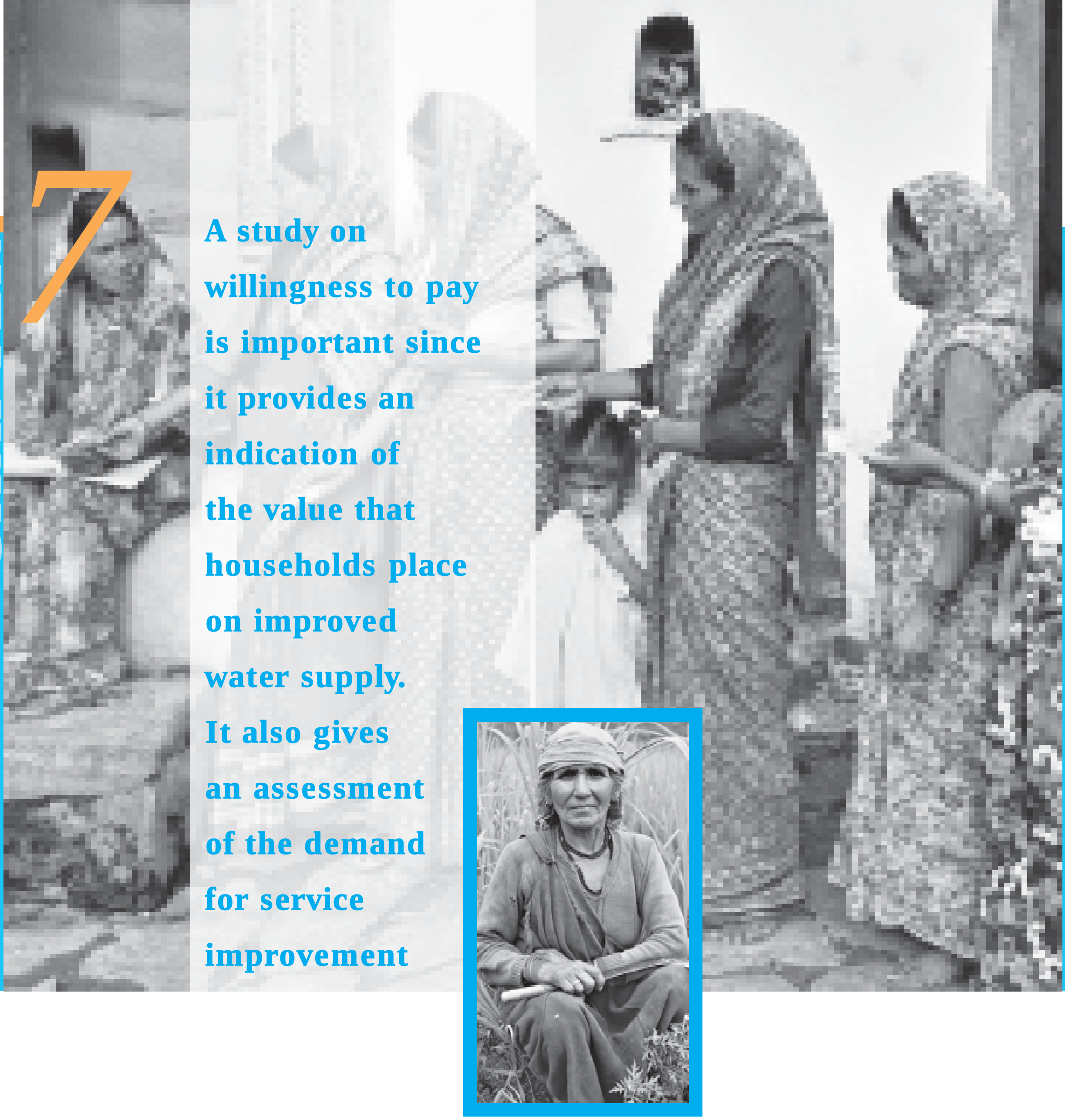
The difference is marked in the cases of Tamil Nadu, Uttar Pradesh, Karnataka, Kerala, Orissa, Punjab, and West Bengal.

Thus the loss to the poor households due to deficiencies of water supply, as a proportion of their income, is relatively greater.

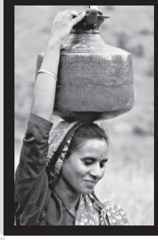
Summing Up

Significant coping costs are borne by rural households because of deficiencies of water supply schemes. The dominant portion of coping cost is the opportunity cost of time spent for water collection. Coping costs are found to be high in Tamil Nadu and Karnataka. Coping costs along with water charges paid are 2 percent to 9 percent of the income of rural households in different states. In a sense, this is the loss rural households suffer due to deficiencies of water supply schemes. Evidently, by taking various measures for improving the effectiveness of rural water supply schemes, as outlined in the previous chapters, the costs being borne by rural households can be minimized.

CHAPTER 7



A study on willingness to pay is important since it provides an indication of the value that households place on improved water supply. It also gives an assessment of the demand for service improvement



Willingness to Pay for Improved Services and Affordability

The performance of water supply schemes and the problems faced by households have been described in Chapter 5. Household coping strategies and coping costs were discussed in Chapter 6. This chapter explores issues related to household willingness to pay for improved services and affordability.

A study on willingness to pay is important since it provides an indication of the value that households place on improved water supply. It also gives an assessment of the demand for service improvement. A study of affordability provides guidance on tariff setting, helping to ascertain how far the consumers will be able to pay the cost of improved services.

7.1 Methodology to Estimate Willingness to Pay

Contingent Valuation Method

The contingent valuation (CV) method[49] has been used in this study to assess the willingness to pay (WTP) for improved services by rural households. This method has found a wide application in empirical studies related to environmental economics, and several studies have applied the CV method to assess the demand for improved water services.[50]

To assess willingness to pay, contingent valuation studies generally use a closed-ended referendum type elicitation method (where the respondent is asked whether or not s/he would be willing to pay a particular amount for the good being valued) or the payment card or checklist contingent valuation method (in which the respondent is asked to indicate the maximum amount s/he would be willing to pay from a ordered set of values, ranging from zero to 'Rs X or more' per month for the good).[51]

Several variants of the payment card method are in use, including the recent 'payment ladder' method.[52] From an ordered set of values (payments), the respondent indicates the amounts that s/he would *definitely pay* (ticks) and the amounts that s/he would *definitely not* pay (crosses). The advantage of this approach is that

[49] For a discussion on the contingent valuation method, see R. Mitchell and R. Carson, *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Washington, D.C.: Resources for the Future, 1989. See also, R.T. Carson, N.E. Flores, and N.F. Meade. 'Contingent Valuation: Controversies and Evidence.' *Environmental and Resource Economics*, 19:173–210, 2001; R.C. Mitchell, 'On Designing Constructed Markets in Valuation Studies,' *Environmental and Resource Economics*, 22:297–321, 2002.

[50] See, for instance, J. Ahmad, B. Goldar, S. Misra, and M. Jakariya, *Fighting arsenic, listening to rural communities: Willingness to pay for arsenic-free, safe drinking water in rural Bangladesh*, New Delhi, Water and Sanitation Program, 2003; Gloria Soto Montes de Oca, Ian J. Bateman, Robert Tinch, and Peter G. Moffatt, 'Assessing the willingness to pay for maintained and improved water supplies in Mexico city,' CSERGE Working Paper ECM 03–11, 2003; James F. Casey, James R. Kahn, and Alexandre Rivas, 'Willingness to pay for improved water service in Manaus, Amazonas, Brazil,' *Ecological Economics*, 58(2), 365–372, 2006; R.V Raje, P.S. Dhobe, and A.W. Deshpande, 'Consumer's willingness to pay more for municipal supplied water: A case study,' *Ecological Economics* 42(3): 391–400, 2002; Dale Whittington, S.K. Pattanayak, J. Yang, and K.C. Bal Kumar, 'Household demand for improved piped water services: Evidence from Kathmandu, Nepal,' *Water Policy,* 4: 531–556, 2002.

[51] The open-ended elicitation method (where the respondent is asked to state the sum s/he would be willing to pay for the good being valued), which was widely used at one time has now fallen out of the favor of researchers due to its shortcomings, particularly the elicited values being affected by hypothetical bias and strategic bias.

[52] Some of the studies that have used the payment ladder approach are Nick Hanley and Bengt Kristrom, 'What's it worth? Exploring value uncertainty using interval questions in Contingent Valuation', Working Paper, Department of Economics, University of Glasgow, 2002; B. Day, N. Hanley, and O. Bergland, 'Non-parametric and semi-parametric approaches to analyzing payment ladder contingent valuation data: bathing water quality improvements in Scotland', Working paper, Economics Department, University of Glasgow, 2001; Bruce Horton, Giordano Colarullo, Ian Bateman, and Carlos Peres, 'Evaluating non-users willingness to pay for the implementation of a proposed national parks program in Amazonia: a UK/Italian contingent valuation study', CSERGE Working Paper ECM 02–01, 2002.

Using a simple payment card method for handpump users allows for several service improvement options, including a switch to piped water systems and add-on facilities with the existing handpumps

it recognizes the stochastic nature of household willingness to pay, that is, there is a probability distribution of the amount that the respondent would be willing to pay for a given good or service. For this study two formats have been used—payment card and payment ladder. The payment card format has been used to elicit the respondent's willingness to pay for improved services of a handpump, while the payment ladder format has been used in the study to elicit the respondent's willingness to pay for improved piped water supply. Using a simple payment card method for handpump users allows for several service improvement options, including a switch to piped water systems and add-on facilities (such as a fluoride filter) with the existing handpumps.

The closed-ended format was not favored for this study because for a proper administration of the closed-ended format it needs to be coupled with split sampling (that is, quoting different payment levels in different sub-samples). It was felt that given the large size of the questionnaire (and the wide range of issues on which information was being collected), the closed-ended format with split sampling would be difficult to administer. Also, in the setting of rural India, a question on whether or not the household will be willing to pay a specified amount for water supply (often viewed by villagers as a responsibility of the state government) would not have a favorable response from the respondent, who in all likelihood would be more comfortable with the question on how much at the most can s/he pay for an improved water supply.

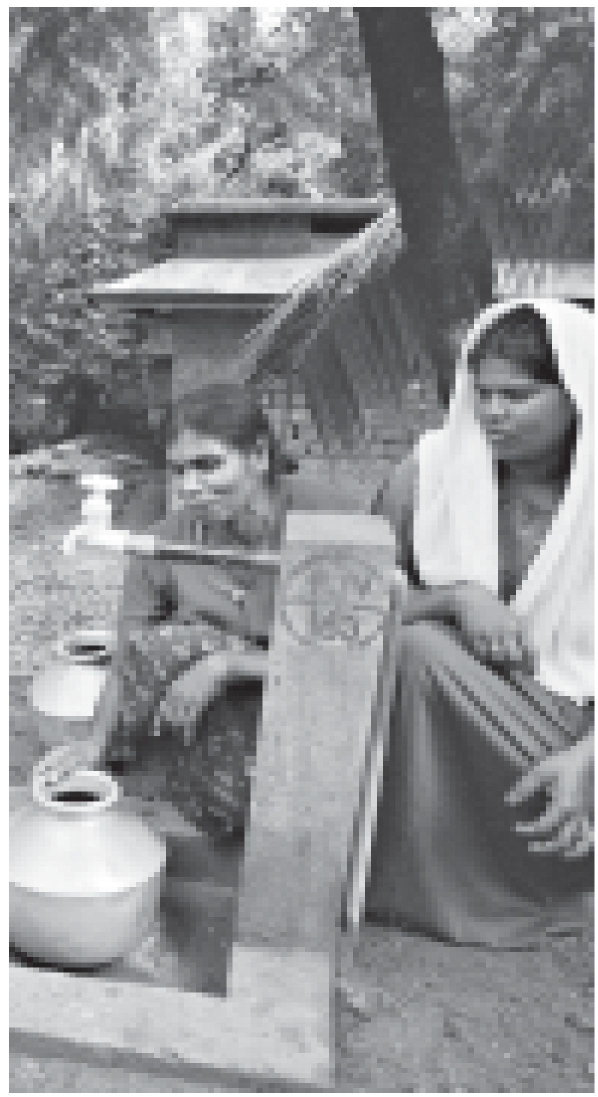
Payment Cards

Before asking the questions on consumer willingness to pay for improved services, the household was asked (the respondent was often the head of the household; male in almost all cases) questions on whether he was satisfied with the current arrangements for water supply.

Only the households that reported dissatisfaction with services were asked about their willingness to pay for improved services. The improved scenario was explained and the payment card was presented.

The improved scenarios and the structure of payment card differed between piped water users and handpump users. The specification of the improved scenario and the structure of the payment card also differed between Uttar Pradesh, which was the first to study, and other states. Having gained experience from the Uttar Pradesh study (the first state to be analyzed), the specification of scenarios and payment cards were later modified.

For piped water users, the improved scenario was specified as better operation and maintenance of the infrastructure or replacement of the existing scheme by a new, better functioning scheme. In both cases, the respondent was to get better services in terms of more water, longer hours of supply, regular supply, and so on. The capital cost contribution that the responding household



will have to make for the improvement in the services was specified. The payment card listed alternate levels of monthly payment that the respondents would have to make towards the O&M of the improved scheme. The respondents were asked to indicate the highest amount they were willing to pay from those listed in the card.[53] Households using piped water were also asked about their willingness to pay for better maintenance of public handpumps and for new handpumps in the village, which they could use as a supplementary source.

For handpump users, the improved services were specified as better maintenance of the handpump. Other options were also explored such as a new handpump, or a new piped water scheme in the village. In several fluoride-affected states, handpump users were offered the option for getting fluoride-free water and their willingness to pay for such measures assessed. Similarly, in West Bengal, the handpump users were offered the option of getting arsenic-free water and their willingness to pay for such measures assessed.

To provide some more details of the payment card used for handpump users, they were asked to indicate the maximum amount they are willing to pay (from those listed in the card) for better maintenance of the existing public handpumps; a new handpump shared by 20–25 households near the respondent's house to be properly maintained (only for households sharing a handpump with more than 25 households at the time of the survey); standposts in a new piped water scheme; and a private connection in a new piped water scheme.

In the arsenic/fluoride-affected states, as mentioned above, the handpump users were asked to indicate their willingness to pay for service improvement options, including a combination of better maintenance of the existing handpump and other measures for taking care of the problem of arsenic/fluoride (community arsenic/fluoride filter, household arsenic/fluoride filter, better piped water supply in a neighboring area from where the households could collect drinking water).

In many of the studies using the payment card method, the lowest amount listed in the card is zero, that is, no payment. Since the listing of 'nil' payment in the card may give a wrong impression to the respondent in the context of the on-going reforms in the sector, a low starting value (varying with the cost of the service) was used. For better maintenance of handpumps, the minimum payment indicated on the card was Rs 3 (US$0.07) per month (going up to Rs 15 per month). For new handpumps, Rs 5 (US$0.11) per month was indicated as the minimum monthly payment to cover the cost of repair and maintenance (maximum quoted payment: Rs 20 per month).

For households using standposts, the lowest payment for O&M indicated on the card was Rs 10 (US$0.2) per month (going up to Rs 150 per month). The minimum monthly payment quoted for private connection users was generally Rs 25 (US$0.6) per month (going up to Rs 400 per month). For households currently using a handpump, the minimum payment for using a private connection of a new piped water scheme was specified as Rs 20 (US$0.5) per month (going up to Rs 300 per month). For capital cost contribution, the quoted amounts were: Rs 400 (US$9) for using a new handpump; Rs 400 to 750 (US$9–17) for using standposts of a new piped water scheme, and Rs 1,200 to 1,500 (US$27–34) for using a private connection of a new piped water scheme.[54]

Econometric Modeling

The data collected on household willingness to pay have been analyzed econometrically. Econometric models have been estimated to relate willingness to pay with the socio-economic characteristics of respondents and their families, household income, and other variables representing the level of services they are currently receiving. Dummy variables for the institutional arrangements under which the scheme functions have been introduced in the models. The estimated econometric model has been used to derive the mean willingness to pay of households.

[53] If the respondent expressed unwillingness to pay the specified capital cost contribution but was ready to pay some of the specified amounts of monthly O&M contribution, s/he was permitted to record a lower amount of capital cost contribution. If the respondent agreed to pay the specified capital cost contribution and indicated the highest O&M payment s/he can make, the respondent was then asked whether s/he can make a higher capital cost contribution, and if yes, how much. The advantage of this format is that it provides data on the maximum amount of capital cost contribution that the households are willing to make.

[54] There are some variations across states reflecting differences in local conditions. In Uttar Pradesh, the capital cost contribution for a new handpump was specified as Rs 100–200 and that for piped water connection as Rs 1,200–2,400.

7.2 Estimated Willingness to Pay

Table 7.1 presents state-wise comparisons of piped water users' estimated willingness to pay for the capital and O&M cost of improved piped water services. As can be seen, households in most states using private connections are willing to pay Rs 30–50 (US$0.7–1.1) per month towards the O&M cost of improved services.[55] In Maharashtra and Punjab, mean willingness to pay is higher (about Rs 63 or US$1.43 and Rs 68 or US$1.54, respectively, per month). Households are willing to contribute on an average Rs 500–850 (US$11–19) towards the capital cost of improved schemes. In Punjab, the mean willingness to pay is higher (about Rs 1,430 or US$33).

In Andhra Pradesh, Karnataka, Kerala, Orissa, Uttarakhand, and West Bengal, rural households using standposts in piped water schemes are willing to pay Rs 13–19 (US$0.3–0.4) per month towards the O&M cost of improved schemes; households in Uttar Pradesh, however, are willing to pay only about Rs 7 (US$0.16) per month on an average. In comparison, households in Maharashtra, Punjab, and Tamil Nadu are willing to pay a higher amount (on average Rs 34, Rs 30, and Rs 24 [US$0.8, 0.7, and 0.5] per month, respectively) as the O&M cost of schemes. On an average, households using standposts are willing to pay about Rs 400–700 (US$9–16) as the capital cost for improved schemes.

Table 7.1 Estimates of Willingness to Pay of Piped Water Users for Improved Piped Water Supply (per Household), State-Wise Comparisons

State	Pvt conn user contribution to O&M cost	Pvt conn user contribution to capital cost	Standpost user contribution to O&M cost	Standpost user contribution to capital cost
	Mean WTP (Rs/month)	Mean WTP (Rs)	Mean WTP (Rs/month)	Mean WTP (Rs)
Andhra Pradesh	40	518	14	420
Karnataka	50	766	18	423
Kerala	51	796	14	626
Maharashtra	63	843	34	424
Orissa	52	534	16	430
Punjab	68	1,430	30	719
Tamil Nadu	49	613	24	460
Uttar Pradesh	34	NA	7	NA
Uttarakhand	43	514	13	429
West Bengal	53	645	19	546
Weighted average	57	982	19	479

NA: not available. WTP: willingness to pay. Pvt conn: private connection.
Source: Estimated from household survey data.
Note: From the data collected from Uttar Pradesh, it is not possible to estimate household willingness to pay towards the capital cost of the improved services.

Among households currently using handpumps, the average willingness to pay for better maintenance of the existing public handpump ranges from Rs 5 (US$0.1) per month in Uttar Pradesh, Orissa, and Tamil Nadu to Rs 8 (US$0.18) per month in Kerala and Rs 11 (US$0.25) per month in Punjab (Table 7.2). The average willingness to pay for the maintenance of a new handpump ranges from Rs 6 (US$0.14) per month in Uttar Pradesh and Uttarakhand to Rs 9 (US$0.20) per month in Kerala, Maharashtra, and West Bengal. The maintenance cost of handpumps per household is generally about Rs 5 per month. Evidently, the estimates of average willingness to pay either exceed or are equal to the cost of maintenance. On an average, the amount

[55] It should be clarified that the willingness to pay reported here is not an extra amount that households would pay over and above what they are paying now. Rather, these are the total amounts the households agreed to pay for improved services.

Table 7.2 Estimates of Willingness to Pay of Handpump Users, State-Wise Comparison

Option		AP	KAR	KER	MAH	ORSS	PUN	TN	UP	UTTK	WB	Weighted average
Better maintenance of existing handpumps	Mean WTP (Rs/month)	7*	6	8	7	5	11*	5	5	NA	7	6
Maintenance of a new handpump	Mean WTP (Rs/month)	9*	7	9	9	8	NA	8	6	6	9	8
Pvt conn of a new piped water scheme: O&M	Mean WTP (Rs/month)	26	20	30	34	NA	44	30	12	19	38	21
Pvt conn of a new piped water scheme: Capital cost	Mean WTP (Rs)	834	1,020	970	860	NA	1,004	1,040	NA	NA	920	983
Standposts of a new piped water scheme: O&M	Mean WTP (Rs/month)	13	12	6	23	15	NA	21	7	9	19	13
Standposts of a new piped water scheme: Capital cost	Mean WTP (Rs)	716	941	294	700	476	NA	805	NA	NA	729	689

*NA: not available. *: includes payment for the cost of a community filter for fluoride. Pvt conn: private connection.*
Source: Household survey data.

that handpump users are willing to pay towards the O&M cost of a private connection in a new piped water scheme ranges from Rs 12 (US$0.3) per month per household in Uttar Pradesh to Rs 34 (US$0.8) per month per household in Maharashtra and Rs 38 per month in West Bengal. These figures fall short of the actual cost, which is likely to be in the range of Rs 40–50 (US$0.9–1.1) per month per household (or higher in some cases).[56] The average sum that handpump users are willing to pay per month as the O&M cost of using a standpost ranges from Rs 6 (US$0.14) per month in Kerala and Rs 7 (US$0.16) per month in Uttar Pradesh to Rs 23 (US$0.5) in Maharashtra.

The estimates of willingness to pay among handpump users in Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, and West Bengal clearly indicate that these households are keen to have piped water supply. The amount that households are willing to pay is, however, not adequate to fully cover the O&M cost. The demand for piped water supply among current handpump users exists in Kerala, Orissa, and Punjab also. However, households in Kerala and Punjab appear to be more interested in private connections rather than standposts.

[56] This assessment is based on the cost norms.

As mentioned earlier, in several fluoride-affected states handpump users were offered options of getting fluoride-free water for assessing their willingness to pay for such measures. As can be seen from Table 7.3, households are willing to pay a higher sum for the O&M if the handpump scheme is supplemented by a well-performing piped water scheme in the neighborhood, or if community-level filters are installed to address the problem of fluoride.

maintenance of the handpump improves and a community fluoride filter is installed.

Table 7.4 shows the willingness to pay of handpump users in West Bengal for measures to address the arsenic problem (Burdwan, Malda, Murshidabad, and South 24 Parganas districts) and fluoride (Birbhum district). The households in arsenic/fluoride-affected area are willing to pay a higher sum for the O&M if the handpump

Table 7.3 Willingness to Pay of Handpump Users for Measures to Address the Problem of Fluoride in Affected States (O&M Cost, Rs/Month)

State	Better maintenance of handpumps	Better maintenance of existing public handpump plus more and regular hours of supply from piped water scheme	Better maintenance of existing public handpump plus household filter for fluoride	Better maintenance of existing public handpump plus community filter for fluoride
	Mean WTP (Rs/month)	Mean WTP (Rs/month)	Mean WTP (Rs/month)	Mean WTP (Rs/month)
Andhra Pradesh	6	7	10	7
Maharashtra	7	10		9
Punjab			25	11
Tamil Nadu	5	11	15	10

Source: Household survey data.
Note: In Punjab, the respondents indicated their willingness to pay only for the fluoride filter options. In Maharashtra, on the other hand, there were very few responses for the option that provided for a household filter.

In Tamil Nadu, for instance, households would pay Rs 5 extra per month for having a community fluoride filter and about Rs 10 extra per month for a household filter (their mean WTP increases from Rs 5 per month to Rs 10 per month for a community filter and further to Rs 15 for a household filter). The option of a household filter did not find much acceptance among households in Maharashtra, but was acceptable to many handpump users in Andhra Pradesh, Punjab, and Tamil Nadu, as reflected in their stated willingness to pay. Indeed, in these three states, the willingness to pay is highest for this option. The difference is particularly marked in the case of Punjab. The rural households are willing to pay Rs 25 per month towards the O&M if the handpump is better maintained and a household filter for fluoride is provided and maintained through annual maintenance contracts. This is in contrast to a payment of Rs 11 per month, which they are ready to make if the

scheme is supplemented by a well-performing piped water scheme in the neighborhood, or if community-level filters are installed to address the problem of arsenic/fluoride. The willingness to pay is substantially higher if the handpump scheme is supplemented by household filters for arsenic/fluoride. In arsenic-affected districts, the households currently using handpumps are willing to pay Rs 8 per month on an average for better maintenance of the existing handpump or a new handpump; they would pay Rs 20 per month if the handpump scheme is well maintained and is supplemented with household arsenic filters. In fluoride-affected areas, a similar increase in willingness to pay is observed for supplementing the handpump scheme with household fluoride filters.

It is interesting to note that in arsenic-affected areas, households place a greater value on the availability of piped water supply in the neighborhood (from where they could collect

Table 7.4 Willingness to Pay of Handpump Users for Measures to Address the Problem of Arsenic and Fluoride in Affected Districts of West Bengal (O&M Cost, Rs/Month)

Water quality status of districts	Better maintenance of handpump (existing or new)	Better maintenance of public handpump plus more and regular hours of supply from piped water scheme	Better maintenance of public handpump plus household filter for arsenic/fluoride	Better maintenance of public handpump plus community filter for arsenic/fluoride
	Mean WTP (Rs/month)	Mean WTP (Rs/month)	Mean WTP (Rs/month)	Mean WTP (Rs/month)
Arsenic-affected	8	13	20	11
Fluoride-affected	9	13	16	13
Not affected by arsenic or fluoride	7	8	–	–
All	8	10	18	11

Source: Household survey data.

arsenic-free water) than having a community filter for arsenic for the public handpump they use. In areas unaffected by arsenic or fluoride, this option (that is, piped water in the neighborhood) does not seem to be very attractive to the households.

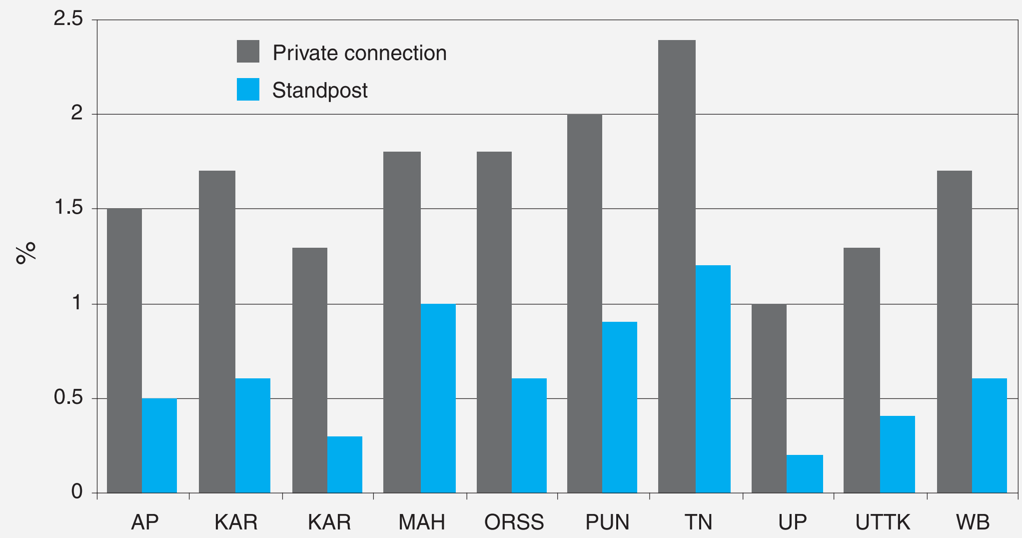
WTP as a Percentage of Household Income

In Kerala, a study of rural piped water supply undertaken in 1988 by B. Singh[57] and others showed that households were willing to pay an average monthly tariff of Rs 5.5 for a domestic connection in areas that did not have access to piped water services. In areas with piped water schemes, households without a water connection were willing to pay a monthly tariff of Rs 8.7–9.7, depending on the quality of service. Households with a piped water connection were willing to pay a monthly tariff of Rs 25 for improved water services.

Based on the average annual per capita income reported in the study (assuming an average family size of six), the percentage of monthly income that households would be willing to pay as monthly tariff was in the range of 0.4–2.0 percent. A review of contingent valuation studies on the demand for improved water supply in developing countries done by M. Jiwanji[58] brought out that in large majority cases (estimates obtained in 11 out of 15 studies), households were willing to pay 0.5–2.5 percent of their income per month for piped water. A study of rural Bangladesh undertaken by Ahmad and others[59] indicates households' willingness to pay about 2 percent of their income for a private connection and about 1 percent of their income for a standpost.

[57] B. Singh, R. Ramasubban, R. Bhatia, J. Briscoe, C. Griffin, and C. Kim. 'Rural Water Supply in Kerala, India: How to Emerge from a Low-level Equilibrium Trap.' *Water Resources Research* 29(7): 1931–42. 1993.
[58] M. Jiwanji, *The Demand for Water in Developing Countries: A Meta-Analysis of Contingent Valuation Studies*. Masters Dissertation, University College, London, 2000.
[59] J. Ahmad, B. Goldar, S. Misra, and M. Jakariya, *Fighting arsenic, listening to rural communities: Willingness to pay for arsenic-free, safe drinking water in rural Bangladesh*, New Delhi, Water and Sanitation Program, 2003.

Figure 7.1 Ratio of Willingness to Pay to Household Income



Source: WTP estimates taken from Table 7.1. Average income has been computed from household survey data.

Figure 7.1 presents the study findings on the ratio of willingness to pay to income for rural populations. The ratio is broadly in the range that is indicated by the findings of earlier studies on willingness to pay for piped water supply in developing countries, that is, 0.5 to 2.5 percent, which lends reliability to the WTP estimates obtained in this study.

7.3 Affordability of Schemes

Income Norms to Assess Affordability

There is limited literature on the methodology to assess how much a household can afford to pay for water supply and sewerage services.[60] The Asian Development Bank has suggested a norm of 5 percent of household income,[61] and the World Bank a norm of 3–5 percent.[62]

A norm of 2.5 percent of the median income of households has been suggested by the United States Environment Protection Agency (USEPA)[63] based on the idea that if the cost of

[60] Available literature on 'affordability' aspects includes: 'Water prices in CEE and CIS Countries: A toolkit for assessing willingness to pay, affordability, and political acceptability,' Danish Cooperation for Environment in Eastern Europe, Ministry of Environment, March 2002; and 'Towards defining and measuring affordability of utilities', Discussion Paper, Public Utility Access Forum, UK, no date.
[61] Samuel Fankhauser and Sladjana Tepic, 'Can poor consumers pay for energy and water? An affordability analysis for transition countries,' Working Paper on Tariff Reform and Affordability, European Bank for Reconstruction and Development, London, UK, 2005.
[62] World Bank, *Sourcebook for poverty reduction strategies, core techniques, and crosscutting issues*, Washington, DC, 2002.
[63] *Affordability criteria for small drinking water systems: An EPA Science Advisory Board Report* (A report by the environmental economics advisory committee of the EPA Science Advisory Board [SAB]), United States Environmental Protection Agency, Washington, DC, 2002.

service (per household) is less than 2.5 percent of the median income, then given the income distribution, the payment would be affordable for low-income households.[64] In a number of studies undertaken in the UK, the affordability criterion has been taken as 3 percent of income.[65] This criterion has been estimated by taking twice the median spending of households on water charges as a percentage of disposable income,[66] and alternatively by taking the ratio of the water bill to the income of the bottom 30 percent of households (in terms of income).[67] The underlying assumption is that if poor households can pay 3 percent of their income towards the water bill, then households with a higher income can also spend 3 percent of their income on the water bill.

Methodology

The methodology applied for ascertaining affordability norm for the UK (based on the observed ratio between the water bill and the income of the bottom 30 percent of households) has been adapted and used in this study to assess the issue of affordability of rural water supply schemes in the 10 states surveyed. If this methodology is to be strictly followed, then the monthly payment made by households for piped water supply schemes as a ratio to their income should be computed for the bottom 30 percent of households, and on that basis the affordability norm should be derived. However, three modifications have been made to arrive at a more rigorous assessment of affordability:

- Rather than considering only the bottom 30 percent of households, the relevant ratio has also been separately computed for the bottom 20 percent, 40 percent, and 50 percent of households. This helps to probe the sensitivity of the estimates, and also addresses the possible criticism of the approach that the choice of the bottom 30 percent of households is arbitrary.
- Along with the monthly payment made for piped water, other water-related expenses have been considered. It should be noted that the monthly payment for piped water is not the only water-related expenditure that households have to bear. Several households also incur expenses on the repair and maintenance of their own tubewell or dug-well, and on the repair of public water sources (handpumps). This expenditure obviously needs to be included in the assessment of affordability.
- A number of households are neither making any payment for the water they get from the supply schemes, nor do they incur any expenses on their own water sources or public water sources. Such households need to be excluded from the computation of the affordability norm, otherwise affordability may be underestimated. Hence, households not paying for the O&M of the water supply schemes or repair/maintenance of their own source/public sources have been excluded from the computation of the affordability norm. Consequently, only households spending Rs 5 or more per month on water supply are included in the analysis.

Derivation of Affordability Norm

The following ratio (R) has been computed separately for the bottom 20 percent, 30 percent, 40 percent, and 50 percent households to derive the affordability norm:

$$R = (E_s + E_{os})/Y \qquad \ldots(7.1)$$

where E_s denotes the payment made per month on an average for water received from the piped water scheme; E_{os} is the expenditure incurred per month on an average in connection with own sources of water such as tubewell or dug-well (cleaning, repair, and so on) or repair of public sources; and Y is the average monthly income.

As mentioned earlier, households that are currently not making any payment towards the O&M of the piped water schemes nor incurring

[64] Scott J. Rubin, 'Criteria to Assess the Affordability of Water Service,' White Paper, National Rural Water Association, 2001, Duncan, USA.
[65] See, for example, Paddy Hillyard and Fiona Scullion, 'Water Affordability Under the Water Reform Proposals,' School of Sociology and Social Policy, Queen's University, Belfast, Bulletin No 9, September 2005; John W. Sawkins and Valerie A. Dickie, 'Affordability of water and sewerage services in Great Britain,' Department of Economics, School of Management and Languages, Heriot-Watt University, Edinburgh, 2002; Martin Fitch, 'Unaffordable Water,' Centre for Utility Consumer Law, University of Leicester, July 2003.
[66] One of the UK Government's national indicators of sustainable development is water affordability, measured by the percentage of households spending more than 3 percent of income on water charges (Department of Environment, Transport, and the Regions, *Quality of Life Counts*, Publ: DETR, 1999). The microeconomic data on which this analysis was based were drawn from the Family Resources Survey. The 3 percent threshold, however, was taken for 'illustrative purposes' only. The percentage of households in Great Britain spending more than 3 percent of disposable income on water charges stood at 21.8 percent in 1994–95 and 18.4 percent in 1997–98.
[67] M. Fitch (*Water Poverty in England and Wales*, Working Paper, Centre for Utility Consumer Law, University of Leicester, 2002) highlights his preference for using the 3 percent figure for judging affordability. He presents an analysis using 1999–2000 data supplied directly by the Office of National Statistics. Using an approach similar to that adopted in the early fuel poverty calculations, he calculates that on an average water charges account for 3 percent of the disposable income of the three lowest income groups by decile.

expenses on own sources/public sources (or spending less than Rs 5 per month on these items of expenditure) are excluded. To explain the above equation further, consider the computation method used for the bottom 20 percent households. For such households, the average payment made towards piped water schemes, the average expenses incurred for own water sources, and/or repair of pubic sources and the average income are computed. Then, the formula in equation (7.1) is applied. The resultant ratio, R, is interpreted as the proportion of income that rural households can afford to pay for water supply.

Derivation of Affordable Payment for a Private Connection

Given R, the affordability norm, the affordable monthly payments for a private connection is derived in the following way:

$$AP_{pc} = R \times Y_{av} \quad \ldots(7.2)$$

where AP_{pc} denotes the affordable payment for a private connection and Y_{av} the average income level of the rural households in the state being studied. Since Y_{av} is the average income of households and R is the proportion of income that households can afford to pay, AP_{pc} is the amount that a typical household would be able to pay for piped water.

Derivation of Affordable Payment for Standposts

To work out the affordable payment for standposts, the affordability norm (R) is multiplied with the average income of the below poverty line (BPL) families in the state, since the BPL families should have abundant access to standposts, and thus the charge for standposts should be such that it is affordable for BPL families. Accordingly, the affordable payment for the use of standposts is obtained as:

$$AP_{sp} = R \times Y_{av\_BPL} \quad \ldots(7.3)$$

where AP_{sp} denotes affordable payment for the use of standposts and Y_{av_BPL} denotes the average income level of the rural population earning up to Rs 1,800 per month (taken as a rough approximation to the poverty line).[68]

Derivation of Capital Cost Contribution

The methodology applied to derive the affordable one-time capital cost contribution of households for new piped water schemes is similar to that described above for O&M payments. The capital cost contribution made by households using piped water schemes (combining cash contributions with the monetary value of labor days contributed) as a ratio to their monthly income has been computed for the bottom 20 percent, 30 percent, 40 percent, and 50 percent households. Households that did not contribute to the capital cost in the past have been excluded from the analysis. The ratio thus computed provides the affordability norm. This part of the methodology is similar to that described above for O&M.

Having obtained the affordability norm, five alternative levels of capital cost contribution are considered—Rs 600, Rs 900, Rs 1,200, Rs 1,500, and Rs 1,800.[69] For each of these, the proportion of households that would be able to pay has been ascertained applying the affordability norm. On the basis of this analysis, the affordable level of capital cost contribution has been assessed.

7.4 Results of the Affordability Analysis

Findings on affordable payment for piped water supply, O&M cost contribution, and capital cost contribution, are presented in Figures 7.2, 7.3, and 7.4. As explained in Section 7.3 above, a separate assessment has been made of the affordable O&M contribution for private connections and standposts. State-wise differences are evident, as can be seen from these figures. Affordable payment per household for a private connection is assessed at Rs 30–40 per month in Orissa and Tamil Nadu; Rs 30–45 per month in Andhra Pradesh; Rs 30–50 per month in West Bengal; Rs 50–60 per month in Karnataka,

[68] The poverty line for rural areas has been estimated for 2004–05 by Himanshu ('Recent Trends in Poverty and Inequality: Some Preliminary Results', *Economic and Political Weekly*, February 10, 2007, pp 497-508) on the basis of the official poverty line for 1999–2000. According to his estimate, the poverty line in 2004–05 was at Rs 358 per capita per month. The average household size at the All-India level was about 5 in 2004–05 (NSS Report No. 515, Employment and Unemployment Situation in India, 2004–05). Thus, taking a household income level of Rs 1,800 per month as a cut-off for poverty seems reasonable.

[69] For the analysis for Uttarakhand, the levels of capital cost contribution considered are Rs 400, Rs 500, Rs 600, Rs 800, and Rs 1,000. This has been done because the proportion of low income households is relatively greater in Uttarakhand.

Figure 7.2 **Affordable Payment Towards the O&M Cost for a Private Connection**

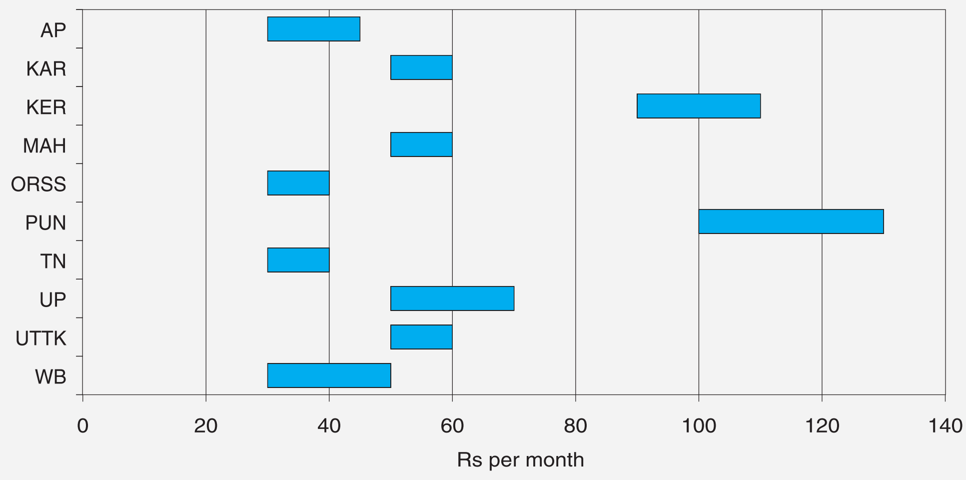
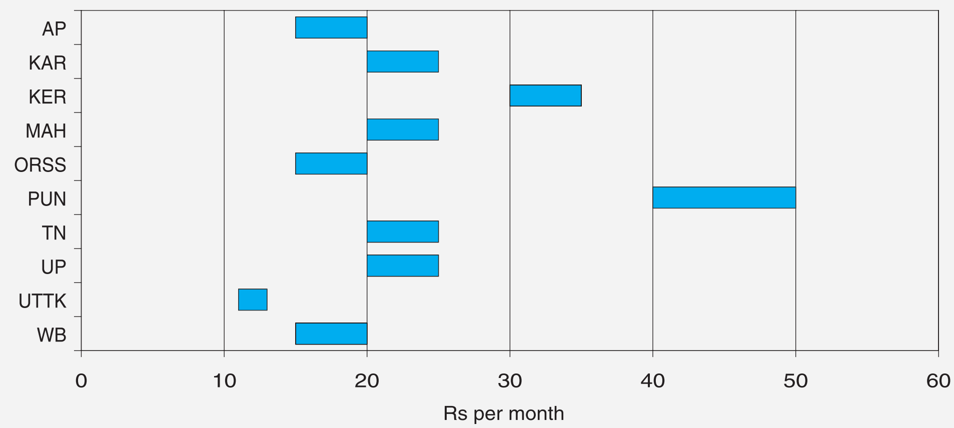


Figure 7.3 **Affordable Payment Towards the O&M Cost for a Standpost**



Maharashtra, and Uttarakhand; Rs 50–70 per month per in Uttar Pradesh; Rs 90–110 per month in Kerala; and Rs 100–130 per month in Punjab (Figure 7.2). The affordable payment level per household with regard to standposts is in the range of Rs 11–13 per month in Uttarakhand and Rs 15–20 per month in Andhra Pradesh, Orissa, and West Bengal. Affordable payment is relatively higher, at Rs 20–25 per month in Karnataka, Maharashtra, Tamil Nadu, and Uttar Pradesh. The level is still higher in Kerala (Rs 30–35 per month) and Punjab (Rs 40–50 per month).

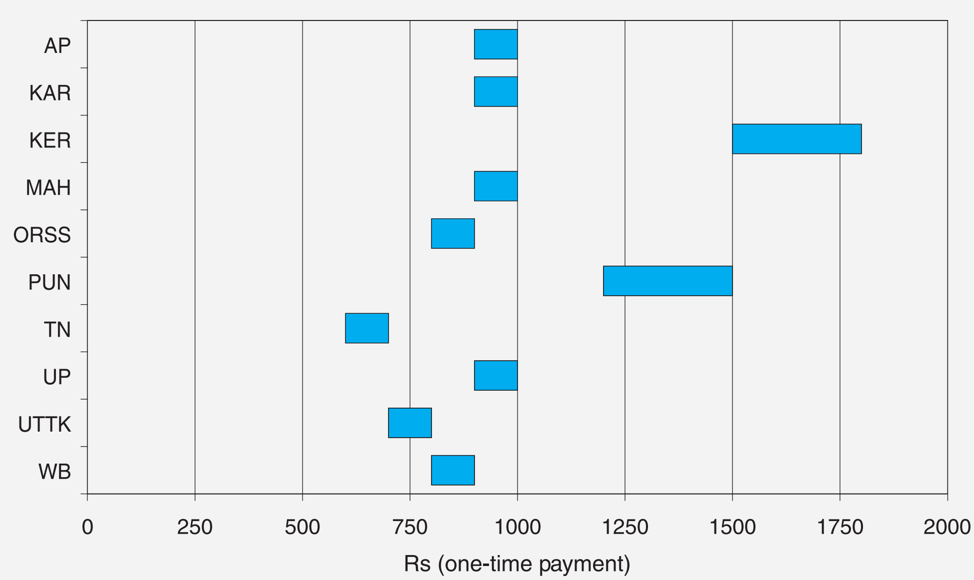
There is a positive correlation between the ranks of states in terms of affordability and willingness to pay towards the O&M cost of piped water supply. Punjab tops in both affordability and willingness to pay, while Andhra Pradesh and Uttarakhand rank low both in terms of affordability and the willingness to pay. However, in general, the household willingness to pay in different states is less than the assessed affordability. This is especially marked in the case of Uttar Pradesh and Karnataka. Turning next to capital cost contribution, for Tamil Nadu and Uttarakhand, the affordable capital cost contribution for a new piped water scheme is estimated at about Rs 600–700 and Rs 700–800, respectively (Figure 7.4). The estimate for Orissa and West Bengal is about Rs 800–900. The majority of rural households in Andhra Pradesh, Karnataka, Maharashtra, and Uttar Pradesh would be able to afford a capital cost contribution of Rs 900–1,000. In Kerala and Punjab, the affordable capital cost contribution is higher (Rs 1,500–1,800 and Rs 1,200–1,500, respectively). The estimates of affordable capital cost contribution above need to be adjusted downward for application to BPL families. The analysis of affordability undertaken for such families suggests that a relatively lower sum, say Rs 400–500, would in general be affordable for them. In general, the cost of improved water supply in rural areas is within affordable limits. Almost all households using public handpumps can afford to pay Rs 5 per month to cover the cost of the maintenance of the handpumps, and almost all households using standposts in piped water schemes can afford to pay Rs 10 per month to cover the cost of the proper maintenance of piped water schemes.

To fully recover the O&M costs of typical piped water schemes, it would be necessary to charge private connection users at the rate of about Rs 50 per month. For new schemes, a capital contribution of Rs 600–1,500 would also be necessary. Most non-BPL households can afford to pay this amount.

7.5 Is Full Recovery of the O&M Cost of Rural Piped Water Schemes Affordable?

In Karnataka, the responsibility for the O&M of piped water schemes and mini water schemes was handed over to the GPs in 1999–2000. In 2002 the state government introduced a uniform policy to be adopted by all the GPs, which stipulates a 100 percent O&M cost recovery from users. However, the state government continues to share the O&M cost through the provision of grants to the GPs. These grants are proposed to be withdrawn in the coming years, and the GPs will be responsible for ensuring 100 percent O&M cost recovery from the users. In the other states covered in the study, the management of the schemes has been handed over to the GPs or they are in the process of doing so. This raises an important issue of whether the GPs would be able to raise a sufficient contribution from beneficiary households to fully cover the cost of the O&M in piped water/mini water schemes. When the actual O&M cost per household of piped water schemes surveyed is compared with the affordable payment level indicated in the affordability analysis above, the cost is found to exceed assessed affordability in 2 percent of schemes in Uttar Pradesh, 3 percent in West Bengal, 5 percent in Punjab, 6 percent in Karnataka, 7 percent in Kerala, 11 percent in Orissa, 14 percent in Tamil Nadu, 26 percent in Uttarakhand, and none of the schemes surveyed in Maharashtra and Andhra Pradesh. It appears, therefore, that in Uttarakhand, if the GPs have to fully meet the O&M cost of piped water schemes from the contributions of beneficiary households, the problem of affordability is likely to be faced in

Figure 7.4 Affordable Capital Cost Contribution



about a quarter of the cases. This also applies to Orissa and Tamil Nadu. Although the level of affordability is found to be relatively low in Andhra Pradesh, the problem of affordability does not arise because of the relatively low cost of water supply. As noted in Chapter 4, the expenditure on the O&M currently being incurred by piped water schemes is on an average about half what the expenditure would be if the schemes were to run according to design and maintained properly (termed as the good practice 'design performance' O&M cost). The implication is that if the schemes are revamped to perform effectively, and the beneficiary households are required to fully bear the good practice (design performance) O&M cost, then the problem of affordability may be encountered in a significant proportion of cases. Indeed, a comparison between the good practice O&M cost and affordable payment reveals that the estimated good practice O&M cost of the schemes covered in the survey exceeded the affordable payment levels in 10 percent cases in Andhra Pradesh, 12 percent in Punjab, 16 percent in West Bengal, 19 percent in Tamil Nadu and Kerala, 20 percent in Karnataka, 26 percent in Orissa, 28 percent in Uttar Pradesh, and 38 percent in Uttarakhand. Maharashtra is an exception in this regard, where in only 5 percent cases, the design performance O&M cost would exceed affordable payment level.

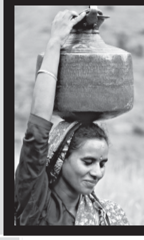
In the current approach where the responsibility of the O&M of piped water schemes would increasingly be handed over to the GPs (and user groups) and that GPs will mobilize revenue from beneficiary households to fully meet the O&M cost, the issue of affordability does not seem to have received adequate recognition. The analysis of survey data indicates that, in several states, the problem of affordability is likely to be faced in a fifth or a higher proportion of cases, if the schemes have to function effectively and the entire O&M cost has to be borne by the beneficiary households. In such cases where the O&M cost is relatively high, some financial support should be given by the state governments to the GPs to ensure the effective functioning and maintenance of the schemes.

Summing Up

Although there are marked inter-state variations in the estimates of willingness to pay and affordability presented in this chapter, the main conclusion that may be drawn from the study is that households are willing and can afford to pay for improved services. Willingness to pay for a private connection of an improved piped water scheme is found to be mostly in the range of Rs 30 to 60 per month while the corresponding figure for a standpost is Rs 13 to 25 per month. Willingness to pay for piped water as a proportion of household income is by and large in the range of 0.5 to 2.5 percent, which is consistent with the other studies on piped water supply for developing countries. The willingness to pay for better maintenance of handpumps is mostly in the range of Rs 5 to 10 per month, which is adequate to cover the maintenance cost of handpumps. Affordable payment for piped water varies from state to state. But, the general level of affordable payment may be taken as Rs 50–60 for a private connection, Rs 20–25 for a standpost, and Rs 900–1,000 as capital cost contribution for an improved piped water supply scheme. The assessed levels of affordable payment for piped water cover the average cost of piped water supply schemes. There are, however, significant variations in costs across schemes, and for a section of the schemes the cost may be well in excess of the affordability limits and may require an O&M subsidy. It is evident from the analysis presented in this chapter that the rural households are willing and can afford to pay the costs of an improved water supply. It also follows that a sector-wide policy reform involving the large-scale transfer of O&M responsibility to user communities would not in general face a problem of affordability. As noted, in certain cases where the costs of supply are too high, appropriate subsidies could be given.

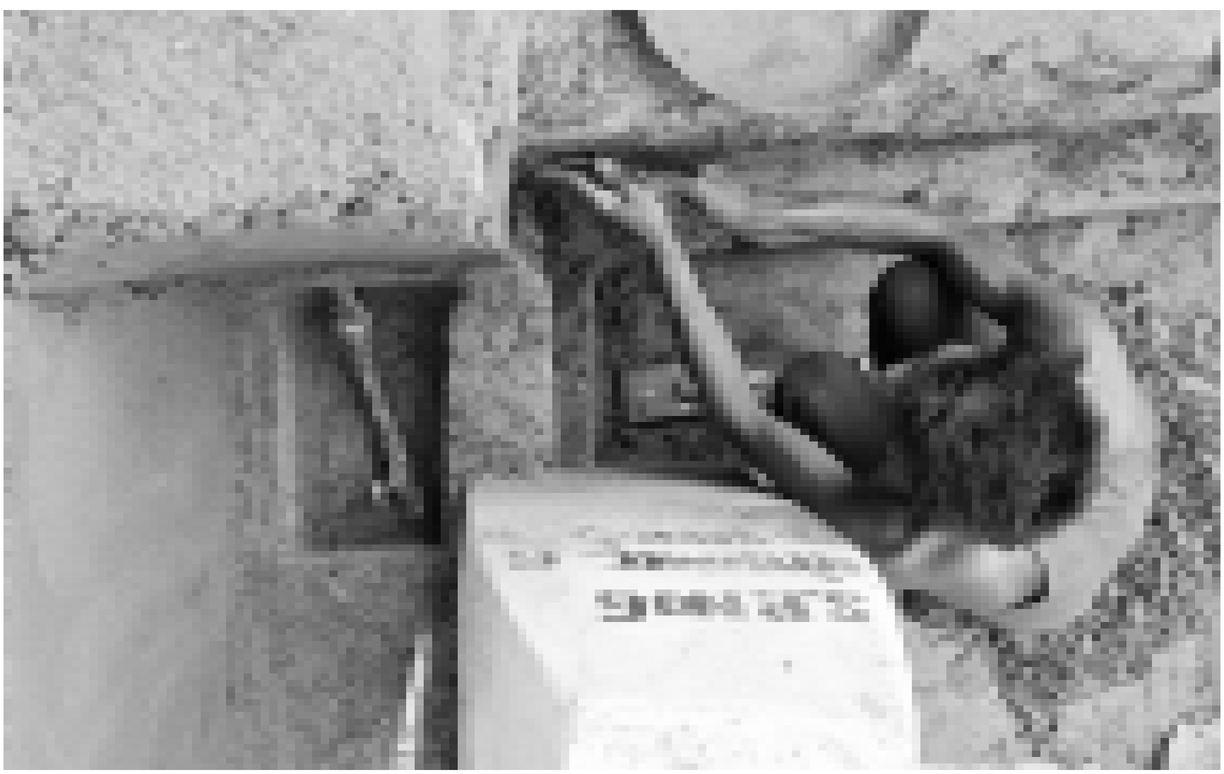
CHAPTER 8

This study is a 'reality check' on the existing design of schemes, with the main intention of alerting the policy-maker with respect to the functionality and sustainability of schemes



Conclusions and Recommendations

Most schemes in the rural water sector continue to be designed and implemented in the traditional 'supply'- (target) driven mode by government engineering departments and boards. While two major 'demand-responsive' reform programs, the Sector Reform Project (SRP) and the Swajaldhara Program, were launched in early 2000, these have yet to be scaled-up and reform policies have yet to be adopted. In the demand-driven programs, the communities are expected to share a part of the capital cost and the entire cost of the operation and maintenance. This study is a 'reality check' on the existing design of schemes, with the main intention of alerting the policy-maker with respect to the functionality and sustainability of schemes. This is the first study of its kind, which analyzes the effectiveness of schemes with respect to the technology type (handpumps, mini water schemes, single village schemes,



The analysis of survey data on the quantity of water supplied by schemes (a key parameter of service) shows that actual supply is often less than the design, especially in summer

multi village/regional schemes) as well as institutional arrangements—schemes that are managed by government departments/state utilities (engineering departments, boards, and so on), village local government (Gram Panchayat), and communities. The main conclusions and recommendations are presented below.

Performance of Schemes

Inadequacies in service provision. The analysis of survey data on the quantity of water supplied by schemes (a key parameter of service) shows that actual supply is often less than the design, especially in summer. For instance, among multi village schemes in Uttar Pradesh, the design lpcd is 55 on an average while the actual lpcd in summer is 22 on an average. Similarly, the design lpcd of single village schemes in Karnataka, Punjab, and Uttarakhand is 53, 57, and 48, respectively, while the actual lpcd in summer is 25, 31, and 18, respectively. Further, the actual hours of supply made by piped water schemes are less than the design hours. Some piped water schemes (about 20–30 percent) do not function for several days in a year due to system breakdowns. Around 30 percent households using piped water schemes do not get daily supply in summer (some do not get daily supply even in other seasons). The water supplied by the schemes does not fully meet the water requirements of the households, especially in summer. Indeed, the water consumption study reveals that most households do not get 40 lpcd from schemes as per the government norm (instead, get about 25 lpcd on an average). The quantity supplied by the schemes commonly constitutes less than half of the water requirement of households, thus compelling the households to make use of other water sources.

Dependence on multiple sources. Due to the inadequacies of the water supply schemes, rural households typically depend on multiple water sources, including their private sources. Many households using piped water, particularly from multi village schemes, have to combine it with public handpumps. About 50 percent rural households in Karnataka and Tamil Nadu have to use government-provided supplementary water sources, since the main water supply schemes accessed by them is insufficient to meet their requirements. Evidently, this dependence

on multiple sources raises the overall cost of water supply to rural areas. Resource wastage is indicated also by over-provisioning of services (noticed particularly in Uttar Pradesh, where more than half of the handpumps are shared by 10 or less households, as against a norm of 50, and in 10 percent cases, a handpump is shared by 4 households or less) and by the tendency to have costly but poorly run multi village schemes when smaller schemes could have provided the same level of service at lower cost.

High coping costs. Data collected from the households in all the 10 states show that rural households are bearing significant coping costs because of the inadequacies of the services provided by water supply schemes; a major part of the coping cost being the opportunity cost of time spent in water collection. The overall average coping cost across states and technologies ranges between Rs 32 and Rs 287 per household per month (the average, taking all technologies and states together, is Rs 81 per household per month). Though there is no clear pattern, the coping cost in a majority of cases is found to be relatively high for households dependent on handpumps or on multi village schemes. It was also seen that coping cost borne by households is relatively high in Tamil Nadu, Karnataka, and Kerala, compared to the other states (due to a relatively higher opportunity of time spent for water collection, the cost of maintenance of own source being an additional factor for Kerala).

Cost of Service Provision

High capital cost and inadequate O&M cost. The analysis of the cost of piped water supply schemes undertaken in the study brought out that the capital cost per household is excessive in a section of schemes, indicating inefficiency, and the level of O&M cost being incurred in piped water schemes is commonly less than what is needed to run the scheme regularly, supply water at the design lpcd level, and undertake proper

maintenance. On an average, the actual O&M cost is about half of the 'good practice (design performance) O&M cost'. The implication is poor functioning of the schemes and inadequate maintenance with an adverse effect on life and the functional status of schemes. The deep tubewell handpumps are no better in this regard. The low expenditure on the O&M of water supply schemes can be traced to inadequate fund allocation and low cost recovery from beneficiary households. Obviously, this calls for greater efforts at cost recovery and an allocation of more funds for the maintenance of schemes so that their useful life can be extended.

Costs relatively lower in demand-driven programs. A major advantage of the demand-driven programs vis-à-vis the supply-driven programs is that in the demand-driven programs, the O&M cost is borne by the beneficiary households, so that a greater proportion of the available program funds can be used for infrastructure building. Further, the institutional costs are relatively much lower in the demand-driven programs, which release funds for infrastructure. A study of the pattern of expenditure on capital, O&M, institutional, and Support Organization/ NGO costs of different programs supports this inference. Taking an average across the states studied, the institutional cost is found to be about 24 percent of rural water supply expenditure in supply-driven programs as against 11 percent in demand-driven programs. When the issue of defunct schemes and over-provisioning of services (say, the number of households sharing a handpump falling far short of the norm) is taken into account, the lower efficacy of supply-driven schemes comes out more clearly.

Reliability, sustainability, and cost recovery better addressed in demand-driven schemes. In terms of the quality of services, as captured by the index of reliability and adequacy used in the study, the survey results indicate an advantage of community-managed schemes over schemes managed by the government/utilities.

Demand-driven schemes are performing better also with respect to the sustainability of water source and cost recovery for operations and maintenance. To give some examples, in Karnataka, 21 percent of community-managed piped water supply schemes had supply disruption due to a low yield or no yield, as against 33 percent of the Gram Panchayat-managed schemes and 60 percent of the public utility-managed schemes. Similarly, in Andhra Pradesh, none of the community-managed piped water supply schemes had a disruption in supply due to low or nonavailability of water, whereas this proportion was 8 percent for public utility-managed schemes

Again, in terms of cost recovery (hence, financial sustainability), community-managed schemes are doing relatively better. In Uttar Pradesh, Uttarakhand, and Kerala, the average O&M cost recovery of community-managed piped water supply schemes is 80 percent or more, whereas the average O&M cost recovery of government/ public utility-managed schemes is below 30 percent. A similar pattern is observed for Maharashtra and Tamil Nadu (Andhra Pradesh is an exception, the cost recovery of community-managed schemes is low and does not exceed that of government-managed schemes). Similarly, in Gram Panchayat-managed schemes, the O&M cost recovery is much higher than in public utility-managed schemes, but is less than in community-managed schemes. In Kerala, for instance, the cost recovery is 74 percent in GP-managed schemes as compared to 13 percent in public utility-managed schemes. But, in community-managed schemes, the cost recovery is over 90 percent. Similarly, in Uttar Pradesh, cost recovery is 83, 70, and 23 percent in community-managed, GP-managed, and public utility-managed schemes, respectively, showing the same pattern.

An interesting finding of the study is that the schemes managed by communities are spending about a quarter to a half of the cost that needs to be incurred to run the schemes at a design performance level. The proportion of actual to 'design performance O&M cost' is relatively higher in the schemes being managed by public utilities. This probably reflects that the schemes managed by communities work under greater financial constraint. Since the communities are under compulsion to meet their expenditure out of the contributions received from the beneficiary households, they have to keep O&M expenditure in check, and thus are able to spend less than what is needed to run the scheme properly and maintain it adequately. This obviously has an adverse effect on the effectiveness of the schemes being managed by the communities.

Significant cost reduction possible through demand-responsive schemes and the decentralization of service delivery. The analysis presented in various chapters of the Report has emphasized the advantages of demand-responsive schemes compared to the supply-driven schemes. The importance of decentralization of service delivery (for example, shifting the responsibility of mini water schemes and single village schemes to GPs and user communities; unbundling multi village schemes into smaller schemes, and handing over the O&M responsibility of intra-village schemes to the GPs) has been emphasized. An illustrative simulation exercise carried out for Uttarakhand to study the fiscal implications of business-as-usual versus decentralized service delivery models, presented in an annex, brings out clearly the significant cost saving that a sector-wide policy reform can attain. The simulation results indicate that the implementation of such a sector-wide policy reform will lead to a saving of Rs 17 billion in a period of 15 years, or one billion rupees per year. The savings in cost are mainly due to lower slippages from 'fully covered' status to 'partially or not covered' status as a result of higher sustainability of the schemes and an increased part of the O&M cost being borne by beneficiary households.

Funding programs continue to support supply-driven schemes. An analysis of the flow of funds brings out that while the advantages of demand-driven programs have been increasingly recognized, the bulk (about 90 percent) of the fund flow for rural water supply during the Ninth Five Year Plan and the first three or four years of the Tenth Five Year Plan was under supply-driven programs. In this context it may be mentioned that in Karnataka and Kerala, the government has shifted the O&M responsibility of water supply schemes to the GPs. This has helped in cutting down the expenses of the government and mobilizing more resources for water supply infrastructure. This is obviously the right direction to move. The analysis presented in the study showed that the GP-managed schemes are not doing any worse than utility-managed schemes. Rather, in some respects, the performance of GP-managed

schemes is better. At the same time, attention needs to be drawn to the problem of funds that the GPs are facing and the effect it has on the maintenance of schemes. In Karnataka, for example, among water supply schemes, relatively more Gram Panchayat-managed schemes have reported a serious neglect of maintenance than in pubic utility-managed schemes (51 percent versus 20 percent). In Kerala, similarly, 100 percent of GP-constructed-GP-managed single village schemes seriously neglect maintenance whereas the relevant proportion is 33 percent for utility-constructed-community managed schemes, and 50 percent for community-constructed-community-managed schemes.

Huge direct and indirect subsidies. Since the extent of O&M cost recovery in piped water schemes is generally low (except the community-managed schemes) and that in handpump schemes is virtually nil (again, community-managed schemes are doing better), there is a huge subsidy flow to rural households for water supply. The estimated amount of subsidy per annum is about Rs 10 billion in Maharashtra, Rs 8 billion in Tamil Nadu, Rs 5.6 million in Andhra Pradesh, Rs 4 billion in Uttar Pradesh and Kerala, Rs 3 billion in Karnataka and West Bengal, Rs 1.4 million in Punjab, and about Rs 1 billion in Orissa and Uttarakhand. Subsidy per household is more than Rs 70 per month in Maharashtra and Tamil Nadu, and more than Rs 60 per month in Kerala and Uttarakhand. It is Rs 33 to 43 per month in Andhra Pradesh, Karnataka, and Punjab, about Rs 20 per month in West Bengal, Rs 17 per month in Uttar Pradesh, and Rs 10 per month in Orissa. The ratio of rural water supply subsidy to state domestic product is 0.4 percent in Kerala, Tamil Nadu, and Uttarakhand, 0.3 percent in Andhra Pradesh, Orissa, and Maharashtra, and 0.2 percent in Karnataka, Punjab, Uttar Pradesh, and West Bengal.

The amount of subsidy given for water supply to rural households is quite large and compares well with the subsidy on rural roads. It may be mentioned that as compared with the total flow of funds for rural water supply in the 10 states studied, the annual subsidy for water supply is 160 percent.

A dominant part of the subsidy for rural water supply relates to the interest and depreciation cost of the investments made in the past in water supply infrastructure, including the associated institutional cost. Institutional cost forms a fairly substantial part of this. Thus, the subsidy relating to the cost of infrastructure can be partly contained by shifting increasingly to the demand-driven programs, since this would require the beneficiary households to share a part of the capital cost and the institutional costs are relatively lower in demand-driven programs.

Effectiveness of Service Delivery

Indices confirm moderate to low effectiveness. The key question addressed in the study concerns the effectiveness of rural water supply schemes in India in providing safe water to the rural people, to be judged in terms of reliability and adequacy, affordability, and environmental and financial sustainability. The analysis of survey data pertaining to households and schemes presented in the study indicate that the effectiveness of piped water supply schemes in rural areas is generally moderate to low. Based on 17 important indicators of performance, four indices of effectiveness representing reliability and adequacy, affordability, and environmental and financial sustainability, have been constructed for piped water schemes. The indices take value in the range of 1 to 10. A liberal system of scoring has been used for the indicators. One would accordingly expect the average scores to be in the range of 8 to 10. Yet, for most schemes, the value of indices is well below the index value of best performing schemes. Taking all piped water supply schemes together, the mean value of the index of reliability and adequacy is found to be 5.6, and that of the index of environmental sustainability, 4.8. The mean value of the indices of affordability and financial sustainability are 4.5 and 3.6, respectively.

The inability of the schemes to perform well is traceable mainly to inadequate expenditure being incurred on the O&M and the problems of source sustainability that have not been adequately addressed. The expenditure on maintenance and repair as a ratio to the capital cost of the schemes (inflation adjusted) is generally in the range of less than 0.5 percent, when good practice requires that 2.5 percent of the capital cost be spent on maintenance. Based on the assessment of the staff managing the water supply schemes, in only about 40 percent of the schemes is the maintenance adequate. Inadequate maintenance is also the prime reason for major breakdowns of schemes. About 23 percent of households have reported a reduced yield or drying out of the source as a reason for receiving inadequate quantities of water in summer. In a number of schemes in the sample, the source had to be deepened or re-bored even before it had completed its design life. All these issues point to problems created by a reduction in yield.

How much infrastructure expenditure trickles down to the beneficiaries? While Rs 100 spent on demand-driven schemes creates assets worth Rs 75, in the case of supply driven schemes, the corresponding figure is only Rs 51. These figures on the amount trickling down to the households out of the expenditure incurred needs to be discounted further because the size of schemes are often not optimum (as discussed below) with the consequence that a part of the resource used merely neutralizes the cost escalation caused by scale diseconomies. A study of the total cost of schemes per KL of water supply brought out that the cost per KL is high in relation to what one would expect. Also, the cost per KL of water in schemes under supply-driven programs was found to be much higher than that of schemes under demand-driven programs, thus reflecting the advantage of demand-driven programs.

Significant inefficiencies with respect to size of schemes. An analysis of the behavior of cost with the scheme size in terms of household coverage reveals that costs are relatively low in groundwater-based schemes of size 500 to 1,500 households. Among surface water-based schemes, the optimum scheme size is about 3,500 to 4,000 households. However, the cost of surface water-based schemes is much higher than the groundwater-based schemes. Hence, unless

there are serious water quality problems, groundwater-based schemes of size 500 to 1,000 or 1,000 to 1,500 should be preferred. A comparison of the actual size of schemes with the optimum size indicated by the analysis points towards significant inefficiencies. Among existing groundwater-based schemes, about one-third are in size below 200 households. Such schemes are not able to reap economies of scale and thus tend to be costly. On the other hand, there are a number of surface water schemes serving more than 7,000 households. There are no economies of scale at that level, rather there are diseconomies. Dividing such schemes into smaller schemes would help in reducing cost.

Cost of multi village schemes as compared to single village schemes. The capital cost, O&M cost, and institutional cost are much higher in multi village schemes as compared to single village schemes. Further, the cost recovery is relatively lower in multi village schemes. The implication is that the provision of rural water supply through the multi village scheme imposes a greater financial burden on the government. Also, in terms of several parameters on the adequacy and reliability of service delivery, such as regularity of supply, hours of supply or lpcd level, the performance of multi village schemes is less effective in comparison to single village schemes. A prime reason for the relatively poor performance of multi village schemes lies in low expenditure being incurred on the maintenance of these schemes. There is also a problem of low yield from the source in summer, notwithstanding the fact that many of the multi village schemes are surface water-based. Further, there are problems associated with water distribution over a larger number of habitations and a considerable proportion of households at the tail-end of the scheme with inadequate water supply and pressure.

Willingness to pay and affordability. There is a clear indication that among the households currently using piped water supply and dissatisfied with the current water supply situation, most are willing to pay for improved services. The estimates indicate that the households using a private connection are in general willing to pay in the range of Rs 30 to Rs 70 per month (all-state average about Rs 60 or US$1.4 per month) for improved services. The households using a standpost (shared connections) of piped water schemes are willing to pay in the range of Rs 13 to Rs 24 per month (all-state average about Rs 20 or US$0.5 per month) towards the O&M cost of improved schemes. The households in Uttar Pradesh, however, are willing to pay only about Rs 7 per month, on an average. On the other hand, the standpost users in Maharashtra and Punjab are on an average willing to pay about Rs 34 and Rs 30, respectively, per month for improved services. As regards capital cost contribution towards improved schemes, the households currently using private connections are willing to contribute on an average about Rs 1,000 (US$22.7) towards the capital cost of the improved scheme, and the households using a standpost are willing to make a capital cost contribution of about Rs 480 (US $10.9) for the improved scheme.

The households currently using deep-bore handpumps are willing to pay about Rs 6 per month for good maintenance of their handpump and Rs 8 per month for the maintenance of a new deep-bore handpump. Among the handpump users, there is interest in getting the advantages of piped water supply schemes, though the average willingness to pay of handpump users observed in the survey falls short of the cost of the provision of piped water supply. The average amount that the handpump users are willing to pay towards the O&M cost for using a private connection of a new piped water scheme ranges from Rs 12 per month in Uttar Pradesh to Rs 34 per month in Maharashtra and Rs 38 per month in West Bengal. These figures on average willingness to

pay fall short of the actual cost, which is likely to be in the range of Rs 40 to 50 per month (and higher in some cases). The average monthly amount that handpump users are willing to pay towards the O&M cost for using a standpost of the scheme ranges from Rs 6 per month in Kerala and Rs 7 per month in Uttar Pradesh to Rs 23 in Maharashtra. These amounts are low compared to the charges that may have to be imposed on standpost users for the full recovery of the O&M cost of a typical new piped water scheme.

The cost of improved services is found to be generally within the 'affordable' payment levels. However, in situations where the cost is beyond the affordable level (say, high head pumping schemes in hilly areas) appropriate subsidies could be given. Based on the analysis of affordability undertaken, it seems reasonable to argue that it would not be right to insist on 100 percent O&M cost recovery in all demand-driven schemes. In certain circumstances, the cost can be prohibitively high so that the beneficiary household could be asked to pay up to a 'ceiling' level, say, Rs 60–70 per month, and the cost beyond that level should be subsidized. For below poverty level households, the ceiling should be lower for capital and O&M cost contributions for high cost schemes.

The study finding that the effectiveness of the water supply service provided to rural communities is moderate to low should alert the policy-maker to the need for adjusting policies and improving instruments for implementing them

The Way Forward

Based on a set of indicators aimed at measuring reliability, affordability, and sustainability, the analysis in this Report clearly shows that the effectiveness of the water supply service provided to rural communities is moderate to low. The performance of rural water schemes is usually below design and below user expectation. This should alert the need for adjusting policies and improving instruments for implementing them. The following recommendations are organized around main themes—enhancing accountability; improving planning and design procedures; improving financing procedures; improving operations; and improving source sustainability.

Enhancing Accountability

Unbundle functions to enhance accountability. Currently, there are overlapping responsibilities for policy formulation, financing and regulation, ownership of assets, and operation of services, resulting in low accountability and deteriorating services. It is important to unbundle and re-structure the state institutions and agencies in line with the shifting role of the state as a facilitator and the devolution of funds, functions, and functionaries to the PRIs and the user committees. Roles and responsibilities of institutions at the state, district, and Gram Panchayat levels should be better defined with regards to policy formulation, financing, and regulation (that should remain state responsibilities), and ownership and development of assets and operation of service (that should be devolved to local levels). Shifting the role of the states and of their engineering agencies to that of a facilitator in charge of providing technical support for the planning, construction, and operation of schemes should help reduce the currently high institutional costs encouraged by the absence of competition and contractual obligations. The existence of high institutional costs with wide inter-state variations points towards significant scope for reducing institutional costs at all levels.

Improving Planning, Design, and Monitoring Procedures

Move towards 'flexible norms' for service delivery. Existing Government of India norms (40 lpcd within a 1.6 km distance and 100 m elevation) could still be used to measure achievement towards the 'fully covered' but they often do not correspond to what rural households desire and are willing to pay for.

The study shows a clear preference for domestic connections and willingness to pay for piped water. Rural communities should be offered a higher level of service subject to the availability of water and willingness to contribute towards its cost through user charges that should eventually recover the O&M and capital costs. Also, the 'fully' covered, 'partially' covered, 'not' covered classification tends to encourage inadequate O&M as 'slippages' from 'fully' to 'partially' covered status often lead to the construction of a new system to replace the poorly maintained existing system.

Reconcile bottom-up demand with top-down 'district-level' planning. Community (bottom-up) demand for piped water schemes should be reconciled with (top-down) planning to improve the sustainability of water sources and ensure that the least cost option is implemented. District-level planning should identify areas where multi village schemes would constitute a sustainable option and would be cost-efficient, based on aquifer and watershed information. Catchment area programs would need to be incorporated in district plans for strengthening sources. Multi village schemes relying on surface water would need to be taken up mostly when aquifers are over-exploited or the groundwater is of poor quality.

Strengthen community participation. There is evidence that community participation, ranging from representational committees to direct involvement in construction, supervision, and/or maintenance activities, has helped improve rural water service delivery. With PRIs assuming increased responsibilities, GPs and user committees should work together and Village Water and Sanitation Committees (VWSC) should be constituted as a sub-committee under the GP.

Improve the design of schemes. The design of schemes should be determined by factors such as technical feasibility, least cost option, user preferences, and beneficiary willingness to contribute towards the capital and O&M cost. Local communities and Panchayati Raj Institutions should have a complete understanding of the likely O&M costs of the various options before selecting a particular technology. NGOs and Support Organizations should assist communities to understand options, required operational arrangement, and related costs.

Consider economies of scale when designing schemes. The study shows significant scale economies in rural water supply, with the implication that small schemes serving 200 or less households may not always be cost-efficient. Significant economies of scale can be achieved when designing rural water supply schemes serving 500 to 1,500 households, unless local conditions are such that only a small scheme is cost-effective.

Monitor service, not infrastructure. The present monitoring and evaluation mechanism should be revamped to independently monitor the inputs, processes, outputs, and outcomes of the rural water supply service (not just the delivery of rural water supply infrastructure) and to disclose its findings to the public. Performance improvement targets should be set and monitored by states. An incentive scheme could be introduced to reward Gram Panchayats on scheme performance and service delivery targets.

Improving Financing Procedures

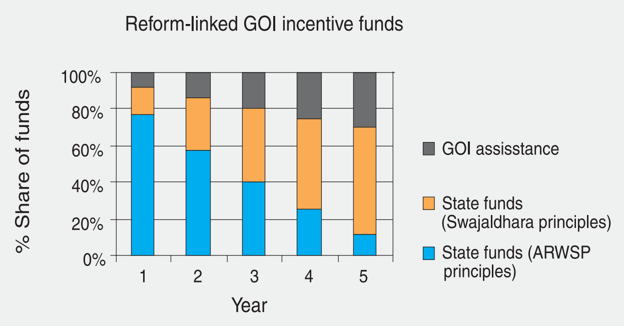
Carry out an independent appraisal of multi village schemes. An important issue is the need for independent appraisal and approval of multi village scheme proposals, so that they are taken up only when the single village scheme is cost-inefficient and technically not feasible. As the payment of 'centage' to state engineering agencies could create perverse incentives, proposals for new multi village schemes need to be independently appraised, according to clear technical and economic criteria, to ensure that the least cost option is implemented.

Clarify cost sharing principles. The O&M costs need to be properly assessed and fully recovered from user charges. Transparent criteria should be developed to determine affordable contributions to the O&M costs, in particular by socially disadvantaged groups. O&M requirements in excess to affordable contributions should be provided through a transparent state subsidy scheme, preferably targeted at households. State-specific 'ceilings' should be established for contributing to capital costs, either upfront or through user charges. Affordability ceilings have been designed and developed as part of the study.

Provide financial incentives for scaling-up reforms. Financial incentives should be provided to encourage states to adopt reforms for new rural water supply investment and address institutional and cost recovery issues for all schemes:

- Incentives to increase state allocations under Swajaldhara could be provided through central funds, by linking these with matching or increasing state funds utilized for implementing the Swajaldhara reform program. Central funds can top-up state funds disbursed on Swajaldhara principles (Figure 8.1).

Figure 8.1 Reform-Linked Government of India Incentive Funds



- Incentive for a state-wide approach could be provided to states that commit upfront to developing a state-wide and sector-wide approach and adopt sector reforms, irrespective of the sources of financing.

Improving Operations

Transfer the ownership of schemes to Panchayati Raj Institutions. The ownership of single village schemes should be handed over to Panchayati Raj Institutions and/or user committees, after proper rehabilitation, and their O&M costs should be covered from user charges. Training should be provided to Panchayati Raj Institutions on technical, accounting, and procurement procedures. To improve the functionality and sustainability of schemes, it is important that the assets belong to and are operated by the Gram Panchayats and the user committees.

Establish contractual relationships to improve service performance. Panchayati Raj Institutions and user committees should contract out the planning, design, construction, and O&M functions to agencies of their choice, either state engineering agencies or private engineering consultants and operators. Cost implications would need to be clearly communicated. Performance improvement targets would need to be included in the contracts and periodically monitored.

Decentralize multi village schemes for improving service delivery. When multi village schemes are justified, bulk water supply and water distribution should be unbundled. Bulk supply should be managed by a professional public or private operator that should enter into enforceable contracts with Gram Panchayats and/or user committees that are responsible for distribution at the local level. The formation of user groups such as VWSCs and district/block user committees are critical for improving the accountability of such schemes. Many multi village schemes are often too large and costly to be managed solely by user groups. A Memorandum of Understanding or a formal contract are other ways of increasing accountability between user committees and the bulk water providers. These contracts can be the basis of detailed agreements regarding the performance targets, including the quantity and quality of water to be supplied and the payment for water supplied.

Encourage private sector participation. The state should encourage private consultants, contractors, and operators to become more active in rural water service delivery, as several examples in India show that they are often more effective in improving service delivery.

Improving Source Sustainability

Improve groundwater management. The concern about source depletion and groundwater availability is associated with falling levels and a conflict between high priority drinking water and other uses such as irrigation and industrial use, within the same aquifer. The over-abstraction for agriculture has a series of consequences for rural drinking water supply, mainly direct aquifer depletion effects (such as falling well yields) and indirect consequences (such as excessive well drilling depths). In such situations, groundwater recharge initiatives may not be sufficient to increase the drinking water supply. These initiatives need to be supplemented with assessments of local groundwater availability and shared with the Panchayati Raj Institutions, so that improved agricultural practices are encouraged by local governments. Independent water resources regulators need to be established to help resolve disputes between users of the same resource.

Implement water quality monitoring. The Water Quality Monitoring & Surveillance Program launched by the Rajiv Gandhi National Drinking Water Mission should be effectively implemented by requesting states to clarify the mandate of agencies in charge of water quality monitoring, and making available adequate financial resources, employing qualified staff, organizing sample collection, and testing.

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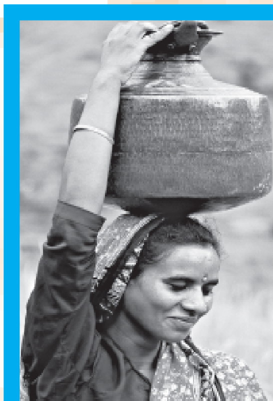
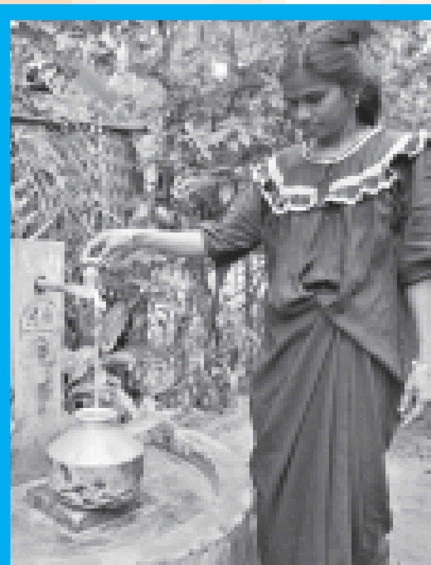
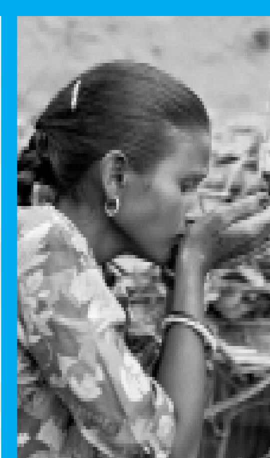
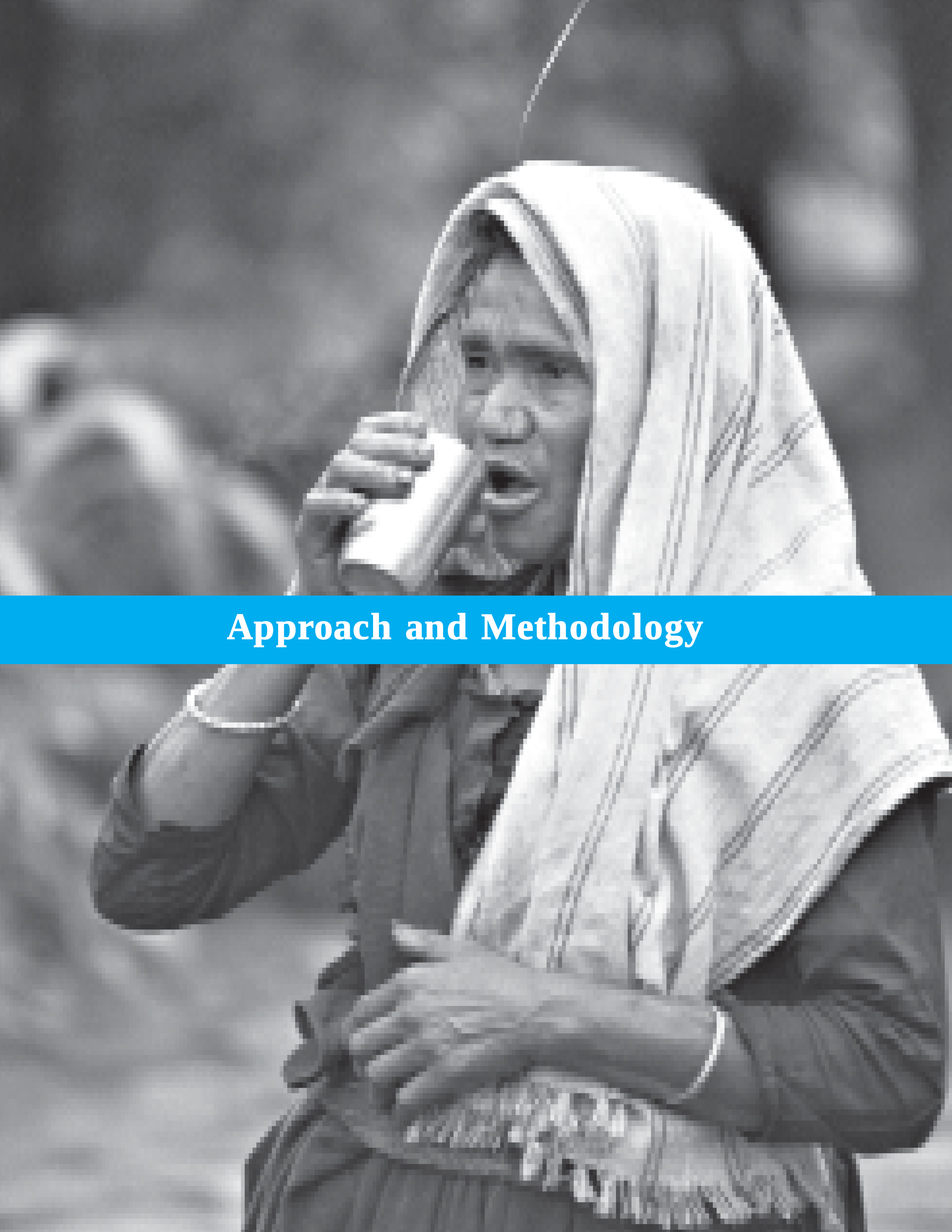
Annexes





Approach and Methodology

ANNEX 1.1

Annex 1.1

Approach and Methodology

Approach

The prime objective of the study is to assess the effectiveness of rural water supply schemes in India in terms of reliability and adequacy, affordability, and environmental and financial sustainability. Primary and secondary data have been obtained through scheme and household surveys conducted in 10 selected states, namely Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal.

A large survey has been carried out for the study, covering representative water supply schemes and households from each of the 10 states studied. The questionnaires and data collection formats have been developed with several rounds of pre-testing. A multi-stage stratified random sampling has been undertaken for selecting representative districts, schemes, and households of representative schemes. The selection of districts has been done to cover representative areas with respect to groundwater exploitation and water quality problems. The sampling process and the choice of the survey schemes were finalized in concurrence with the respective state governments.

The issue of effectiveness of rural water supply schemes has been approached from both aspects—the cost of service provision and the performance of schemes. The analysis of cost not only covers the cost of water supply infrastructure and the O&M cost of the schemes, but also the cost incurred by organizations that implement the water supply programs and the cost that households bear due to inadequate services provided by the schemes. Thus, a comprehensive assessment of the cost of service provision is made. The performance of schemes has been assessed in terms of reliability and adequacy, affordability, and environmental and financial sustainability. For this purpose, a set of indicators has been especially developed and indices of effectiveness have been constructed to rate the performance of surveyed schemes against the standard of well-performing schemes. In analyzing the performance of schemes, the extent of cost recovery and the level of subsidies for water supply being provided to rural households have been taken into account.

The cost and performance of schemes have been compared across scheme categories. For this purpose, the schemes have been categorized according to technology and the agency responsible for implementation and management. The aim is to gain an understanding of how the choice of technology and institutional arrangements may influence the effectiveness of water supply schemes. The technological categories of schemes considered are handpumps, mini water schemes, single village schemes, and multi village schemes (including regional schemes). As regards the classification of schemes according to the agencies responsible for the implementation and the management of schemes, the agencies considered are utilities, PHED, and other such government agencies under the direct control of the state government, Zilla Panchayat or Zilla Parishad (district-level local self-government), village-level Gram Panchayat, and communities/ user groups.

The analysis of the cost of schemes and their performance in terms of services provided has been followed by an analysis of coping costs, willingness to pay, and affordability. This carries the analysis of effectiveness a step further for giving policy directions for service improvements. The key questions that the analysis addresses are—how strong is the rural household demand for service improvement and whether rural households are willing and can afford to pay for service improvements.

Methodology

Diverse methodologies have been applied to investigate the different sets of issues covered in the study. The main points concerning these methodologies are discussed below.

Cost of schemes: The data on capital cost of schemes are at historical prices. To permit comparison, the cost data given by the managers of schemes have been adjusted for inflation to arrive at the capital cost at 2005–06 prices. The capital and O&M costs per household have been compared across technologies and across implementation/ management agency. To ascertain cost inefficiencies, the capital and O&M costs of schemes have been compared with cost norms, taken from secondary sources.

The O&M cost of piped water supply schemes has been compared with 'design performance O&M cost' to judge if adequate expenditure on O&M is being undertaken. The 'design performance O&M cost' has been computed for each scheme. This is defined as the cost that the schemes would have to incur, if the schemes are run properly to meet the design lpcd, provide water supply regularly, and carry out proper maintenance of the system.

Two adjustments have been made to the cost data to work out the design performance O&M cost. First, an estimate of electricity requirement at the design performance level is worked out taking into account the population to be served, the design lpcd, and the pumping head. Based on the electricity requirement, the cost of electricity is computed. The other adjustment relates to maintenance and repair. Annual expenditure required for the maintenance and repair for design performance of schemes is taken as 2.5 percent of the capital cost. The actual expenditure on maintenance and repair is commonly less than this norm.

To gain an understanding of the factors influencing the cost of piped water schemes, an econometric analysis of cost has been undertaken. Separate cost functions for capital cost and O&M cost have been estimated in which the number of households served, lpcd level, water source (ground or surface water), water quality, and technology have been taken as explanatory variables. To study economies of scale, a U-shaped cost function has been estimated using a simple specification that relates cost to the number of households served. This analysis has been done separately for groundwater-based and surface water-based schemes. Using the estimated cost functions, the optimum size of schemes has been determined, and the actual size of the schemes surveyed has been compared with the optimum size to ascertain whether economies of scale are being reaped.

For each scheme, the total cost of water supply has been computed by considering the cost at scheme level; the institutional cost; and the coping cost borne by user households. This has been expressed as cost per KL of water to facilitate comparison. The total cost of water per KL has been compared with the economic cost of supply, which has been derived on the basis of cost norms. This provides an overall assessment of cost-efficiency of rural water supply schemes.

The household-level survey data have been used to compute the revenue realized from water charges. The estimates of revenue per household and cost per household provide the estimates of O&M cost recovery.

Flow of funds and subsidy: A particular focus of the study is on the flow of funds and institutional cost. The expenditure data of various programs collected from state-level agencies have been used to compute the institutional costs. For demand-driven schemes, the cost incurred on capacity-building and Support Organizations/ non-government organizations have been computed. The shares of capital cost, O&M cost, institutional cost, and capacity-building/Support Organizations/non-government organizations cost out of total expenditure have been computed for supply-driven and demand-driven programs, for each of the states surveyed. The purpose is to ascertain whether the institutional costs are excessive.

The computed proportions of O&M cost, institutional cost, and Support Organizations/ non-government organizations cost have been used to estimate the portion of RWS expenditure under demand- and supply-driven programs that gets translated into water supply infrastructure. Other data used for this purpose are the proportion of defunct schemes (secondary data at the state level) and the extent of over-provisioning of services in the states (based on survey data collected from the states).

The estimates of subsidy have been worked out at the state level. The estimates of scheme-level O&M cost per household have been used to get an estimate of the O&M cost at the state level.

The capital expenditure and institutional cost at the state level have been worked out with the help of expenditure data of the water supply programs. The survey data have been utilized to make an estimate of the contributions being made by households towards the O&M cost of schemes. An estimate of indirect power subsidy has been made, taking into consideration the cost of power and the tariffs being charged to water supply schemes.

All these pieces of information have been used to make an estimate of the total subsidy for rural water supply and subsidy per household, in each of the 10 states studied.

Performance of schemes: Seventeen indicators have been developed to study the effectiveness of schemes, representing reliability and adequacy, affordability, and environmental and financial sustainability. Four values are assigned to each indicator (1, 2, 3 or 4), depending on whether the performance in respect of the indicator has been negligible, low, medium or high. The indicators have been used to form four indices: reliability and adequacy; affordability; environmental sustainability; and financial sustainability. The indices have been rescaled in the range of 1 to 10. The mean values of indices have been compared across technology type, scheme management agency and states, to study variations in the effectiveness of schemes.

Besides these indices, several other parameters have been compared across technology and management agency to study the effectiveness of representative schemes. The estimates provide the overall performance of schemes in a state, while the performance could vary between regions within the state.

Coping cost: Coping costs borne by households due to inadequacies of the water supply schemes have been computed on the basis of cost of storage; expenditure incurred on the repair and maintenance of own water source and public sources (on personal basis); and the opportunity cost of time spent for water collection.

The survey data have been used to estimate the amount of investment in storage vessels by households, and an assessment has been made of the annualized cost of the investment. Specific data were collected on the expenditure that households incur on the repair and maintenance of own source and public sources. These data have been used to make an estimate of coping cost.

The basic data used for the computation of opportunity cost of time spent for water collection from public sources are how many trips are commonly undertaken; time taken per trip; and the distribution of water collection responsibility between adult male, adult female, and children (that is, how the number of trips is distributed among the three types of household members).

Based on information on the number of trips, and travel and queue time per trip, the amount of time spent by households for collecting water from public sources has been computed.

To compute the opportunity cost of time, the work participation rates of adult male and female household members have been taken into account, along with the average daily wage rate and the number of days in a year an adult male or female may expect to find work. The opportunity cost of children's time is taken as zero.

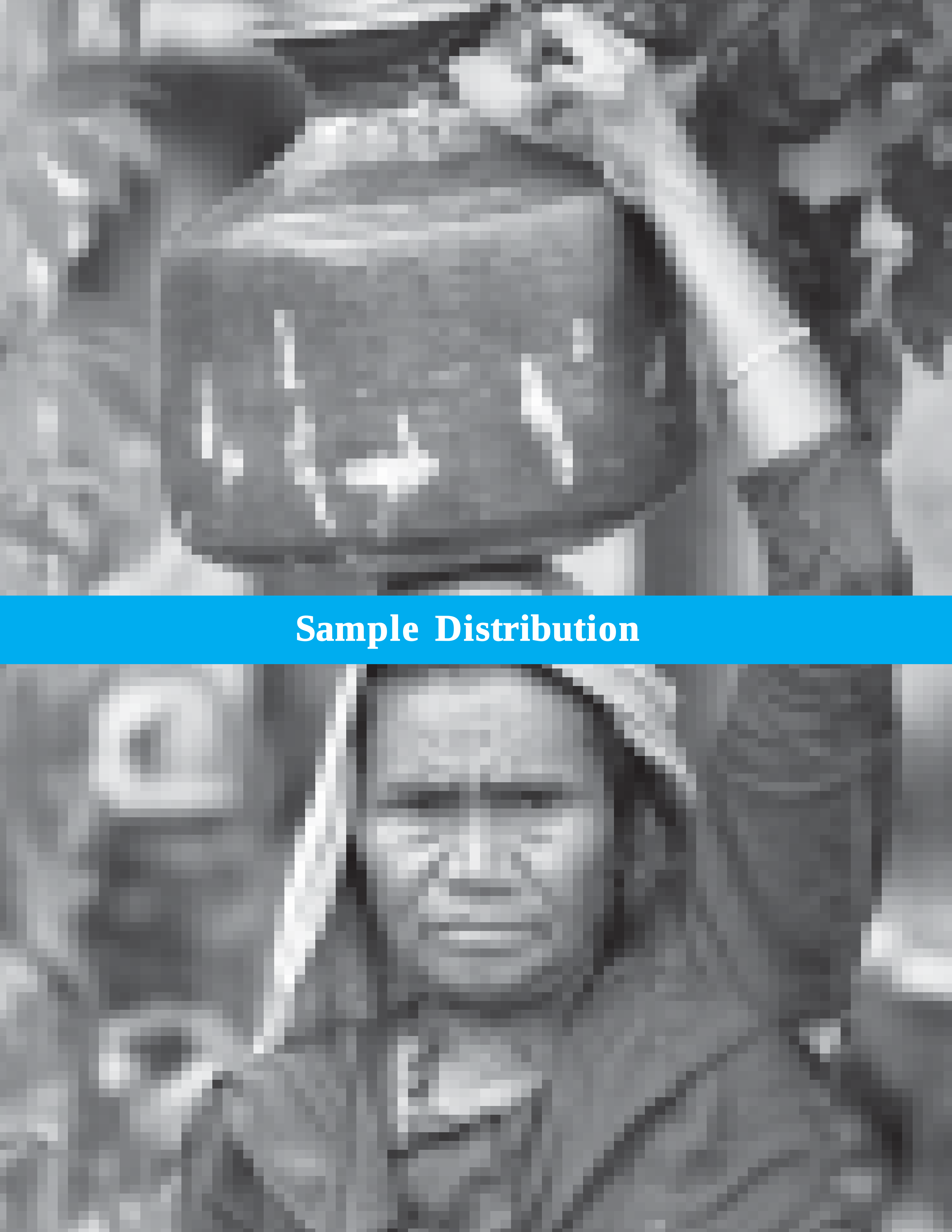
Willingness to pay: The contingent valuation methodology has been applied in the study to estimate household willingness to pay for improved services. The specification of the scenario is critical for a contingent valuation study. A good deal of effort and care has gone into scenario building to minimize the possibility of biases. Several rounds of pre-testing of the questionnaire was carried out before the scenario on improved services for the willingness to pay question was finalized.

For the study, two formats have been used—payment card and payment ladder. The payment card format has been used to elicit respondent willingness to pay for improved services of handpumps, while the payment ladder format has been used to elicit respondent willingness to pay for improved piped water supply. The use of a simple payment card method for handpump users makes it possible to ask willingness to pay questions for several service improvement options, including a switch to piped water systems and add-on facilities (such as a fluoride filter) with the existing handpumps. The data collected in the survey have been used to estimate econometric models explaining the household willingness to pay and the estimation of the mean willingness to pay for improved services.

Affordability: The analysis of affordability involves two steps—determination of the affordability norm, and derivation of the affordable payment-level based on the norm. The derivation of the affordability norm has been based on the methodology that has been applied in several studies in the UK. The monthly expenditure incurred by the households for water supply (payment of water charges and expenditure on the repair/maintenance of own and public sources) as a ratio to their income has been computed for the bottom 20 percent, 30 percent, 40 percent, and 50 percent of households. These have been taken as alternative norms of affordability for the O&M cost contribution. The norms have been multiplied by the average income of households to compute the affordable monthly payment for a private connection. The norms have been multiplied by the average income of below poverty line households to compute the affordable payment for the use of a standpost. The affordable capital cost contribution has been worked out in a similar manner.

It should be pointed out that the analysis of willingness to pay and affordability involve two different approaches. The former is based on stated preference and the latter on revealed preference. By taking both the approaches, it becomes possible to cross-check the results obtained. Further validation of the findings on household willingness and ability to pay for improved water supply has been done by studying the expenditure on non-essential items incurred by rural households.

Sample Distribution



ANNEX 1.2

Annex 1.2

Sample Distribution

Table 1 Distribution of Households by State and Technology

State	Handpump	Mini water scheme	Single village scheme	Multi village scheme	Regional scheme	Total
AP	520	240	982	584	822	3,148
KAR	397	802	2,546	753		4,498
KER	239	1,167	1,713	735	753	4,607
MAH	440	244	1,051	900	500	3,135
ORSS	840		678	1,655		3,173
PUN	358		689	2,091		3,138
TN	400	491	1,041	1,199		3,131
UP	3,207	16	123	809		4,155
UTTK	524		1,324	811		2,659
WB	760	239	1,036	3,602	752	6,389
Total	**7,685**	**3,199**	**11,183**	**13,139**	**2,827**	**38,033**
(%)	**20%**	**8%**	**29%**	**35%**	**7%**	**100%**

Table 2 Distribution of Households by State and Managing Agency

State	Community	Gram Panchayat	Public utility	Zilla Parishad	Government	Total
AP	663				2,485	3,148
KAR	1,987	2,511				4,498
KER	2,122	278	2,207			4,607
MAH	629	623		1,883		3,135
ORSS	305				2,868	3,173
PUN		3,138				3,138
TN	217	967	1,947			3,131
UP	590	2,497	1,068			4,155
UTTK	1,146		1,513			2,659
WB		1,090		40	5,259	6,389
Total	**7,659**	**11,104**	**6,735**	**1,923**	**10,612**	**38,033**
(%)	**20%**	**29%**	**18%**	**5%**	**28%**	**100%**

Table 3 Distribution of Piped Water Schemes Covered in the Study by State and Type of Program

State	Piped water schemes (including mini water)		
	Under supply-driven program	Under demand-driven program	Total
AP	30	15	45
KAR	51	30	81
KER	25	43	68
MAH	35	7	42
ORSS	23	12	35
PUN	48	0	48
TN	30	15	45
UP	49	3	52
UTTK	28	19	47
WB	58	0	58
Total	**377**	**144**	**521**

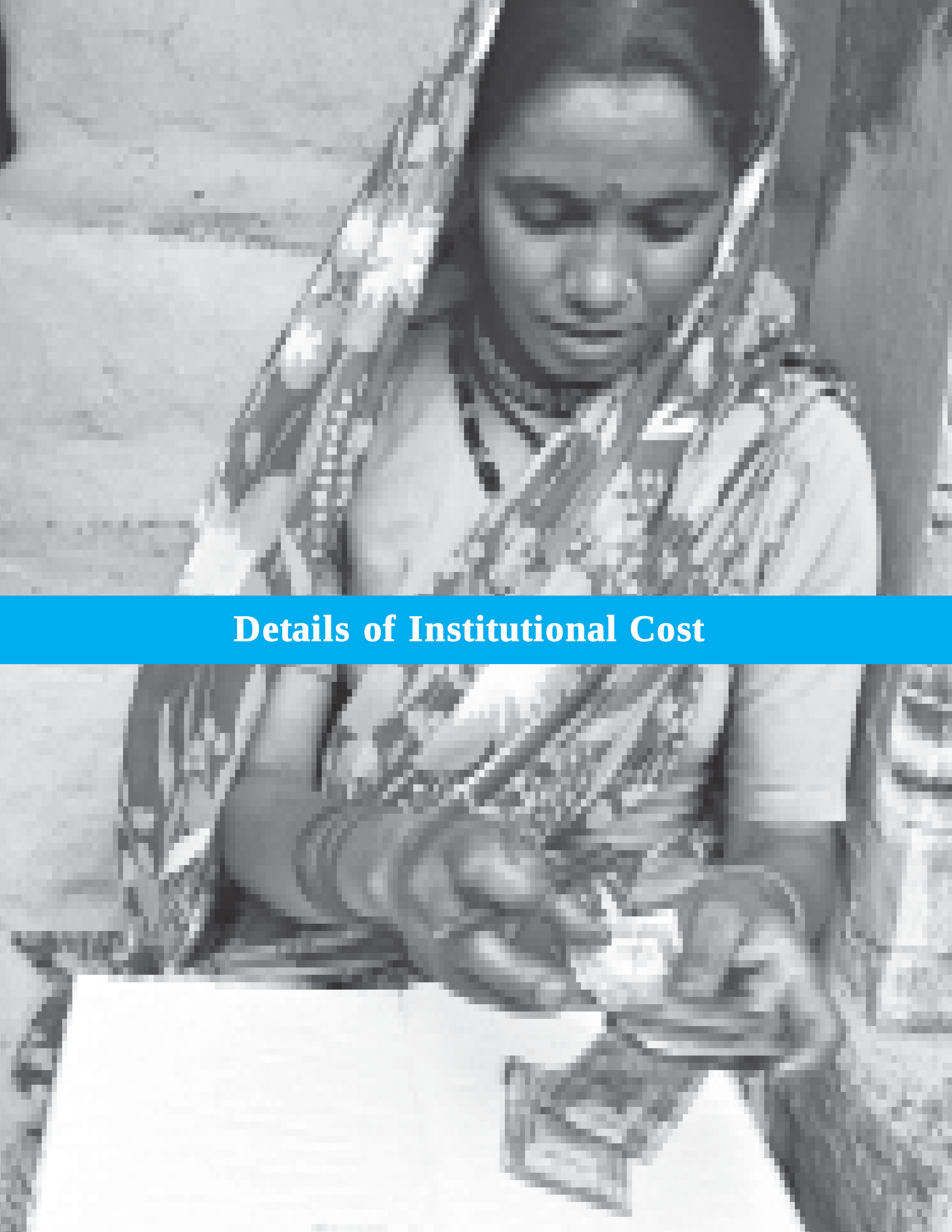
Table 4 Number of Schemes Covered in the Water Quality Study, by State

State	Water supply schemes		
	Handpump	Piped water	Total
AP	8	10	18
KAR	10	19	29
KER	4	22	26
MAH	9	11	20
ORSS	12	6	18
PUN	12	6	18
TN	4	12	16
Total	**59**	**86**	**145**

Table 5 Number of Households Covered in the Water Consumption Study, by State

State	Main public water source used		
	Handpump	Piped water	Total
AP	8	17	25
KAR	13	27	40
KER	4	30	34
MAH	8	19	27
ORSS	11	14	25
PUN	13	11	24
TN	4	20	24
Total	**61**	**138**	**199**

Details of Institutional Cost



ANNEX 3.1

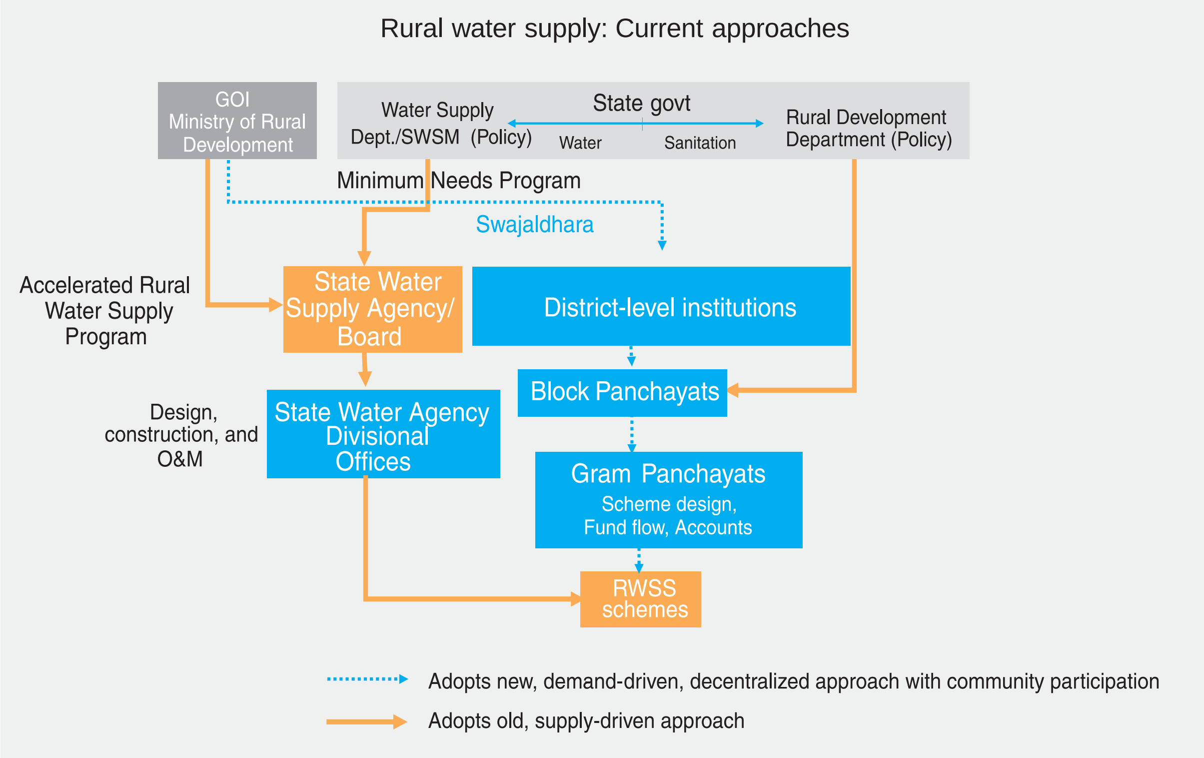
Annex 3.1

Details of Institutional Cost

The typical institutional arrangements and fund flow for supply- and demand-driven rural water schemes are shown below in Figure A3.1.1.

The various items that constitute the institutional cost can be divided into four broad groups—payment and provision to employees (salaries, staff welfare expenses, gratuity and pension, and so on); office expenses (rent, postage, telephone, printing and stationery, exhibition and publicity expenses, training and other expenses, and so on); traveling expenses; and administrative expenses (bank charges, professional fees,

Figure A3.1.1 Key Institutions and Financial Flows—Current Approaches



In the discussion on the flow of funds, it has been pointed out that institutional costs are relatively much higher in supply-driven programs than demand-driven programs. The important components of the institutional cost are given here.

Figure A3.1.2 **Break-up of Institutional Costs—A Typical Supply-Driven Program**

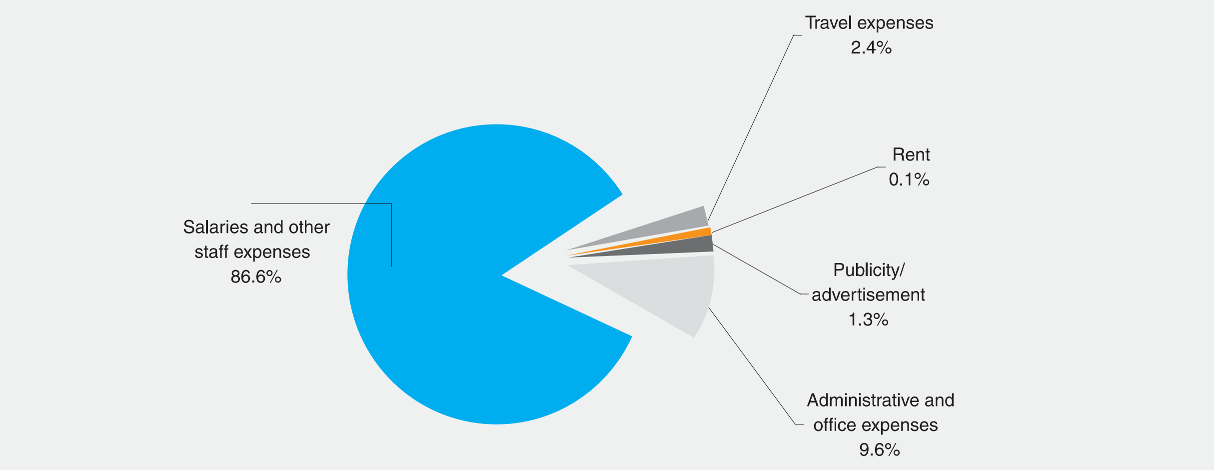
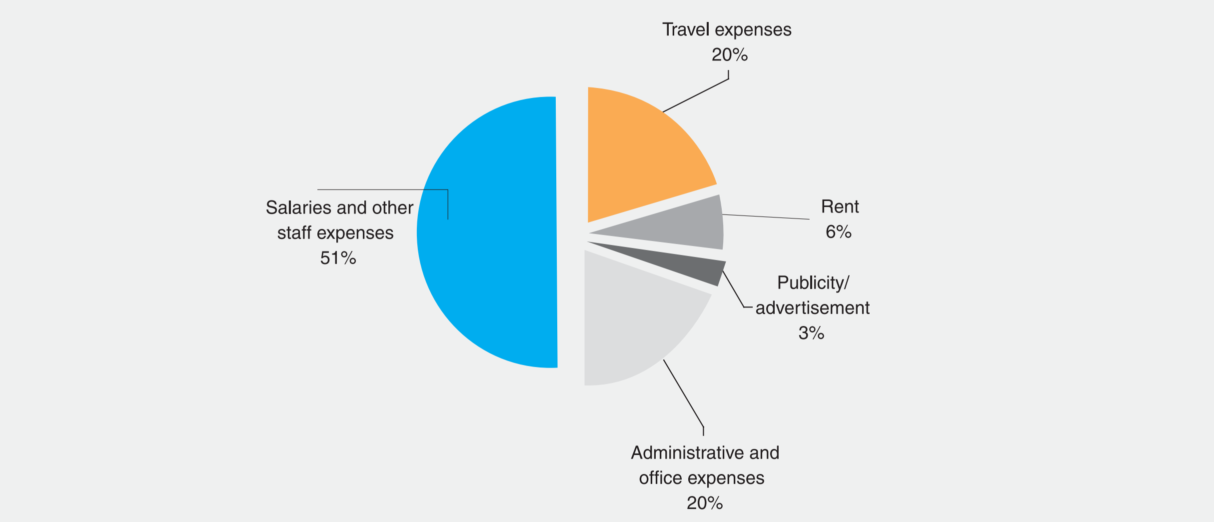


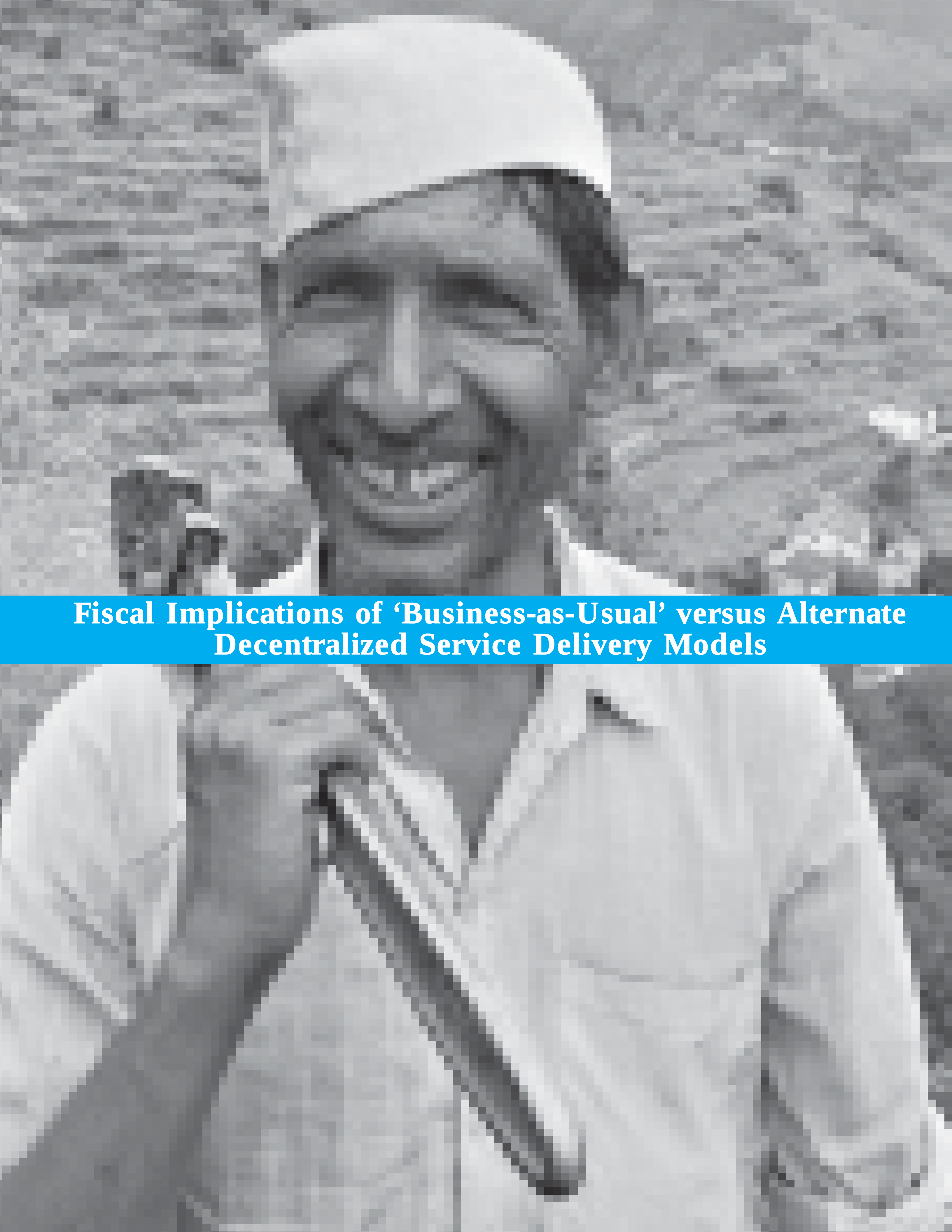
Figure A3.1.3 **Break-up of Institutional Costs—A Typical Demand-Driven Program**



payment to auditors, and so on). Salaries paid to the staff and other expenses on staff welfare are the main element of the institutional cost of both supply-driven and demand-driven programs. This may be seen from Figures A3.1.2 and A3.1.3, which show the relative shares of important cost items constituting the institutional cost of typical supply-driven and demand-driven water supply programs. Data for Karnataka and Punjab for 1997–98 to 2005–06 have been used for preparing the figures.

It is interesting to note that in supply-driven programs more than 85 percent of the institutional cost are the salaries and staff welfare costs, including gratuity and pension. The expenses on travel, publicity, and so on, are rather small in relation to a demand-driven program. In the demand-driven programs, the staff costs are the main item, but it accounts for only one half of the total expenses. Travel and rent are important items of cost. Administrative cost and office cost, other than rent and publicity, account for about 20 percent of the total institutional cost.

Comparison of the break-up of the institutional cost between supply-driven and demand-driven water supply programs clearly shows that a part of the institutional cost under supply-driven programs may not be very productive insofar as it is used merely to pay salaries and meet other staff costs for an unduly large bureaucratic set-up created for the implementation of the central and state government schemes for rural water supply.



Fiscal Implications of 'Business-as-Usual' versus Alternate Decentralized Service Delivery Models

ANNEX 3.2

Annex 3.2

Fiscal Implications of 'Business-as-Usual' versus Alternate Decentralized Service Delivery Models

Given the considerable inefficiency that marks the current arrangements for the provision of rural water supply, an alternate model aimed at providing reliable, sustainable, and affordable services can be less costly for the central and state governments and yet provide a better service to the consumers. As an illustration of this point, a simulation exercise has been carried out for Uttarakhand to study the fiscal implications of a sector-wide policy reform, the results of which are presented here.[70] Three scenarios are considered for the exercise and for each of them the year-wise expenditure on rural water supply and sanitation in the period 2006–07 to 2021–22 (end of 13th Five Year Plan) has been estimated.

The three scenarios considered are:

- Business-as-Usual
- Decentralized service delivery for single village schemes
- Decentralized service delivery for single and multi village schemes involving a sector-wide policy reform

In the three cases, it is assumed that all NC (not covered) and PC (partially covered) habitations existing in Uttarakhand (April 2006) will be covered by the end of the 11th Five Year Plan. In addition, the expenditures to be incurred on catchment area conservation and management, rural sanitation, and rural water supply and sanitation to public institutions have been taken into account in all the three scenarios. On 1 April 2006, there were about 18,000 NC/PC habitations out of a total of 40,000 habitations in Uttarakhand. The cost of covering these habitations by the end of 11th Plan ranges from Rs 13 to 17 billion under various scenarios.

The total cost of catchment area conservation and management, provision of water supply and sanitation to public institutions, and rural sanitation in the period 2006–07 to 2011–12 is about Rs 1.8 billion. The capital expenditure for ongoing and newly-approved schemes and the rehabilitation of damaged schemes due to natural calamities is another Rs 5.5 billion in this period. These costs are taken to be the same under all the three scenarios.

The 'Business-as-Usual' scenario foresees that the current institutional arrangements continue and the provision of rural water supply continues by and large in the supply-driven mode.

The second scenario introduces an element of reform with decentralized service delivery for single village schemes. It is assumed that all new single village schemes constructed to cover the NC/PC habitations in the period 2006–07 to 2011–12 would be under the demand-driven mode, that is, there would be community contribution to capital cost, and the schemes would be managed by communities. The O&M costs of these schemes will be mostly borne by

[70] This exercise makes use of data provided in the Medium Term Development Program prepared for the Uttarakhand Rural Water Supply and Sanitation Project, 2006.

Table I Assumptions Underlying the Simulation Exercise

Assumption about parameters	Scenarios		
	Business-as-Usual	Decentralized service delivery for SVS	Decentralized service delivery for SVS and MVS
Institutional cost	31% of total cost	16% of total cost for new SVS set up; 31% of total cost of all other schemes	16% of total cost for new SVS/MVS and SVS transferred to the GPs; 31% of total cost for all other schemes
SO/NGO cost	nil	21% of hardware cost for newly set-up SVS schemes	21% of hardware cost for newly set-up SVS/ MVS schemes, and the cost of revamping of SVS before handing over to GPs
Cost recovery from user charges	10%	80% for newly constructed SVS; 10% for other schemes	80% for newly constructed SVS and phased-out SVS to GPs; 50% for newly constructed MVS; 20% for other schemes
Capital cost contribution	nil	10% for newly constructed SVS	10% for newly constructed SVS; 10% for newly constructed MVS subject to affordability cap
Ratio of SVS to MVS in the newly constructed schemes	40:60	40:60	60:40
Capital cost of schemes	20% higher capital cost than that in the third scenario	20% higher capital cost except for the newly constructed SVS for which the cost is the same as the third scenario	SVS: Rs 600,000 per habitation MVS: Rs 910,000 per habitation Revamping of SVS: Rs 300,000 per habitation
Annual rate of slippage of habitations	6%	1% for newly constructed SVS, 6% for others	1% for new and revamped schemes, 6% for others

communities (cost recovery is assumed to be about 80 percent). But, the rest of the schemes in the state are assumed to remain in the same institutional arrangement as present. This scenario does not allow for the decentralized management of multi village schemes, nor does it allow for the devolution of single village schemes to Gram Panchayats. Thus, the second scenario involves only a partial reform of the sector.

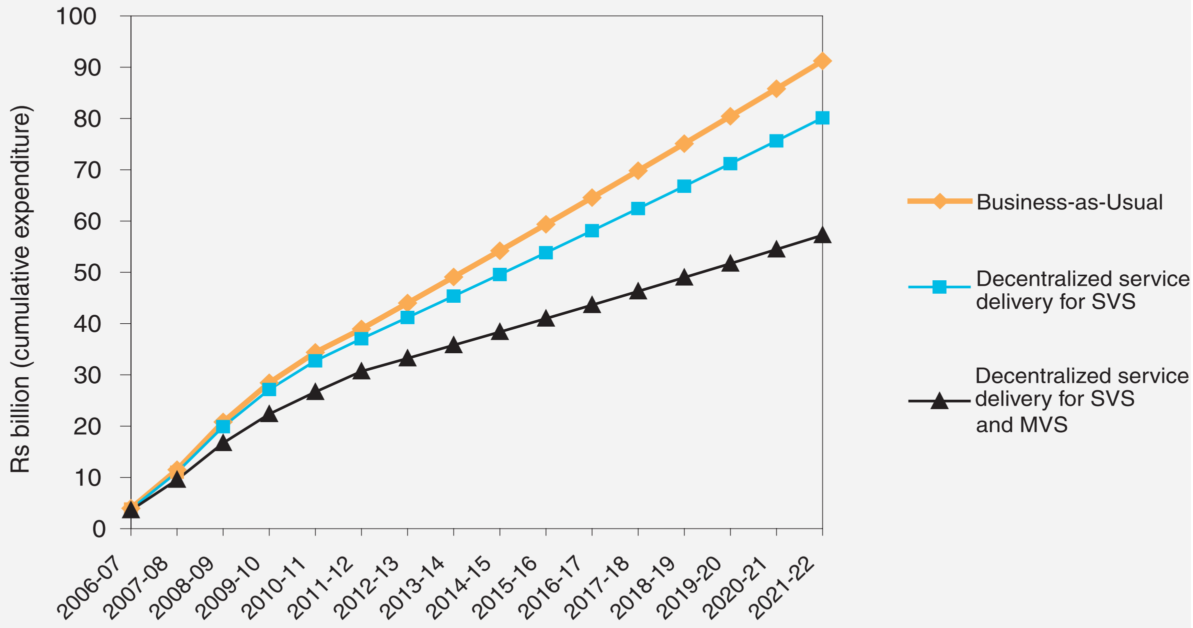
The third scenario, which is based on a sector-wide policy reform, foresees a comprehensive devolution of schemes from Uttarakhand Jal Nigam and Uttarakhand Jal Sansthan to the Gram Panchayats. The expenditure that has to be incurred on the revamping of schemes before these are handed over to the GPs has been taken into account (Rs 1.7 billion to be incurred during 2006–07 to 2011–12). All new schemes set up to cover the NC/PC habitations in the period 2006–07 to 2011–12 will follow the new policy approach. This applies to both single village and multi village schemes. In the case of large multi village schemes, it is assumed that the intra-village distribution will be managed by the communities. For both new single village schemes and multi village schemes, the communities will contribute towards capital cost. However, in this scenario, the multi village schemes currently with the Jal Nigam/Jal Sansthan will continue as per the present institutional arrangements. The multi village schemes that are under construction or that have been approved before

November 2006 would continue to be managed by the Jal Nigam/Jan Sangsthan. For such schemes, it is assumed that cost recovery will improve from 10 percent to 20 percent. Thus, under the third scenario, the major part of the sector comes under the new policy approach, while some part remains outside. An improvement in cost recovery is assumed for the part remaining outside the sector-wide policy approach.

The differences in the cost or expenditure in the three scenarios arise due to differences in institutional cost, cost recovery, cost of schemes, proportion of multi village schemes among the new schemes constructed, and the rate of slippage (which arise due to the differential efficacy of the arrangements). The assumptions are specified in Table 1. To provide some explanation for the assumptions, the institutional cost for supply-driven and demand-driven programs have been computed for Uttarakhand (discussed in Chapter 3), and have been used to assess the fiscal implications.

The same applies to the Support Organization/non-government organization cost. The proportion of multi village schemes is assumed to be lower in the third scenario, since the sector-wide policy reform foresees a more rigorous appraisal of such schemes before they are implemented. An analysis of cost data for the piped water schemes of Uttarakhand reveals that the average capital cost of supply-driven schemes are about 30 to 40 percent higher than the norm. A conservative assumption has been made here. The cost of schemes in the ‘Business-as-Usual’ scenario is assumed to be 20 percent higher.

Figure A3.2.1 **Fiscal Implications of Policy Reform for Uttarakhand**



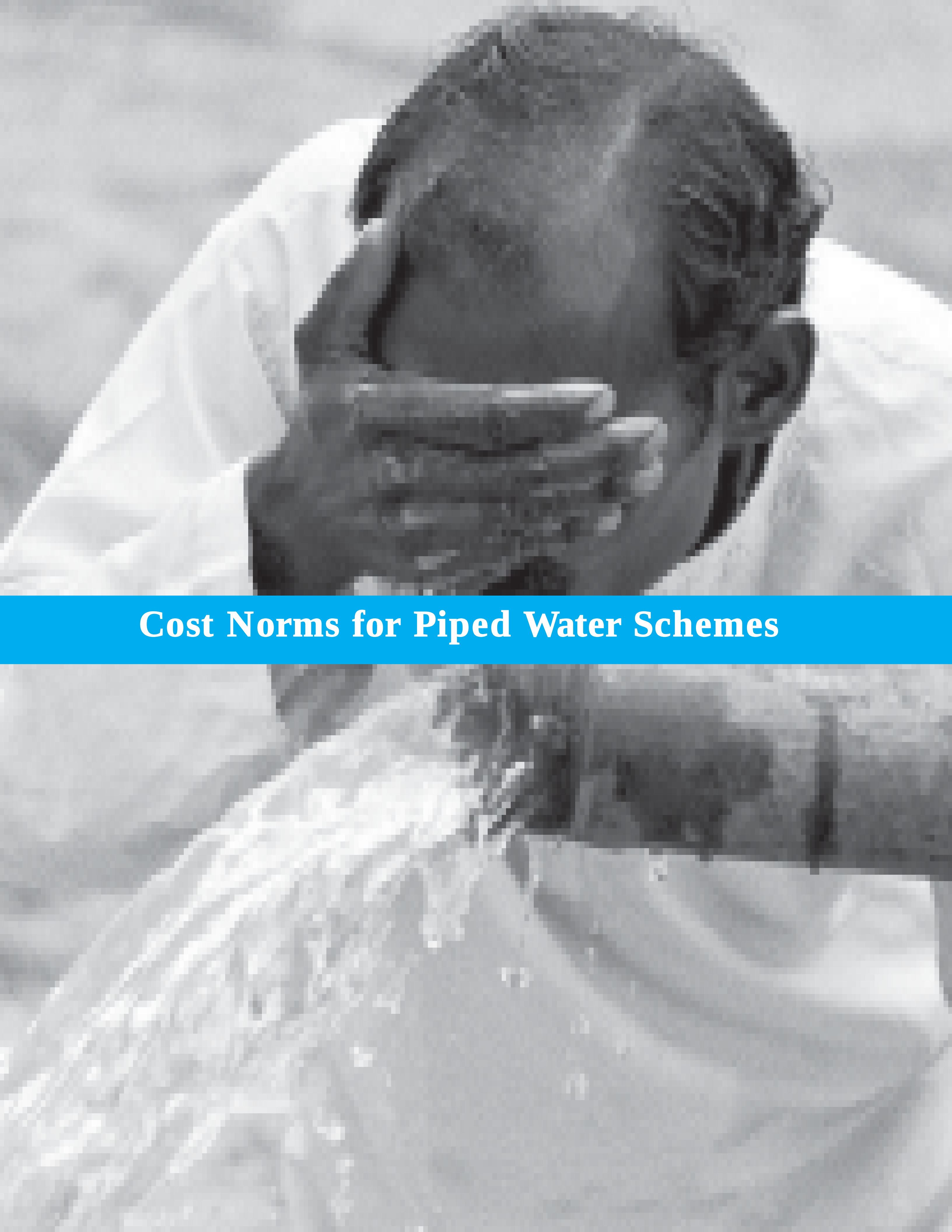
Available information on slippage (taken from the website of the Ministry of Rural Development) indicates that between April 1999 and March 2005, 14,980 habitations in Uttarakhand slipped from fully covered to NC or PC status.

Given the total number of habitations (about 40,000), the annual rate of slippage comes to about 6 percent. It is assumed that in the 'Business-as-Usual' scenario, the same rate of slippage would prevail in the 12th and 13th Five Year Plans. In the other scenarios, a much lower rate of slippage is assumed on the grounds of better management and greater care for source sustainability.

Figure A3.2.1 shows the cumulative RWSS expenditure under the three scenarios. The 'Business-as-Usual' scenario is contrasted with the decentralized service delivery for single village schemes and the decentralized service delivery for single and multi village schemes. The gap in the cumulative expenditure is relatively more marked in the case of decentralized service delivery for single and multi village schemes (which also involves the transfer of single village schemes to Gram Panchayat management).

The discounted present value of RWSS costs to be incurred by the central/state government in the period 2006–07 to 2021–22 is Rs 52 billion in the 'Business-as-Usual' scenario. It is lower, at about Rs 46.7 billion in the decentralized services delivery for the single village scheme scenario (without the phasing out of the single village schemes to Gram Panchayats), and still lower at about Rs 34.9 billion in the decentralized single village scheme and multi village scheme scenario (with the phasing out of single village schemes to Gram Panchayats). Thus, between the 'Business-as-Usual' and sector-wide policy reform there is a gap of about Rs 17 billion.

The gap in the discounted value of cumulative expenditure is basically a reflection of the inefficiency of the system in place. Based on the estimates obtained, it would be possible to save about one billion rupees in cost every year through the adoption of a sector-wide policy reform.



Cost Norms for Piped Water Schemes

ANNEX 4.1

Annex 4.1

Cost Norms for Piped Water Schemes

Table 1 Capital Cost (Rs per Capita)

State	Mini water scheme	Single village scheme	Multi village scheme
Karnataka	775	520 (GW) 1,400 (SW)	590 (GW) 1,825 (SW)
Kerala	2,115		1,460
Maharashtra	410	1,250	1,250 (GW) 1,610 (SW)
Tamil Nadu	735	790	1,490 (GW) 1,150 (SW)
Punjab		1,500 (GW) 2,000 (SW)	1,380 (GW) 1,750 (SW)
Uttar Pradesh		1,575	1,210 (GW) 4,120 (SW)
Uttarakhand		1,870 (pumping) 2,970 (gravity)	1,490 (pumping) 3,590 (gravity)

GW = groundwater-based; SW = surface water-based. Cost norms adjusted for 2005–06 prices.
Note: There are significant variations across states due to differences in hydrogeological conditions and the number of households typically served by each scheme.

Table 2 O&M Cost (Rs per Capita per Month)

State	Mini water scheme	Single village scheme	Multi village scheme
Karnataka	5	9 (GW) 10 (SW)	7 (GW) 10 (SW)
Kerala	6		7
Maharashtra	7	20	20 (GW) 24 (SW)
Tamil Nadu	5	8	21 (GW) 13 (SW)
Punjab		4 (GW) 5 (SW)	9 (GW) 11 (SW)
Uttar Pradesh		7	9
Uttarakhand		5 (pumping) 7 (gravity)	5 (pumping) 12 (gravity)

GW = groundwater-based; SW = surface water-based. Cost norms adjusted for 2005–06 prices.
Note: There are significant variations across states due to differences in hydrogeological conditions and the number of households typically served by each scheme.

Information Sources

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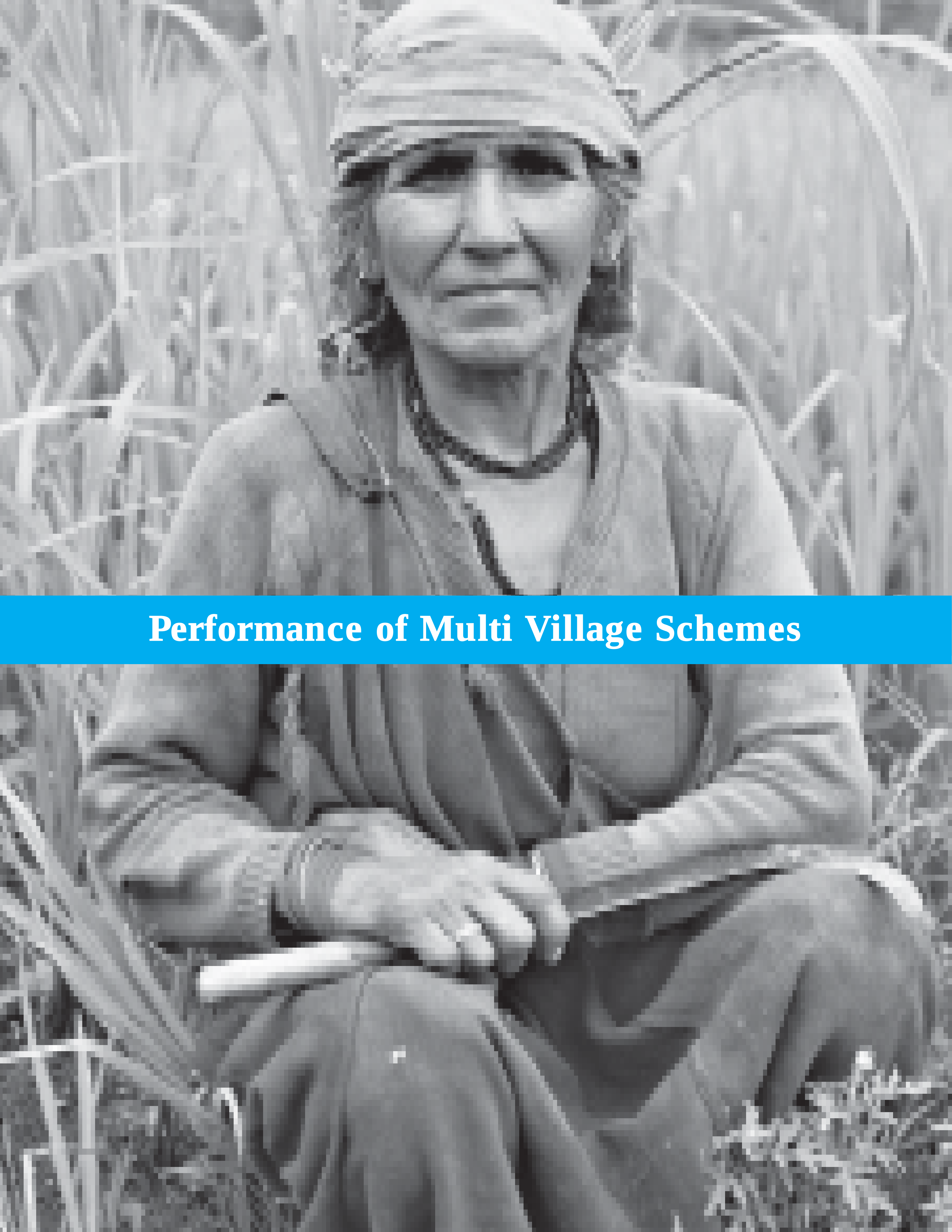
'Economic Analysis of SWAP (SWAJAL Project Phase-II),' prepared by Dalal Mott MacDonald, February 2006.

Performance of Multi Village Schemes



ANNEX 5.1

Annex 5.1

Performance of Multi Village Schemes

The indices of effectiveness presented in Chapter 4 indicated that the performance of multi village piped water supply schemes (including regional schemes) is relatively inferior to that of the single village and mini water supply schemes. A more detailed analysis of the performance of multi village schemes is undertaken in this annex, with a particular focus on how the performance of multi village schemes compares with that of single village schemes. The analysis is confined to 9 out of the 10 states surveyed, leaving out Uttarakhand, since the scheme cost and operating conditions in Uttarakhand are quite different from other states.

At the outset it may be noted that the multi village schemes are relatively more costly (Table 1). Taking a weighted average across states, the capital cost per household of multi village schemes is about 25 percent higher than that of the single village schemes, while the O&M cost of multi village schemes is about 11 percent higher.

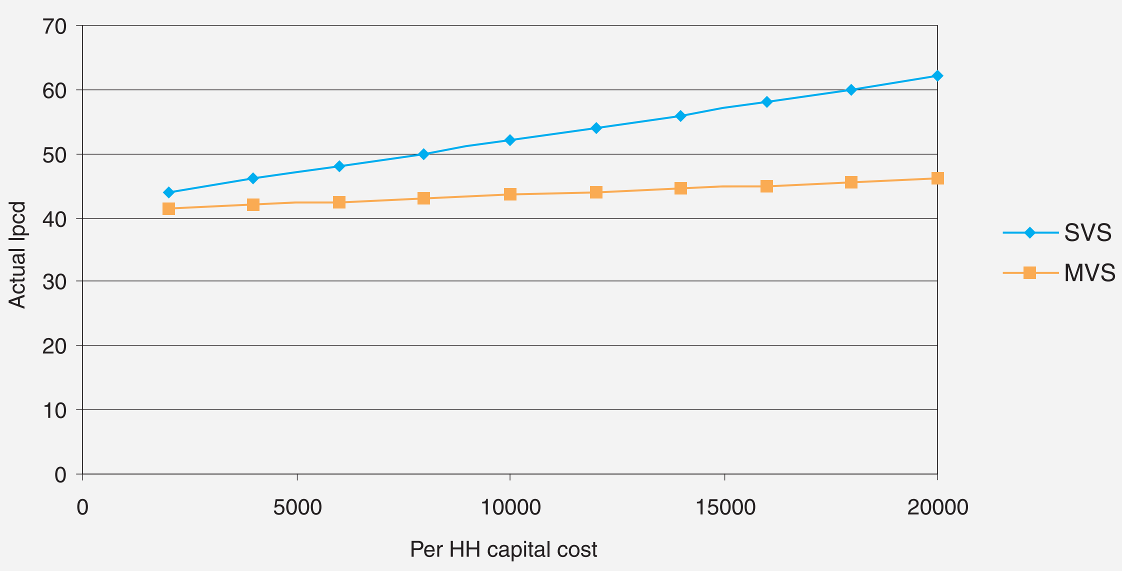
The averages conceal the high variations that exist in the cost of schemes. In a number of cases, the capital cost per household is very high in multi village schemes. In one case, the capital cost per household is Rs 65,000 and the O&M cost is about Rs 3,000 per household per annum. Out of the 150 multi village and regional schemes covered in the study (excluding the schemes in Uttarakhand), the capital cost per household exceeds Rs 10,000 in 16 percent of the cases, and exceeds Rs 20,000 in 4 percent cases. An additional factor that tends to raise the cost of service provision through multi village schemes is that such schemes are invariably in the supply-driven mode with high institutional costs. (It has been noted in Chapter 4 that institutional costs in the supply-driven programs are much higher compared to demand-driven programs.) Further, the high cost of multi village schemes is accompanied by relatively lower cost recovery from beneficiary households with the consequence that the flow of funds from the central and state governments to construct and manage such schemes is relatively higher.

Table 1 Average Costs of Single and Multi Village Piped Water Supply Schemes

Technology	Capital cost (Rs per household)	O&M cost (Rs per household per annum)
Single village schemes	5,300	280
Multi village (including regional) schemes	6,600	310

The proportion of private connection users who regularly pay towards the O&M of the multi village schemes is 53 percent whereas it is higher, at about 75 percent, for single village schemes. Very few among the standpost users pay, and this reduces the level of cost recovery. In Andhra Pradesh, Tamil Nadu, and West Bengal, the single and multi village piped water supply schemes mainly serve the standpost users with

Figure A5.1.1 Investment and Actual lpcd, Single and Multi Village Schemes, Estimated Regression Equation



very few paying customers, which causes the level of cost recovery to be low. Overall, the level of recovery of the O&M cost through user charges is about 50 percent in single village schemes and about 35 percent in multi village schemes. The higher cost of multi village schemes would be justified if these provided a more reliable service. However, this is not so. Many of the multi village and regional schemes are based on surface water. Being based on surface water, these are expected to be less affected by seasonal variations in groundwater availability and thus be able to provide a more regular supply of water. Indeed, the multi village schemes are designed to provide a regular supply of water at the level of 40 lpcd or higher. In reality, however, the multi village schemes are in many cases not providing water regularly and the supply level falls short of the government norm of 40 lpcd.

An analysis of the relationship between investment per household and the actual lpcd level (as reported by the scheme management) shows that while in single village schemes, higher investment is associated with higher lpcd, this is not the case with multi village schemes. The estimated regression lines are shown in Figure A5.1.1. In many respects, the performance of multi village schemes is worse than the single village schemes.

Table 2 Average Design and Actual Hours of Supply, Single Village and Multi Village Schemes

Technology	Design hours of supply	Actual hours of supply
Single village schemes	4.6	2.6
Multi village (including regional) schemes	7.7	2.9

The design hours of the supply of multi village schemes are on an average higher than that of single village schemes, but the actual hours of supply are about the same as that of single village schemes (Table 2). The actual lpcd level in multi village schemes in summer is less than design and even less than the government norm of 40 lpcd in a substantial proportion of cases. This is indicated in Table 3. This also applies to the single village scheme, but to a lesser degree.

In several other respects, the performance of multi village schemes is relatively worse than that of single village schemes. About 33 percent households using multi village schemes are able to meet less than half of their water requirement from the scheme; this proportion is lower at

21 percent for single village schemes. About 8 percent households using single village schemes get water only one day a week or two to three days a week. This proportion is higher at about 13 percent for multi village schemes. The majority of rural households using single or multi village schemes get water only once a day (on the days water is supplied). The proportion of households getting water only once a day is about 47 percent in single village schemes; it is relatively higher at 53 percent in multi village schemes.

There are various reasons for the poor performance of multi village schemes. It is well known that since the distribution is over a larger number of habitations, there is a considerable proportion of households who are at the tail-end of the scheme and face problems due to inadequate water supply and pressure. The survey results confirm this fact. It is important to emphasize that the expenditure incurred on repair and maintenance in multi village schemes falls far short of the norm. In single village schemes, the expenditure on minor repair and

Table 3 Design and Actual Lpcd, Single Village and Multi Village Schemes

State	Type of scheme	Design lpcd (average of surveyed schemes)	Actual lpcd computed from household data on water consumption	
			Summer	In other seasons
Andhra Pradesh	Single village scheme	44	35	35
	Multi village scheme	42	35	35
Karnataka	Single village scheme	53	25	41
	Multi village scheme	61	27	39
Kerala	Single village scheme	70	48	50
	Multi village/regional scheme	45	43	46
Maharashtra	Single village scheme	45	40	40
	Multi village/regional scheme	47	31	37
Orissa	Single village scheme	45	23	24
	Multi village scheme	48	23	23
Punjab	Single village scheme	57	31	31
	Multi village scheme	53	28	28
Tamil Nadu	Single village scheme	40	39	48
	Multi village scheme	40	35	45
Uttar Pradesh	Single village scheme	59	33	35
	Multi village scheme	55	22	29
West Bengal	Single village scheme	41	32	33
	Multi village/regional scheme	43	33	39

Table 4 Performance of Single and Multi Village Schemes, Comparison of Select Parameters

	Single village schemes	Multi village schemes
% HH not able to meet more than half of their water requirement from scheme	21%	33%
% HH getting water only once a week or 2/3 days a week	8%	13%
% HH getting water only once a day	47%	53%

maintenance is about 1.3 percent of the total capital cost of the schemes. The corresponding figure for multi village schemes is about 0.4 percent. Similarly, the expenditure on repair and maintenance per household served is Rs 40 per year in single village schemes, while it is about Rs 20 per year in multi village schemes.

Evidently, the relatively lower expenditure on the maintenance of multi village schemes adversely affects their performance. The problem of inadequate maintenance is further compounded by the problem of inadequate yield from the water source, especially during summer months. As a result, the supply and pressure is low.

The analysis presented in the study, particularly the analysis in this annex, clearly indicates that multi village schemes use more resources than single village schemes without commensurate service benefits. It should, however, be recognized that this is the overall picture of the cost and performance of multi village schemes and there may be exceptions. Indeed, in some cases, the capital cost per household is found to be lower, the quantity of water supplied per capita is found to be higher and the time spent by households for water collection is found to be lower in multi village schemes as compared to single village schemes in the state. Notwithstanding such exceptions, the general conclusion that may be drawn is that the multi village scheme is commonly not an efficient technological option for rural water supply in India, and these should be adopted only where single village schemes are not sustainable, that is, in water quality-affected regions and in over-exploited aquifers.

Some Good Practice Examples

ANNEX 5.2

Annex 5.2

Some Good Practice Examples

Based on information gathered from the state agencies, this annex provides some good practice examples. Most of these examples illustrate how well the schemes are performing, despite challenging local conditions in getting a sustainable source.

Lessons from Good Practice Cases

The key lessons from good practice cases are given below.

Community involvement for transparency and accountability: The main lesson that may be drawn from the good practice cases is that substantial improvement in water supply services and a high level of cost recovery is possible with community involvement in the design and implementation of projects. In these examples, the Village Water and Sanitation Committee (VWSC) members regularly visited the site of the work during project implementation and guided the contractor during the course of the work to ensure that high quality of work is carried out. Also, regular meetings of the VWSC, proper maintenance of the registers and books of accounts, and the availability of the books of accounts for scrutiny by the VWSC members created confidence among the user communities and helped in the successful completion of the projects. Such transparency in the management of funds is important for ensuring that the users get induced to pay water charges and there is a regular collection of O&M contribution by the user communities.

Decisions on efficient and equitable distribution: In many examples, there is a conscious attempt by the community that the service level should be a 'private tap' and not a 'standpost'. It was felt that if service is provided at the standpost level, then the offtake by different households cannot be accounted for, and the leakage/wastage cannot be controlled. However, the distribution needs to be fair. Thus, in one of the good practice examples, the household could connect to the scheme through a single tap connection in front of the house, and was not allowed to take pipe connections inside the house and avail water from multiple taps. Nor are households allowed to connect supply water to a storage tank. These measures ensure that the households do not tap more water than the scheme is designed to provide.

Setting appropriate tariffs to improve financial sustainability: Besides fairness in distribution, there is also an issue of fairness in tariff. In one good practice example, differential tariff rates are charged for households depending on the number of household members since the quantity of water consumed would differ among them.

An interesting lesson emerging from one example of a supply-driven scheme is that when it is managed by the Village Panchayat and provides a satisfactory service, it is possible to achieve substantial recovery of the O&M cost, even if the users are served through standposts (shared connections).

Karlakatta Village Scheme, Sambrani GP, Uttar Kannada District, Karnataka

Karlakatta village in the Sambrani GP consists of 50 households above poverty line (APL) and 100 households below poverty line (BPL). The village had one mini water supply scheme, which was not working properly before the Jal Nirmal Project. The villagers had to walk a long distance to fetch safe drinking water, especially during the summer months. Given these difficulties, the villagers came forward to take up the demand-responsive scheme under the World Bank Jal Nirmal Project.

A Village Water and Sanitation Committee was formed during the initial planning phase of the project, and the villagers participated in the planning and implementation activities. The VWSC has been conducting regular meetings every month. Good maintenance of the registers and books of accounts has been observed. The community contributed Rs 1.17 lakh as beneficiary contribution towards the scheme. The construction work is of good quality and the scheme is designed to provide water to all households through individual connections.

After construction, the scheme was handed over to the VWSC in June 2005. From that time, the VWSC has been operating and maintaining the scheme locally. A minimum of Rs 35 per month per household was fixed as water tariff. However, the monthly water tariff depends on the number of household connections, and the existing tariff is Rs 55 per month per household. So far, 125 households have taken individual connections.

At the end of March 2007, 100 percent O&M cost recovery was recorded for the year 2006–07. All households are paying regular tariff and the beneficiaries are getting adequate water supply every day. Good operation and maintenance of the scheme is observed.

Muthalamada Mini Water Supply Scheme, Pallakad District, Kerala

The mini water scheme of Muthalamada Gram Panchayat, Pallakad district, has been constructed under the World Bank-supported Jalanidhi scheme. This scheme is located in an upland taluka, which is designated as a 'gray' area (water exploitation is between 65 and 85 percent of the total recharge). The sustainability of the source is a challenge.

The mini water schemes in Kerala are unlike those in other states, where service is provided mostly from a public tank-type standpost. In Kerala, the service provided even from the small mini water scheme is mostly at the household level. There is a stricture that the service should be availed only from the single tap connection in front of the house, and the user household should not take pipe connections inside the house to avail water from multiple taps. Further, the supply water is not allowed to be directly connected to a storage tank. This is to ensure that the consumer does not tap more water than the design of the scheme.

The scheme covers 50 households with a capital cost of Rs 607,300. The per household cost is estimated to be Rs 12,146, which is within the Jalanidhi norm of Rs 15,000 per household. Ninety-eight percent of the households have made contributions towards 10 percent capital cost of the scheme.

The O&M cost of Rs 1,900 per month is shared across 50 households, amounting to Rs 38 per household. An amount of Rs 40 per month is collected from households. All households are regularly paying the O&M charges. Water is provided through a piped water supply system with services offered at the household tap-level.

The community-driven mini water schemes do not deliver services at the standpost level, as the water taken by different households cannot be accounted for, nor the leakage/wastage controlled. The source of water is a dug-well, and the yield test was undertaken before finalizing the source.

All households have reported that the scheme provides water on a reliable basis throughout the year; 95 percent households have reported receiving daily water supply in summer.

The average quantity of water available both in summer and winter is 61 lpcd, which is well above the Government of India norm of 40 lpcd. The dependence on the scheme is high, with only 10 percent households having private wells.

Piped Water Scheme, Vadakkanchery Village, Pattambi Block, Kerala

The single village piped water scheme of Vadakkanchery Gram Panchayat, Pattambi Block, Kerala, is constructed under the Jalanidhi project. The quantity of water supplied by the scheme is more than 70 lpcd in non-summer months. Most households (93 percent) do not have any private water supply arrangements and their dependence on the scheme is very high. However, some households located uphill from the storage tank face shortages in the summer months.

Despite the supply problems, the scheme has done quite well in terms of cost recovery. Almost all households have contributed to the capital cost and are regularly paying towards the O&M cost. The pressure on the households to find an appropriate solution to their water supply problems has led to regular financial contributions. The community spirit and sense of responsibility are the main factors in sustaining the scheme, considering that services are not equitable during summer months. The community realizes that if all users do not contribute, the scheme will not be able to function and the life and sustainability of the scheme would be affected.

Piped Water Supply Scheme, Heggar Village, Dongri GP, Uttar Kannada District, Karnataka

Heggar village in Dongri GP consists of 55 APL families, with a population of about 520 persons. Before the Jal Nirmal project, the villagers were facing acute water problem during the summer months. They were drawing water from Gangavalli river or open wells. Given the acute scarcity of water and the trouble of fetching water from a distance, the villagers came forward to take up the water supply and sanitation scheme under the Jal Nirmal Project.

The implementation of the project was done by the community, based on the community contracting system under the project. The villagers participated actively during the planning and implementation of the project. The VWSC conducted regular meetings each month. The community mobilized 100 percent contribution (Rs 170,000) towards the capital cost of the project.

The user community as well as VWSC members were actively involved in the supervision and monitoring of the construction work. The quality of construction was good due to proper supervision by the villagers. Besides, the concerned officers of the Panchayati Raj Engineering Department and the project personnel also actively monitored and supervised the implementation process of the project. The scheme was handed over to the VWSC in December 2004 and from that date the VWSC has been operating and maintaining the scheme. The O&M budget for 2006–07 was Rs 13,200. The water tariff was fixed at Rs 20 per household per month. This tariff is paid by every household regularly. The VWSC collected 100 percent O&M water tariff during 2006–07. All 55 APL families have taken individual household connections and are getting a sufficient and equal quantity of water. If anybody damages the system, s/he is fined appropriately.

Chirchankal Mini Water Scheme Constructed under the Accelerated Rural Water Supply Program in Bijapur, Karnataka

The mini water supply scheme in Chirchankal village in Bijapur was constructed in 2002 under the ARWSP for Rs 183,000. Being a supply-driven program, it did not require the user community to either participate in the planning process or contribute to the capital cost. The water is sourced from a tubewell and abstracted by an electricity-operated pumpset. As per the scheme authorities, no yield test was undertaken at the time of source selection, hence the supply is low in summer (33 lpcd) and just above the Government of India norm in other seasons (44 lpcd). The service provision is only at the level of the tank-type standpost. This supply-driven scheme, which is operated and maintained by the Village Panchayat, has proved that the decentralized governance works well for rural water supply. The scheme provides a daily supply of more than three hours per day. This is quite commendable, considering that Bijapur is severely affected by groundwater exploitation and insufficient recharge.

The Village Panchayat charges Rs 10 per month towards the O&M cost to all standposts users. This amount is not sufficient to recover the running cost of the scheme, and an amount of Rs 53,000 exists as unpaid electricity bills.

However, the scheme has demonstrated that user contributions can be generated and if the service improves, the users could be motivated to pay more.

Mini Water Scheme in Heggar Village, Uttar Kannad District, Karnataka

The village of Heggar is located in a hilly terrain, and groundwater is available only at a depth. Solving the water problem for the village meant identifying alternate sources. A nearby upland stream was identified by the user community. Under guidance of the Jal Nirmal project functionaries, the reliability of the source was assessed with a yield test, measuring discharge and year-round source dependability. Water from the stream is abstracted through an intake structure and channeled to the scheme storage tank through gravity. Since the households are scattered and located at varying elevations, the distribution is undertaken through diesel-based pumping.

The scheme had been constructed for Rs 196,000 in 2004, with about 71 percent households contributing towards the mandatory 10 percent capital cost of the scheme. The user community has been closely involved in the planning and construction process and is confident in operating and maintaining the scheme. The service was planned mostly at the household level for two reasons—to address the scattered households in an undulating topography and to ensure better service and willingness to pay. Thus 87 percent of the households have tap connections while the rest depend on the standposts.

Despite the unfavorable water availability situation, the scheme has been able to ensure water supply on a daily basis for three hours or more. The households get a fairly large quantity of water per day (70 lpcd in summer and 80 lpcd in other seasons).

Although users complain that there are some days in summer when the supply is less than normal, they are generally satisfied with the scheme. The annual cost of maintenance is Rs 8,000 per annum, or Rs 666 every month. There is no cost on water abstraction as it is gravity-based; the cost for pumping and distribution make up the O&M cost. The recovery for the O&M cost from tap connections is about Rs 22 per household per month. Ninety-two percent of the beneficiary households pay towards the monthly O&M and have ensured no breakdown of service.

Veliannur Single Village Piped Water Scheme in Palakkad, Thrissur District, Kerala

The single village piped water scheme of Veliannur Gram Panchayat, Thrissur district, was constructed under the Jalanidhi project in 2004. Although this is a single village scheme, the coverage is only for 40 households. Due to a lack of alternative groundwater sources, this scheme is providing water from a nearby surface source. The yield has been tested for discharge and assessed for dependability before it was finalized. The scheme has been constructed at a total cost of Rs 2,013,747. The cost of intervention per household is very high, estimated at Rs 50,343, much above the project norm of about Rs 15,000 per household. Ninety-four percent of the households have contributed towards the capital cost (paying about Rs 7,065 per household), which accounted for 14 percent of the total capital cost. Additionally, the Gram Panchayat contributed 9 percent of the capital cost. Thus, the project had to pay about 77 percent of the scheme cost.

The cost of the O&M per household is Rs 99 per month, which is much higher than most demand-driven schemes. Although all households have reported regular payments towards the O&M, the recovery has not been enough to recover costs, and is the main reason for arrears in the electricity payment for the scheme. The scheme supplies water on a daily basis in summer, which is primarily due to reliable water source selection. About 17 percent of the households, who have houses at a slight elevation, face lower pressure of supply, especially during summer and thereby report water shortages. The quantity of water supply is just above the government norms, at 48 lpcd in summer and 49 lpcd in other seasons. Thus the cost of the scheme is justified in ensuring reliable supply rather than a larger quantity of water per household. About one-third of the households have private wells, and their daily water requirement is supplemented from these wells.

Water Consumption Study

ANNEX 5.3

Annex 5.3

Water Consumption Study

A study on water consumption in rural households was undertaken in seven states (Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Punjab, and Tamil Nadu) during September 2007. About 25 households (belonging to diverse water supply schemes) were covered in each state, except Karnataka and Kerala, for which 40 and 34 households, respectively, were covered.

Actual consumption of water according to source and use was recorded. A recording format was used to record the water consumption by individual members, and for combined household uses for different activities.

Additionally, documentation of the type of water scheme used for different activities, and the number of members residing in the households, was done.

The main findings of the water consumption study are presented in Tables 1 and 2.
As can be seen from the tables, the main public source provides only a part of the water requirement of the rural households, commonly much less than 40 lpcd, the official norm.
To meet their requirements, the households have to combine the main public source with supplementary public sources and private sources.

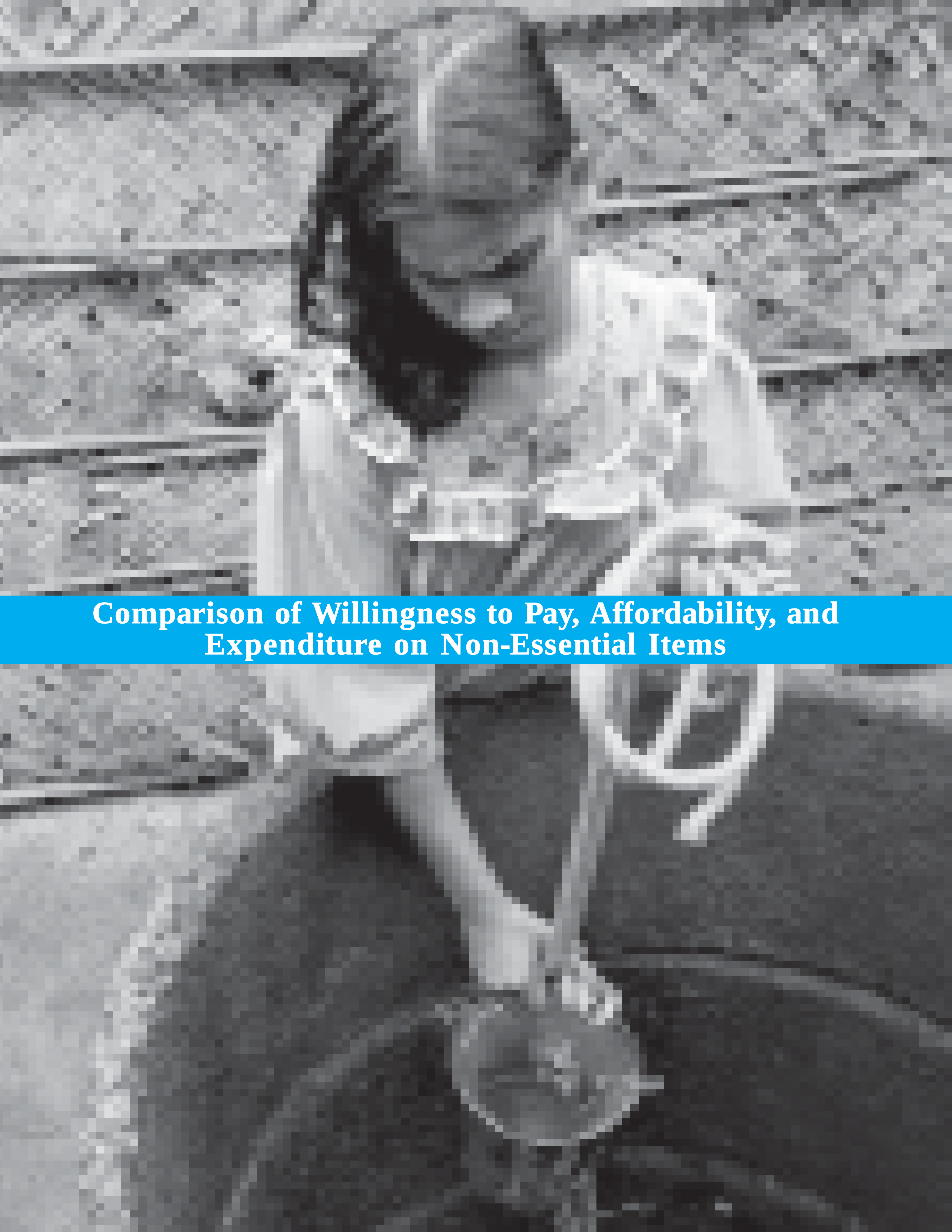
Table 1 Water Consumption in Rural Households, Liters per Capita per Day (lpcd)

Technology	Sources	AP	KAR	KER	MAH	ORSS	PUN	TN
HP	Main public source	15.2	18.5	33.2	26.6	22.8	21.6	25.0
	Other sources	30.3	28.3	85.2	23.6	33.3	79.6	26.1
	Total	45.5	46.8	118.4	50.2	56.1	101.2	51.1
MWS	Main public source	25.0	15.5	22.6	20.0			47.8
	Other sources	30.5	41.9	78.8	11.5			21.3
	Total	55.5	57.4	101.4	31.5			69.1
SVS	Main public source	24.3	18.3	22.4	23.7	18.5	25.3	35.6
	Other sources	38.0	28.6	74.9	18.6	36.1	57.5	34.0
	Total	62.3	46.9	97.3	42.3	54.6	82.8	69.6
MVS	Main public source	20.9	15.7	40.7	32.2	23.4	19.6	26.7
	Other sources	42.8	29.3	64.3	40.6	31.1	70.0	33.5
	Total	63.7	45.0	105.0	72.8	54.5	89.6	60.2
Regional	Main public source	20.4		38.5	29.3			
	Other sources	36.6		105.7	8.7			
	Total	57.0		144.2	38.0			

Table 2 Water Consumption by Activity (Liters per Capita per Day)

Activity	Main public source	Other sources	Total
Drinking	2.3	1.2	3.5
Cooking	2.5	1.4	3.9
Washing utensil	5.8	2.8	8.6
Washing clothes	3.8	12.6	16.4
Bathing and toilet	4.4	20.0	24.3
Watering cattle	2.1	3.2	5.3
Outdoor defecation	0.2	0.8	1.0
Other activities	2.8	1.9	4.6
Total	23.9	43.9	67.8

Note: Data for seven states combined.



Comparison of Willingness to Pay, Affordability, and Expenditure on Non-Essential Items

ANNEX 7.1

Annex 7.1

Comparison of Willingness to Pay, Affordability, and Expenditure on Non-Essential Items

The average expenditure incurred by rural households on non-essential items (*pan, bidi,* other tobacco products, and intoxicants) may be taken as an alternate indicator of the amount they can afford to pay for water supply.

As shown in Table 1, the average expenditure on non-essential items incurred by rural households in various states is commonly more than the estimated willingness to pay and affordability for private connection. Thus, the conclusion drawn earlier that affordability is not an issue in providing rural people a vastly improved water supply system is borne out by the figures on non-essential expenditure. For standposts, it is more appropriate to consider the expenditure on non-essential items incurred by the bottom 30 percent of the households (in terms of per capita monthly expenditure), since it is the households in such consumption classes that should be able to afford the payment for standposts. In this case, again, the estimated willingness to pay and affordability is generally less than the mean expenditure on non-essential items.

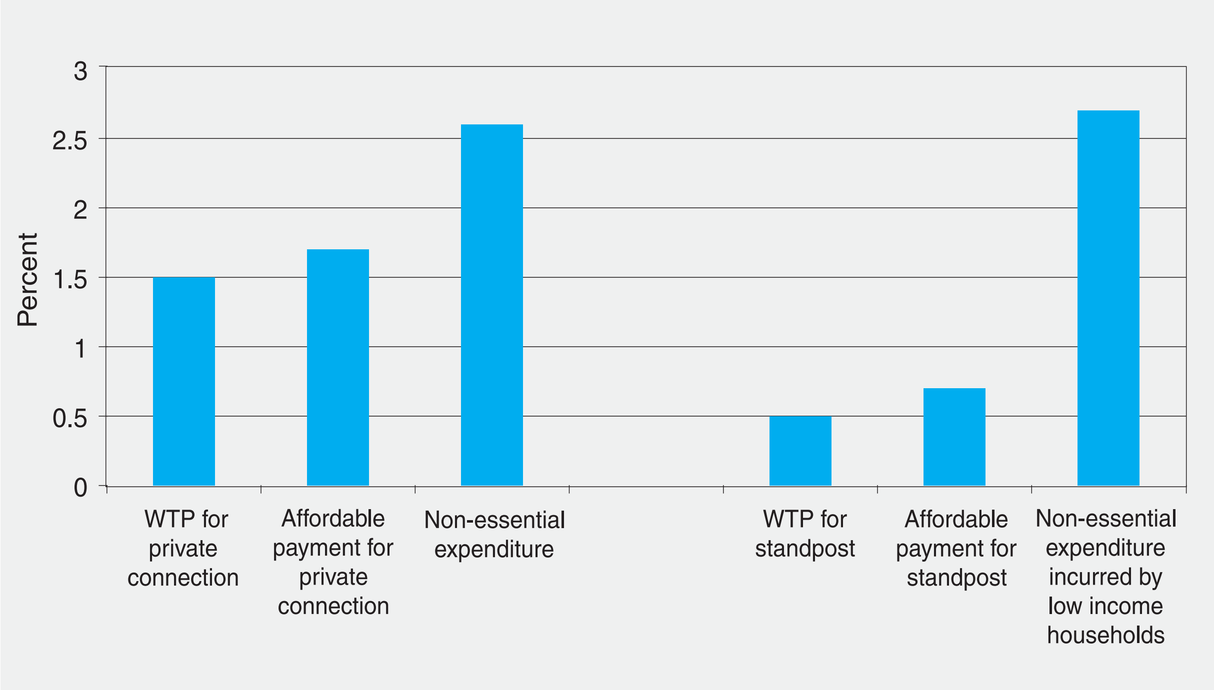
Table 1 Comparison of Willingness to Pay, Affordability, and Expenditure on Non-essential Items

State	Willingness to pay (Rs/month)		Affordability (Rs/month)		Non-essential expenditure (*pan, bidi*, other tobacco products, and intoxicants) per rural household per month (Rs)	
	Private connection	Stand-post	Private connection	Stand-post	All HH	Bottom 30% HH in terms of per capita monthly expenditure
Andhra Pradesh	40	14	30 to 45	15 to 20	93	51
Karnataka	50	18	50 to 60	20 to 25	85	59
Kerala	51	14	90 to 110	30 to 35	97	58
Maharashtra	63	34	50 to 60	20 to 25	54	37
Orissa	52	16	30 to 40	15 to 20	49	31
Punjab	68	30	100 to 130	40 to 50	74	35
Tamil Nadu	49	24	30 to 40	20 to 25	58	31
Uttar Pradesh	34	7	50 to 70	20 to 25	72	41
Uttarakhand	43	13	50 to 60	11 to 13	87	55
West Bengal	53	19	30 to 50	15 to 20	59	44
(As % of monthly household income)						
Andhra Pradesh	1.5	0.5	1.1–1.7	0.6–0.7	4.0	3.8
Karnataka	1.7	0.6	1.7–2.0	0.7–0.8	3.6	3.5
Kerala	1.3	0.3	2.2–2.7	0.7–0.9	2.2	2.7
Maharashtra	1.8	1.0	1.4–1.7	0.6–0.7	2.1	2.5
Orissa	1.8	0.6	1.0–1.4	0.5–0.7	2.6	2.8
Punjab	2.0	0.9	2.9–3.8	1.2–1.5	1.7	1.4
Tamil Nadu	2.4	1.2	1.5–2.0	1.0–1.2	2.6	2.4
Uttar Pradesh	1.0	0.2	1.5–2.1	0.6–0.7	2.4	2.2
Uttarakhand	1.3	0.4	1.6–1.9	0.3–0.4	2.7	2.7
West Bengal	1.7	0.6	1.0–1.6	0.5–0.6	2.2	2.7
Weighted average#	1.5	0.5	1.4–2.0	0.6–0.8	2.6	2.7

Note: Data on the expenditure on non-essential items taken from Level and Pattern of Consumer Expenditure, 2004–05. *NSS 61st Round (July 2004–June 2005), National Sample Survey Organization, Ministry of Statistics and Program Implementation, Government of India, December 2006. (# rural state population in 2001 [based on Census] used as weights.)*

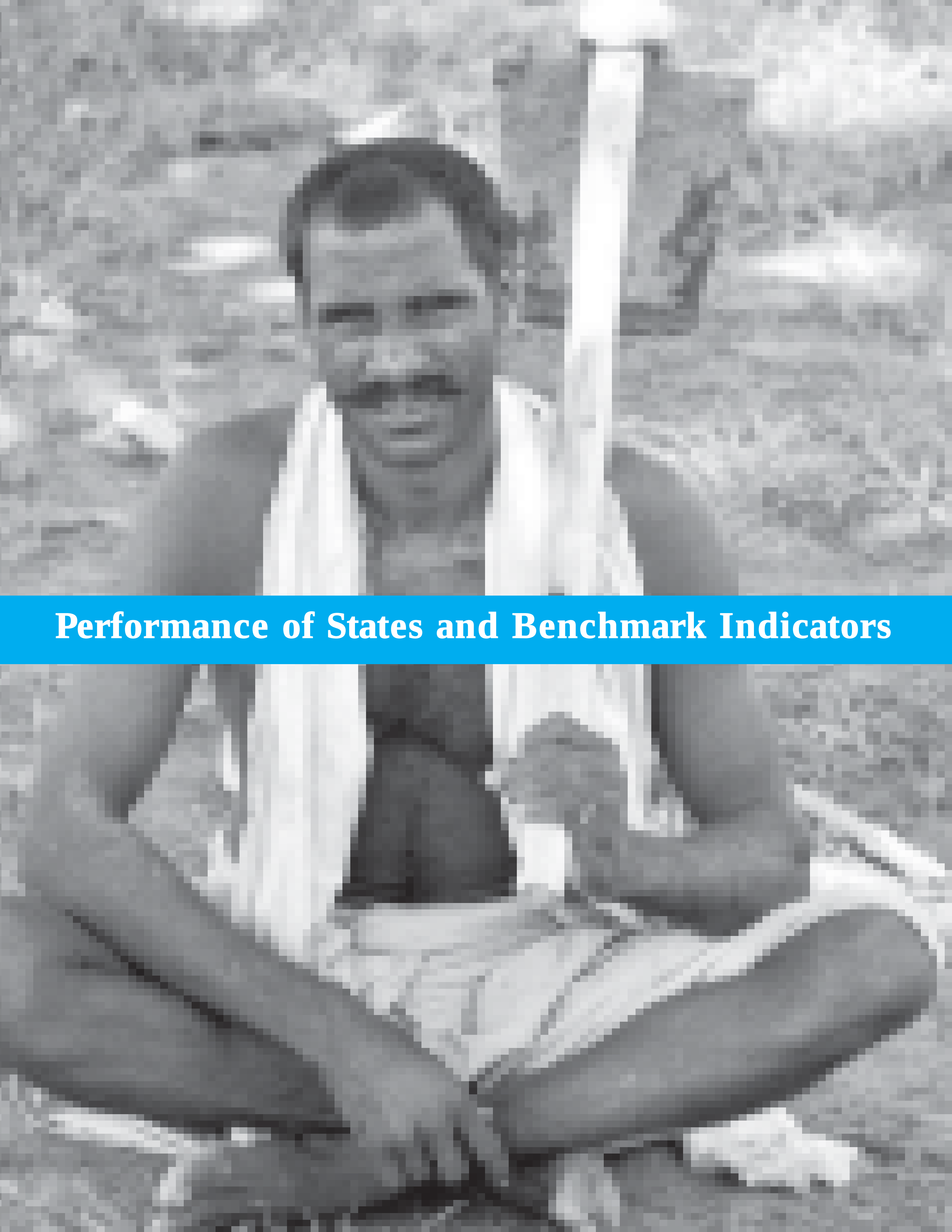
The NSS data do not provide monthly income, and therefore the average monthly consumption expenditure of rural households of the state has been used in place of the monthly income for the last two columns. The ratio computed for the bottom 30 percent households makes use of the average monthly consumption expenditure of such households.

Figure A7.1.1 Willingness to Pay, Affordability, and Non-Essential Expenditures (Percent of Household Income)



In the lower panel of Table 1, willingness to pay, affordability, and expenditure on non-essential items are shown as a ratio to the household income (a graphic presentation is made in Figure A7.1.1). The willingness to pay for a private connection as a proportion of income is about 1.5 percent on an average. The affordable payment level is about 1.4 to 2.0 percent on an average. The expenditure on non-essential items as a proportion of total consumption expenditure (taken as a proxy for income) is about 2.6 percent on an average. As regards standposts, the willingness to pay as a portion of income is about 0.5 percent and affordability is 0.6 to 0.8 percent, on an average. The expenditure on non-essential items incurred by the bottom 30 percent households is 2.7 percent of their total consumption expenditure. Evidently, the estimates of willingness to pay and affordability are well within the amount that rural households spend on non-essential items.

Performance of States and Benchmark Indicators



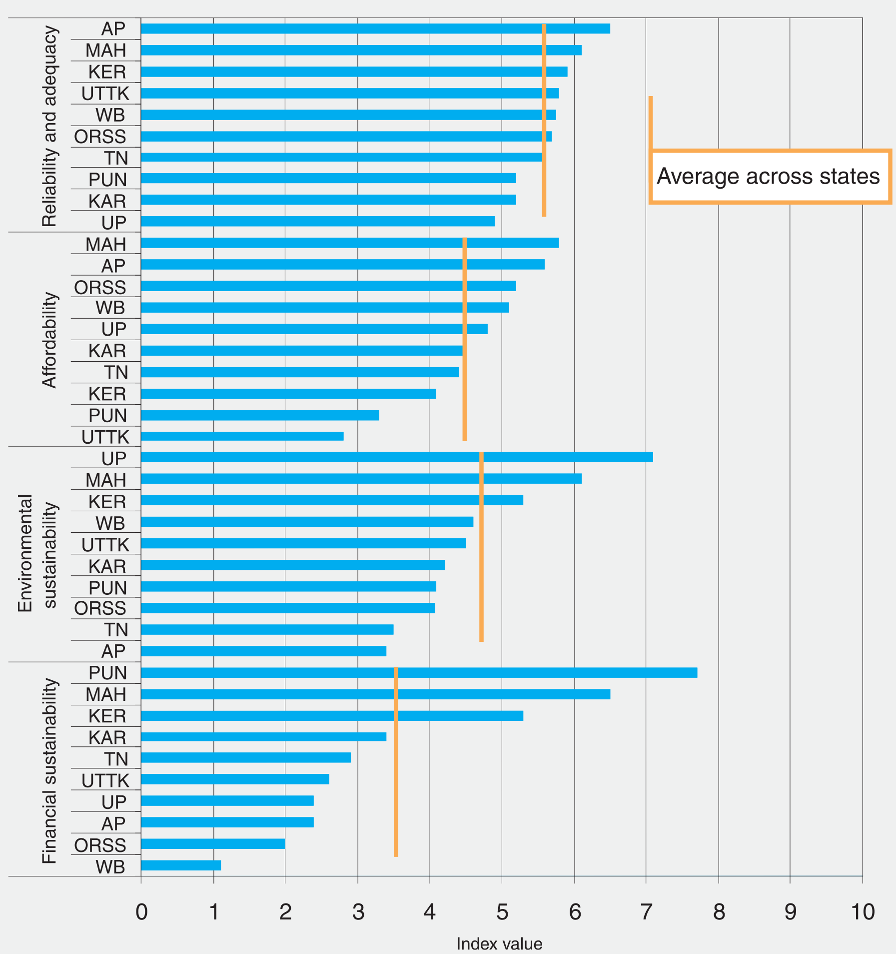
ANNEX 7.2

Annex 7.2

Performance of States and Benchmark Indicators

A state-wise comparison of the indices of effectiveness is presented in Figure A7.2.1. It is evident from the figure that the ranks of states differ from one index to another. Thus, some states are doing well in terms of one index, but their performance may not be as good in terms of another index. It is, therefore, not possible to come up with a general ranking of states in terms of effectiveness of water supply schemes. The best that can be done is to rank the states in terms of each of the four indices of effectiveness considered in the study.

Figure A7.2.1 Indices of Effectiveness, State-Wise Comparison



The index of reliability and adequacy does not show much variation across states. It is seen, however, that the value of the index for Andhra Pradesh, Maharashtra, Kerala, and Orissa exceeds the average across states. On the other hand, the index value for Punjab, Karnataka, and Uttar Pradesh are the lowest among the states, indicating that these states have a relatively worse performance. It should be pointed out that uniform procedure and criteria have been used for obtaining the scores and constructing the index of reliability and adequacy. In the ranking process, some states are bound to be ranked lower than others. The low ranking of states indicates that in some respects their performance is worse than the average performance across states. The rank is low for Punjab because the hours of supply per day is relatively low and the proportion of water requirement met by the scheme is also relatively low compared to the average across states. In the case of Karnataka, some of the reasons for low rank are fewer days of supply in a week in summer and a relatively high incidence of breakdowns. In the case of Uttar Pradesh, low water pressure and frequent breakdowns are some of the reasons for the low rank. The indices of affordability, and environmental and financial sustainability exhibit greater inter-state variation than the index of reliability and adequacy. In terms of affordability, Maharashtra, Andhra Pradesh, Orissa, West Bengal, and Uttar Pradesh have a relatively better performance, while Kerala, Punjab, and Uttarakhand are at the bottom. The performance of Uttar Pradesh, Maharashtra, and Kerala is better than the all-state average in terms of environmental sustainability, while Punjab, Andhra Pradesh, Orissa, and Tamil Nadu are the worst performers among the states covered in the study. Andhra Pradesh, Orissa, and Tamil Nadu perform poorly also in terms of financial sustainability. Two other states with relatively poor performance in terms of financial sustainability are Uttar Pradesh and Uttarakhand. West Bengal has the worst performance in terms of financial sustainability among the 10 states studied. In contrast, the financial sustainability of the water supply schemes is relatively much better in Punjab, Maharashtra, and Kerala. For all the four indices, the performance of Maharashtra is better than the average across states. Indeed, Maharashtra is among the top two states in each case. Thus, Maharashtra may be regarded at the best performing state among the 10 states covered in the study.

Benchmarking Rural Water Service Performance

A list of indicators[72] for benchmarking the performance of rural water supply service across states is given below. The data for these indicators could be obtained through a random sampling of representative schemes across the state. Separate information needs to be collected for single and multi village schemes.

List of Indicators

(Separate data required for single village and multi village schemes)

Reliability and Adequacy

Percent schemes supplying water as per design norms (design norm of 40 lpcd or more than 40 lpcd)
Percent schemes supplying daily (at least four hours of regular daily supply)
Percent schemes with households spending less than 30 minutes per day in collecting water
Percent schemes with no major breakdown in the past six months (a major breakdown defined as 'more than two days of disruption in water supply')
Percent schemes with good water quality: (i) no bacteriological contamination; (ii) no chemical problems of arsenic, fluoride, salinity

Financial Sustainability

Percent schemes with more than 80 percent O&M cost recovery
Percent schemes with more than 80 percent collection efficiency

Affordability

Water tariff for household connections as a ratio of rural per capita income
Water tariff for standpost users (shared connections) as a ratio of rural per capita income
Percent schemes with more than 50 percent household connections

Environmental Sustainability

Percent schemes with source providing more than 80 percent yield (as per design norms)

[72] This is a list of 'outcome'-related indicators on the performance of schemes. A similar list on the 'impact'-related indicators can be based on household surveys.

Acknowledgment

List of State Government Officials

Andhra Pradesh

Mr Munindra, Additional Secretary, Panchayati Raj Engineering Department (PRED)
Mr Muralikrishna, Executive Engineer, PRED
Mr Brahmananda Chary, Director, PRED

Karnataka

Mr V.P. Baligar, Principal Secretary, Panchayati Raj and Rural Development Department
Mr S.D. Meena, Principal Secretary, Karnataka Rural Water Supply and Sanitation Agency (KRWSSA)
Mr Rama Krishna, Deputy Director, Panchayati Raj and Rural Development Department

Kerala

Mr K.J. Mathew, Principal Secretary, Kerala Water Resources Department
Mr Jyothi Lal, ED, Karnataka Rural Water Supply and Sanitation Agency (KRWSSA)
Mr Joseph, Project Assistant, KRWSSA
Mr Satheesh, Finance Executive, KRWSSA

Maharashtra

Mr Sanjeev Kumar, Additional Secretary, Rural Water Supply and Sanitation Department
Mr M.V. Domkondwar, Member Secretary, Maharashtra Jeevan Pradhikaran

Orissa

Mr S.N. Tripathy, Commissioner, Department of RD
Mr Ananda Pattanaik, Chief Engineer, RWSS, Orissa

Punjab

Mr D.K. Bhasin, Senior Consultant, Punjab Rural Water Supply Department

Tamil Nadu

Mr E.D. Natesan, Engineering Director, TWAD Board
Mr Narasimha, Ex EN, TWAD Board

Uttar Pradesh

Mr K.K. Aggarwal, Managing Director, UP Jal Nigam
Mr Anil Srivastava, Secretary, UP Jal Nigam

Uttarakhand

Mr Gambhir Singh, Director, Swajal PMU
Mr V.K. Sinha, Additional Director, Swajal PMU

West Bengal

Mr Ashim Burman, Principal Secretary, PHED and Environment, Government of West Bengal
Mr Devesh Bhattacharya, Chief Engineer, Water Quality, PHED, Government of West Bengal
Mr Animesh Bhattacharjee, Chief Engineer, Computerization of Arsenic Data wing

Author and Task Manager: Smita Misra
(Sr. Economist, SASDU, World Bank)

Pictures by: Guy Stubbs/Water and Sanitation Program–South Asia

Created by: Write Media

Printed at: PS Press Services Pvt. Ltd.

The World Bank, New Delhi Office, 70 Lodi Estate, New Delhi 110 003, India
Tel: (91-11) 24617241, 24619491