Efficiency Evaluation of Urban Water Supply Utilities in India

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ABSTRACT

This paper attempts to explore the relative inefficiencies of the municipal water supply services in 147 urban centres of India with populations exceeding 100,000. The phenomenon of urbanisation and the recent liberalisation of economy have propelled the government to initiate reforms to improve the heavily burdened infrastructures. So far, the urban water supplies have been managed by the government, mostly through the urban local bodies (ULBs). One of the major thrust areas of the reforms programme is the induction of efficiency enhancement steps in ULBs for improvement of services. The current study was conduced to explore the relative inefficiencies in water supply operations and to evaluate the extent of financial savings, and the potential saving possible in the quantum of water lost hitherto as Unaccounted for Water (UFW).

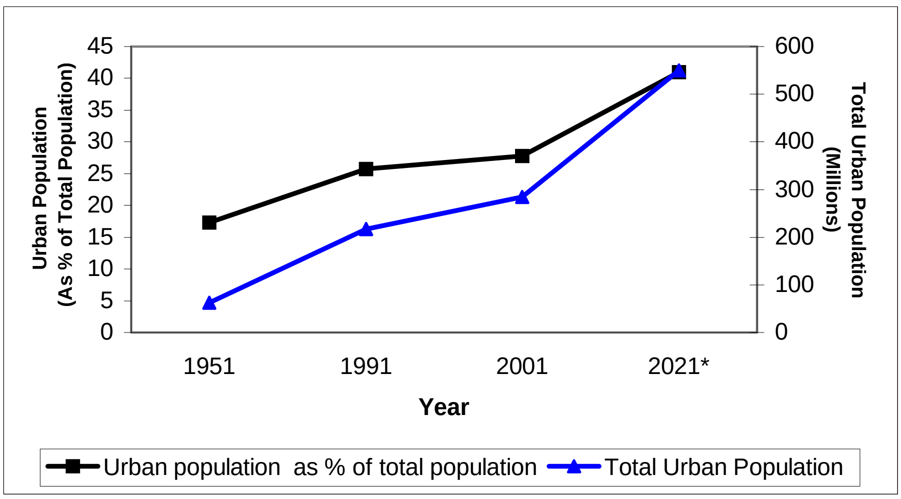
The performances of water supply utilities were evaluated using the non-parametric technique of Data Envelopment Analysis to compute the extent of relative technical inefficiencies. The efficiencies were computed for two models that employed Operating Expenditures and UFW as the input variables respectively. Performances of most water supply utilities were found sub-optimal, suggesting the existence of significant potential for cost and UFW reductions. The paper discusses the results in the context of related policy issues that can facilitate improvement of water supply services and develops a framework for applying DEA for efficiency evaluation of such services.

Keywords: relative inefficiencies, water supply services, performances, Data Envelopment Analysis, technical inefficiencies

1. The Indian Urban Water Supply Sector

India is increasingly facing the problem of rapid urbanization, a consequence of, rapid economic development in an otherwise traditional agrarian economy. In India, the share of urban areas in net domestic product has been on the rise: it was estimated to be 37.7 % in 1971, 41.1 % in 1981, and is estimated to rise to over 50 % by the year 2011 (HSMI, 2003). High productivity of urban areas is however, subject to the expansion and improvement of the urban infrastructure services.

The proportion of urban population in India as per the last census conducted is 27.78% (Census of India, 2001), although wide variations exist in interstate population distribution. For example, the states of Delhi and Pondicherry have nearly 93% and 66.6% of their populations categorized as urban, while Himachal Pradesh and Bihar have only 9.8% and 10.5% of their respective populations categorized as urban (Census of India, 2001). However, on an average, there has been a marked rise of urban population in India (Figure 1). The urban population is expected to rise to around 40% by 2020 (Planning Commission 2002a), and it is estimated that by 2025, more than fifty percent of the country's population will live in cities and towns (Planning Commission, 2002b). Coupled with this phenomenon of urbanization, there is also a trend towards concentration of urban population in a small number of large urban centers. The number of urban centers has doubled between 1901 and 1991, but the urban population has in the same period grown eight-fold, resulting in a "top-heavy urban hierarchy" (Planning Commission, 2002b). It is therefore certain that infrastructure services will have to grow proportionately to make up for the backlog as well as to cater to the future needs, constituting an unenviable task for the urban planners and policy makers.



*Projected figures

Figure 1. Population Growth Trends in Urban India

The demographic trends towards urbanization are accompanied by a change in the management and financing of urban development as a result of liberalization of the Indian economy in the recent years[1]. Decentralization of municipal governance has led to a substantial reduction in budgetary allocations for infrastructure development (Planning Commission, 2002c). Under the constitution of India, water supply is largely a state subject, and following the 74th Constitutional Amendment[2], the states assign the responsibility to the Urban Local Bodies (ULBs) for managing water supplies in urban areas. The Central government allocates funds and also ensures that funds are provided in the State budgets. States generally plan, design and execute water supply schemes (and often continue to operate) through their State Public Health Engineering Departments, Water Boards, and municipalities.

The entire water supply and sanitation programme has therefore so far been government managed, without an active participation of the private sector. To the government's credit, progressively larger allocations have been made for water supply and sanitation in the various Five Year Plans (Figure 2). However, these allocations fall short of what actually is required. The Central Public Health Environmental Engineering Organization (CPHEEO), has estimated the requirement of funds for 100% coverage of the urban population under safe water supply and sanitation services at Rs.1,729,050 Millions (Urban India, 2004) (Indian Rs 48=1US$). Finances of this magnitude are beyond the budgetary resources of Central, State and Local Governments, and it is increasingly being realized that new sources of resources for augmentation[3] and strengthening of services have to be explored. Such challenges have impelled the government of India to initiate institutional, fiscal and financial reforms in the sector (MoUD&PA, 2004).

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[1] The Indian economy has opened up and is following a course of liberalization and reforms in the recent times. It is therefore imperative that the infrastructure sector (which forms the core of all development) be made to grow to support the development, and Water sector being no exception, would have to grow to ensure sustainability. So far there has been a lot of stress on achieving reliable water qualities, but there has been virtually no effort on improving the water services as a whole.

[2] In India the 74th Constitutional Amendment, 1992 has now made it mandatory to establish strong decentralized democratically elected local bodies for urban areas to ensure "economic development and social justice". The Act delegated the primary responsibility for urban management to local governments, implying that the urban local bodies form critical parts of states' governance. However, implementation of the act has been rather slow.

[3] The Tenth Plan (Planning Commission, 2002c) envisages 100% coverage of rural and urban population with safe drinking water as per the stipulated norms and standards (40 lpcd of safe drinking water within a walking distance of 1.6 Kms or elevation difference of 100 meters in hilly areas, to be relaxed as per field conditions; at least one hand pump/spot source for every 250 persons).

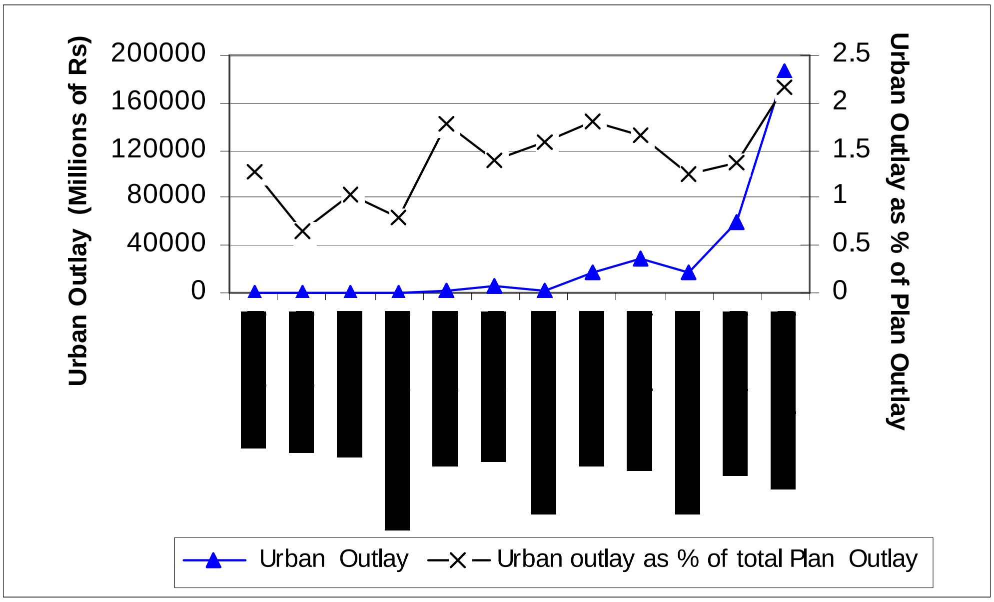

Figure 2. Urban Outlay for Water and Sanitation in various Plan documents of the Government of India (Source: Planning Commission, India)

One of the major thrust areas of this reforms programme is the induction of efficiency enhancement steps in ULBs. The problems of sustainability of water availability, maintenance of supply system and dealing with the issue of water quality are accorded as the major challenges in the National Eleventh Five Year Plan[4] (Planning Commission, 2007).The solution to water supply problem in India has traditionally been related to capacity addition or quality improvement, rather than improvements in service efficiencies of the existing services. Efficient operation of existing water supply schemes is a theoretical first step in any move to make the schemes operate in a viable fashion. Such internal efficiency measures may incorporate increasing the availability of water, and reducing the operational expenditures. Since the low quality of service is the single biggest obstacle to the levy of reasonable user charges, efficient operation will also help improve acceptability of higher user charges. It is also being realized that for accessing financial resources from the market and for induction of private sector, the urban water supply utilities have to be made creditworthy and efficient. In short, therefore, the performances of the sector need to be analyzed to bring about improvements in the water supply services.

[4] Indian economy is planned every 5 years, and currently, the XI five-year plan is just about to take off.

The present paper therefore explores the inefficiencies prevalent in the Indian water supply utilities and presents an evaluation of the potential of efficiency improvements possible in urban centres of India. The study seeks to answer the following specific issues:

1. How DEA can be applied for evaluating the performances of water supply services?
2. What is the quantum and extent of inefficiencies in water supply operations for major cities in India?
3. What is the extent of financial savings possible if inefficiencies are mitigated?
4. What is the potential for saving the quantum of water lost hitherto as Unaccounted for Water (UFW)? What are the specific issues that are vital to the reduction of losses?
5. What are the policy implications of the findings of the study?

The paper has been organized as follows: After an overview of the Indian water supply sector and establishment of the need for exploring the inefficiencies of water supply utilities in the Introductory section 1, a brief survey of the literature relevant to efficiency evaluation studies in the water supply sector has been presented in Section 2. The methodology for the study has been detailed in Section 3, which also includes a sub-section on choice of variables for the study. Section 4 presents the results of the data analysis, followed by a discussion on UFWs. This section further details the efficiency analysis performed by employing Data Envelopment Analysis (DEA) models to evaluate the Indian water supply utilities. A concluding section 5 follows the results of the study, along with a brief discussion on policy implications of the study.

2. State of the Literature: DEA based efficiency analysis in the water supply sector

Despite the fact that over the last two decades there has been increasing interest in assessing productivities and efficiencies of water and wastewater services for evolving optimal structures for the water supply and wastewater industries (Abbot and Cohen, In press), the efficiency measurement studies have been "relatively scarce" in the water and sewage sector (Tupper and Resende. 2004), and only a few of these have been conducted in the sector by employing DEA. One of the first studies was undertaken by Sawkins and Accam (1994), on the Scottish Water industry and provided some initial guidelines on the likely choice of input and output variables. Cubbin and Tzanidakis

(1998), made a discussion on the use of comparative efficiency exercises of regulating utilities by employing Regression analysis and DEA, and applied the methodologies for the England and Welsh water industry. Thanassoulis (2000a and 2000b) published a series of two essentially very similar articles. The first of the articles spelled out theory and methodology of application of DEA in the regulation of UK water distribution utilities and concentrated again on use of DEA by the regulator of water companies in England and Wales in 1994 in the context of setting price limits, while the second paper again spelled out the details of DEA and its use in the regulation of (English and Welsh) Water companies. The use of DEA was thus far limited to the regulation of water companies in the UK and illustrated the evolution of water services on commercial and business lines in UK and the acceptance of water supply as an industry in UK in comparison to the rest of the world.

Outside UK, DEA was employed for developing a yardstick competition model for Portuguese water and sewerage services regulation (Marques, 2006). Regulatory issues in the Brazilian Water and Sewage sectors were analyzed and explored by employing DEA for efficiency evolution by Tupper and Resende (2004), and Maria Luisa Corton and Sanford V. Berg (In Press) have conducted a study for the efficiency analysis of water service providers in six countries in the Central American region. DEA was employed in Asia for evaluating the efficiencies of 108 water supply service entities in the Kanto region of Japan (Aida et al, 1998). However, no DEA based efficiency evaluation study seems to have been reported from developing parts of Asia yet. Similarly the other problem region of the world, Africa seems to have missed out completely any study on evaluating water supply services with the sole exception of a study by Akosa et al (1995) that evaluated DEA based efficiency scores for 10 water supply and sanitation projects with the sample utilities comprising a variety of differing functions in Ghana.

DEA based efficiency evaluation studies have thus been very rare in the developing countries, primarily because of lack of appropriate database on the performances of water supply services and also because the water supplies are yet to take on the form of an industry that would have needed management on business lines for improvement of operational efficiencies and effect savings.

3. Methodology

3.1 Data Envelopment Analysis For Benchmarking Utilities

DEA is a multi-factor productivity analysis for measuring the relative efficiencies of a homogenous set of decision-making units (DMUs), and can be applied to analyze multiple outputs and multiple inputs without pre-assigning weights and without imposing any functional form on the relationships between variables. There are a number of DEA models and modifications that exist. For water utilities, input quantities act as decision variables that need minimization as the output is often fixed. Hence, the DEA models discussed below have an input orientation.

3.1.1 The CCR Model

This model was suggested by Charnes, Cooper and Rhodes (1978) (hence the CCR model), and built on the idea of Farrell (1957) which is concerned with the estimation of technical efficiency and efficient frontiers. This model assumes a constant return to scale assumption.

The efficiency score in the presence of multiple input and output factors is defined as:

Efficiency = weighted sum of outputs/weighted sum of inputs (1)

Assuming that the chosen sample has z utilities (called Decision Making Units (DMUs) in the popular DEA terminology), each with *m* inputs and *n* outputs, the relative efficiency score of a test DMU *p* is obtained by solving the following model proposed by Charnes et al. (1978):

$$\begin{aligned} \max \quad & \sum_{k=1}^{n} v_k y_{kp} / \sum_{j=1}^{m} u_j x_{jp} \\ s.t. \quad & \sum_{k=1}^{n} v_k y_{ki} / \sum_{j=1}^{m} u_j x_{ji} \le 1 \quad \forall i \\ & u_{j,} v_k \ge 0 \quad \forall j, k \end{aligned} \qquad (2)$$

where

$i = 1$ to z,

$j = 1$ to m,

$k = 1$ to n,

y_{ki} = amount of output k produced by DMU i,
x_{ji} = amount of input j utilized by DMU i,
v_k = weight given to output k,
u_j = weight given to input j.

The fractional program in (2) is subsequently converted to a linear programming format and a mathematical dual is employed as shown in (3), to solve the linear problem. The dual is required as it reduces the number of constraints from z+m+n+1 in the primal to m+n in the dual; thereby, rendering the linear problem easier to solve. Charnes et al. (1978) spell this model development and can be referred for greater details.

$$\begin{aligned} &\min_{\theta,\lambda} \theta \\ &s.t. \quad \theta x_{jp} - \sum_{i=1}^{z} \lambda_i x_{ji} \geq 0 \quad \forall j \\ &\qquad -y_{kp} + \sum_{i=1}^{z} \lambda_i y_{ki} \geq 0 \quad \forall k \\ &\qquad \lambda_i \geq 0 \quad \forall i \end{aligned} \qquad (3)$$

where,
θ = efficiency score, and
λ_i = dual variables (weights in the dual model for the inputs and outputs of the z DMUs).

The above problem is run z times in identifying the relative efficiency scores of all the DMUs, and values of θ (efficiency score), and λ_i (weights in the dual model for the inputs and outputs) are computed. The weights obtained show the target utility in the most favorable mode. The linear program is to be solved for each individual DMU in the sample. The method creates a frontier using information on the assumed most efficient utilities and measures the efficiency relative to the rest of the utilities. DEA attempts to approximate the efficient frontier by a ‘‘piece-wise’’ linear approximation based on the sample. Efficiency scores are constructed by measuring how far a utility is from the frontier. A test DMU is considered inefficient if a composite DMU (defined as linear combination of units in the set) can be identified which utilizes less input than the test DMU while maintaining the same or greater output levels. In general, a DMU is efficient if it obtains a score of 1; while a score of less than 1 indicates that it is inefficient. Koopmans (1951) provided a more comprehensive definition of efficiency:

A DMU is efficient if it operates on the frontier and also has zero associated slacks. The units involved in the construction of the composite DMU can then be utilized as benchmarks for the inefficient test DMU. The technique also computes the input and output refinements that would turn an inefficient unit into an efficient one.

3.1.2 The BCC Model

When the utilities do not perform at optimal scales, this model can be modified to account for variable return to scale conditions as shown by Banker, Charnes and Cooper (1984) (hence the BCC model), by adding a convexity constraint. This BCC model relaxes the constant returns to scale assumption of the CCR model. This model employs the same equation as employed in the CCR model, with the modification that a convexity constraint is now added to equation (3) as shown in equation (4).

$$
\begin{aligned}
&\min_{\theta,\lambda} \theta \\
&s.t. \quad \theta x_{jp} - \sum_{i=1}^{z} \lambda_i x_{ji} \geq 0 \quad \forall j \\
&\qquad -y_{kp} + \sum_{i=1}^{z} \lambda_i y_{ki} \geq 0 \quad \forall k \\
&\qquad \sum_{i=1}^{z} \lambda_i = 1 \\
&\qquad \lambda_i \geq 0 \quad \forall i
\end{aligned}
\tag{4}
$$

In addition of efficiency score the DEA also allows for computing reference unit for inefficient DMUs and the necessary improvements required in the inefficient unit's inputs and outputs to make it efficient. It should be noted that DEA is primarily a diagnostic tool and does not prescribe any reengineering strategies to make inefficient units efficient. Such improvement strategies must be studied and implemented by managers by understanding the operations of the efficient units.

3.2 Selection of Inputs and Outputs

Selection of input and output variables comprises one of the most important exploratory tasks of carrying out a benchmarking analysis. The choice of variables depends on not just the choice of methodology and technical requirements of the chosen model, but also on data availability and its quality, as well as on countries' own socio-economic structure. No universally applicable rational framework is available for selection of variables.

Thanassoulis (2000a; 2000b) had, while using the factors identified by OFWAT to best explain the OPEX for water companies had carried out an analysis to identify the input-output factors for DEA assessment. The author then found that the set {Properties, Length of Main, and Water Delivered} constituted a fairer selection of company efficiencies. The factor "Properties" was represented by the number of connections that a company served. In line with this finding, the present study employed the same outputs for the DEA Models (Table 1).

Table 1 List of DEA Inputs and Outputs as Employed in the Current Study

	Inputs	Outputs
Model 1	1. OPEX (Millions of Rs. /year) (Note: 48 Indian Rs =1US$)	1. Number of Connections 2. Length of Distribution Network (Kms) 3. Water Supplied (mld)
Model 2	1. UFW (mld)	1. Number of Connections 2. Length of Distribution Network (Kms) 3. Water Supplied (mld)

For both the Models, same set of outputs was employed. While the number of connections reflected the reach of the services to the consumers, the network lengths were used as an indicator of the geographical dispersion of the consumer base, and the water supplied reflected the level of service provided to a given population in the city.
In Model 1, the operating expenditure (OPEX) was chosen as the input variable. In line with the analysis of Cubbin and Tzanidakis (1998), the OPEX was adjusted by subtracting a number of items largely outside the control of the water utilities. These items included the depreciation costs, abstraction charges and pumping costs.

In the Model 2, it was endeavored to explore the potential for reduction of UFW[5], a variable that is considered "a good proxy for the overall efficiency of operation of a water utility" and comprises "a major concern about the operations of a utility" (Yepes and Dianderas, 1996). The UFW levels therefore, reflect the productivity levels of a utility, and form an input variable under Model 2.

[5]UFW is the difference between the water delivered to the network and the water sold, and includes the "physical losses" (pipe leaks and overflows), and the "commercial losses" (unpaid bills, illegal connections, and legal uses that go unbilled (example, fire-fighting) (Yepes and Dianderas, 1996).

4. Data Analysis: Results and Discussion

The analysis was performed for a total of 147 Indian water supply utilities that were analyzed for the analysis in model 1, while information on UFW was available for 82 of these utilities for analysis under the model 2. The data used was obtained from the Ministry of Urban Development, India (NIUA, 2005).

Preliminary Data Exploration

In all 147 water supply utilities with populations more than 0.1 Million were analysed for calculating the efficiencies. The sample characteristics are presented in Table 2. The difference in size between utilities is large, as revealed by the last two columns of Table 2. For UFW, the descriptive statistics is presented for 82 water supply utilities due to constraint of data availability.

Table 2. Sample Characteristics

	Average	Median	Standard Deviation	Minimum	Maximum
OPEX Rs Millions	78.98	12.48	357.78	0.403	3765.70
Number of water supply connections	51721.01	19800	120837.3	293	1350000
Length of distribution network km	484.59	200	884.9241	6	7906
Total Water Produced mld	123.52	29.55	345.8164	0.68	2978
UFW (mld)*	41.74	7.57	104.43	0.29	675

*Based on data for 82 utilities

4.1.2 A Discussion on the Significance of UFWs

In the present sample, out of the 147 utilities, only 82 utilities reported UFW estimates. The maximum loss was reported as 47.62%, while none if the utilities reported losses less than 10% (Figure 3). The sample mean for UFW was 20.18%, a value too high when compared with average UFWs of 6% in Singapore, 11% in Japan, 12% in USA and 15% in France (Yepes and Dianderas, 1996).

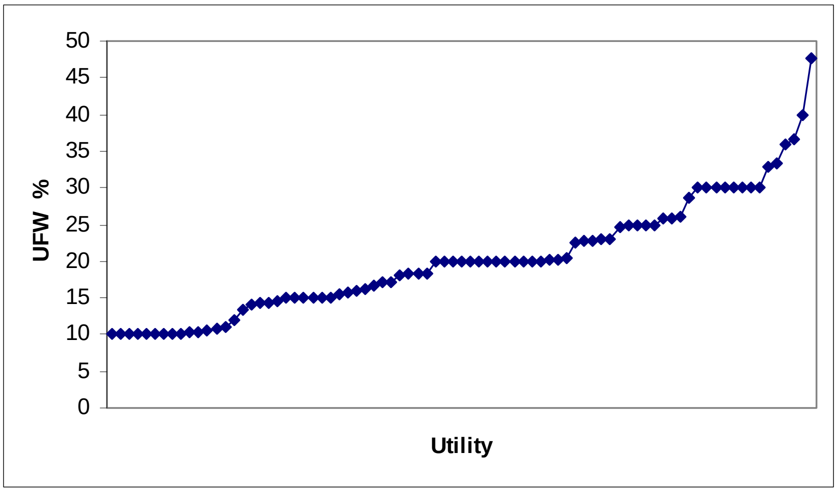

Figure 3. UFW levels in the reporting Utilities

Tynan and Kingdom (2002) had carried out a review of performance for 123 utilities of varying sizes across 44 developing countries, and had recommended a target for unaccounted-for water of less than 23% for the developing countries based on the performance of the top 25 % of developing country utilities. This target was exceeded by as many as 24 utilities in the present case.

These high levels of officially reported unaccounted-for waters represent a crude measure of asset maintenance, and indicate poor system management and poor commercial practices as well as inadequate pipeline maintenance. It is therefore appropriate that in countries like India, UFW be regarded as a critical indicator to reflect the productivity levels of a utility, and efficiencies of utilities be measured with respect to the UFWs. Model 2 discusses the results obtained with respect to the DEA based analysis in terms of UFW as an input that needs to be minimized.

This is of special significance in India as the government policy now accords emphasis on reduction of UFWs to reduce the associated costs and increase the availability of water[6].

Application of DEA

DEA was used to set benchmarks based on the comparison of the operations of water supply services. An input-oriented approach was chosen since the objective of the analysis was to suggest benchmarks to enable cost and UFW reductions in order to produce a given output.

Evaluation of Inefficiencies

Both the CCR and the BCC formulations were applied to the two models for which variables were chosen as depicted in Table 1.

4.2.1.1 Model 1

To increase the validity of the proposed model, the assumption of the "isotonocity" relationship was examined amongst the input and output variables using correlations. Table 3 represents the statistical R-Matrix for model 1. The results indicate that the

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[6] "*Maximum emphasis should be placed on* restoration of designed capacity and achievement of full capacity utilization, *leakage detection and remedial action, because it will prevent wastage, reduce costs and increase availability...*"(Planning Commission, 2002c) (Emphasis added by author)

variables do not violate the isotonicity assumption. The values of correlation coefficients indicates that the variables are reasonably correlated: neither too less of correlation nor too high a correlation that would otherwise make it difficult to determine the unique contribution of a variable to the analysis.

Table 3. Correlation coefficients (Pearson Correlation): Model 1

Variable	OPEX	Number of Connections	Network length	Water Produced
OPEX	1.000			
Number of Connections	.916	1.000		
Network length	.822	.852	1.000	
Water Produced	.877	.762	.818	1.000

DEA was applied and the efficiency scores for various utilities were computed using both the CCR and the BCC formulations (Figure 4). The sample mean efficiency was found to be only 28.3% and 40% under the two formulations, indicating that the utilities are quite inefficient compared to the best practices. In fact, in the CCR formulation, as many as 24 utilities had efficiencies below 10%, while very few utilities exceed 60% efficiency scores. As the Table 4 indicates, the majority of utilities (92% and 72% respectively for the CCR and BCC formulations) had efficiency scores below 50%.

Table 4. Distribution of Efficiency Scores

	Model 1		Model 2	
Efficiency Range	Number of CCR utilities	Number of BCC utilities	Number of CCR utilities	Number of BCC utilities
0-25%	106	60	4	2
25-50%	29	46	41	28
50-75%	9	21	17	24
75-100%	1	7	16	15
100%	2	13	4	13

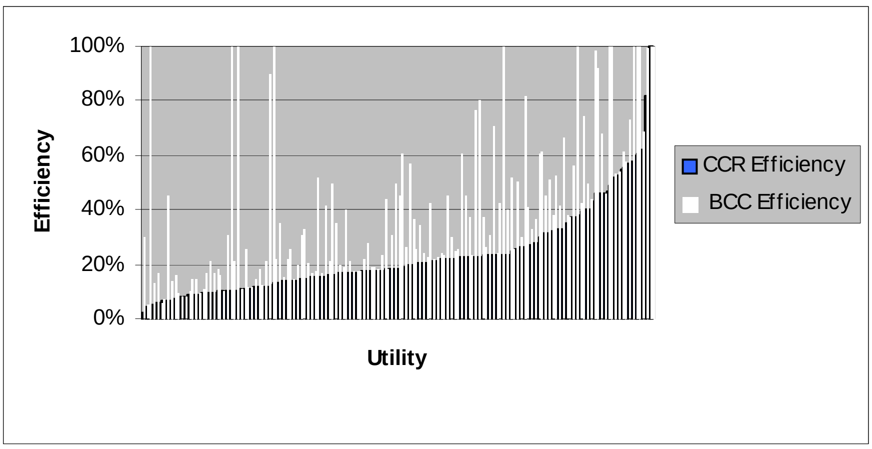

Figure 4. Efficiency variations in the two formulations under Model 1

4.2.1.2 Model 2

Table 5 lists the correlation coefficients between the various variables, and the results indicate the presence of a substantive relationship between the variables, with all coefficients exceeding a value of 0.75.In particular, strong relationship was evident between the variables UFW and Water produced.

Table 5. Correlation coefficients (Pearson Correlation): Model 2

	UFW	Number of Connections	Network length	Water Produced
UFW	1.000			
Number of Connections	.812	1.000		
Network length	.867	.865	1.000	
Water Produced	.978	.752	.825	1.000

The DEA mean efficiencies were computed as 54.5% and 65.5% respectively under the CCR and the BCC formulations, indicating once again that the utilities are largely inefficient. In fact, as the Table 4 indicates, the majority of utilities had efficiencies of less than 50% for the CCR formulation (Figure 5).

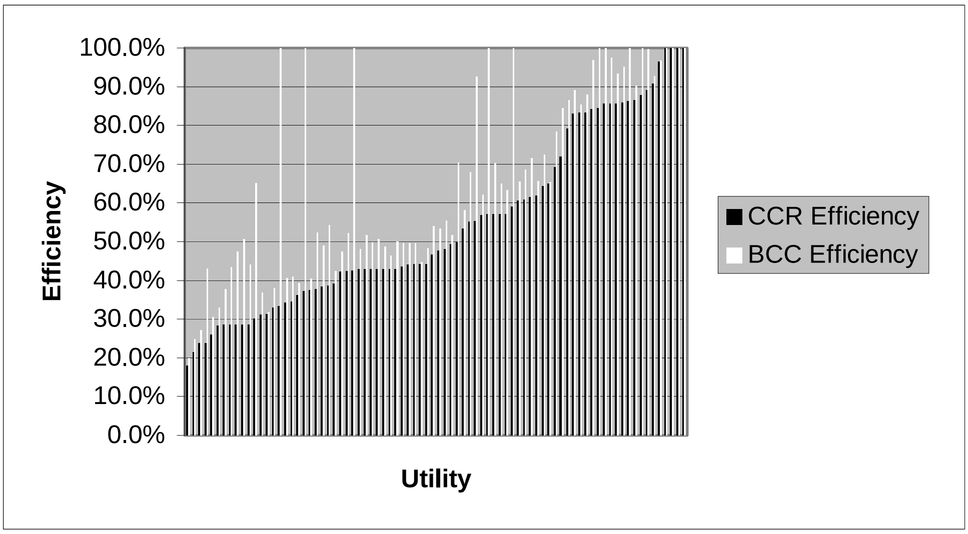

Figure 5. Efficiency variations in the two formulations under Model 2

4.2.2 Estimation of Potential Savings

Table 6 provides an exhaustive decomposition of potential savings in the water supply sector summed over all the sample utilities. The Table demonstrates the necessity for induction of efficiency in the urban water supply services in India.

Table 6. Excess Inputs in the Water supply utilities in the Indian Cities

	Input	CCR formulation	BCC formulation
Model 1	OPEX, Millions of Rs.	10481	3393
	Estimated % Savings	90.3%	29.2%
Model 2	UFW mld	2107.58	887.48
	Estimated %Savings	66.8%	28.1%
	Savings as % of water produced	13.9%	5.9%

In model 1, it is theoretically possible to save nearly Rs. 3393 Million in the short run, and this constitutes as much as 29.2% of the total cost. Analysis of Model 2 indicates that it is possible to theoretically save 28.1% of the total quantum of water currently being wasted as UFW. Microanalysis of individual utilities would be required to identify the potential areas that would need to be addressed in order to realize these potential savings.

Given the model inadequacies and the field constraints and requirements, these savings may actually be notional and may be less in reality. But one must consider the fact that these potential savings are with respect to the Indian best practices, which may themselves be lagging behind the international best practices. Hence, the actual scope for enhancing efficiencies in the Indian water supply services may be substantially large, and if realized, the resultant savings and finances may be harnessed to expand services and to invest in O&M, resulting in incremental increase of efficiencies and savings. It is therefore, necessary for the inefficient utilities to imitate the appropriate best practices.

It must be noted that much higher level of input savings seem to occur in the CCR formulations (Table 6), in comparison to the respective BCC formulations, since the former includes an additional scale element in efficiency computations. Achieving optimal scales of operations may be beyond a utility's control in the short-term, and to be fair to the utility managers and administrators, the policy makers must design incentives based on the BCC model as in the short term it is only possible to effect savings based on BCC model. Clearly, the ground realities may actually force even lesser savings for UFWs. However, the diagnostic results clearly reveal the existence of the potential for efficiency induction through curtailment of UFWs in the Indian urban water supply sector and the policy-makers and planners must conduct micro-level diagnostic investigation for identifying the methods and choices for reduction of losses.

5. Policy Implications and Concluding Remarks

The present study attempts to evaluate the efficiencies in water supply utilities for 147 urban centers in India with populations exceeding 0.1 Million, by employing a non-parametric frontier analysis using DEA. Two specific models were used in the analysis.

The results of the efficiency analysis by employing a DEA study clearly indicate large inefficiencies both in terms of financial (operating expenditures) and technical (UFW) analysis; a vast majority of the water supply utilities do not seem to be operating at the minimum level of resource input. The results of the study also indicate that significant potential exists for effecting savings if operational expenditures and UFWs are managed prudently. Such savings are estimated to be in the range of Rs. 3393 Million, implying a 29.2% potential in curtailment of current expenses, while it is possible to save 28.1% of the water currently lost as UFW.

It must be pointed out here that the actual potential for curtailment of UFWs in reality might even be notional, particularly in the developing country context where reduction of UFWs necessarily involve not just financial and engineering solutions to reducing the pipe leakages, but include a host of sensitive issues that have socio-economic and socio-political ramifications originating from the concerns that comprise the challenge of providing water to all, and removal of unauthorised connections including those by the poor who may not be able to pay for the services rendered to them. Reductions of UFW necessarily involve political and administrative decisions and long term commitment to reforms to disconnect the large unauthorized connections, and to serve the slum communities where bills may not be paid. The present legal and regulatory framework is however, abysmally inadequate to support such measures.

It should be noted that DEA is primarily a diagnostic tool and does not prescribe any reengineering strategies to make inefficient units efficient. Such improvement strategies must be studied and implemented by managers by understanding the operations of the efficient units and formulated by micro-analysing expenses and UFWs at the individual utility level. However, to improve the overall sector performances, a number of measures might be taken. The degree of competition in at least those parts of water supply services that are not strictly monopolistic (such as the meter reading and billing services) could be explored and some public–private linkages may be evolved as an initial step to an eventual commercialization of the sector. Adoption of efficiency benchmarks may be accepted by utilities on their own and the process would be greatly reinforced if an independent regulatory regime is established and made functional. Creation of a regulator, however, is largely, a policy issue that needs immediate attention. An institutional regulatory basis and transparent governance mechanisms for acceptance of performance benchmarks is necessarily required for a country like India where political considerations have impelled non-transparent and distorted economic signals for the service provider as well as for the consumers.

The present study also underscores the need for a rigorous and in-depth study of performance of the overall water supply sector in India, and assumes special significance in view of the government of India's policy of "concerted action to improve the performance of the water supply utilities in the public sphere" (Planning Commission, 2002c). Such an analysis may offer valuable cues to the policy makers, planners and to the utility managers to ensure that the utilities demonstrate sustainable operational practices. Based on the efficiency analysis, design of appropriate incentive measures would also certainly encourage the adoption of best practices for overall improvements in service delivery of the water supply utilities. Any savings can help reduce the State budgetary support, and the government can use such studies for resource allocation based on a transparent regime that encourages the utilities that exhibit efficiency gains.

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