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Performance Evaluation of Urban Local Governments: A Case for Indian Cities

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Performance Evaluation of Urban Local Governments: A Case for Indian Cities[1]

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Abstract

The paper assesses the performances of the urban local bodies in the state of Karnataka in India.We use non parametric Data Envelopment Analysis as a tool to measure technical efficiencies of the ULBs. If we compare the services in a particular size class of city with the norms we find that in the smallest size class it is water supply which has the minimum shortfall from norms, in the medium size cities it is road density which is closest to the norms and in the largest city size class it is the solid waste management which performs the best with zero shortfall from norms. On an average for all the services there is a shortage of 57 per cent of the ONM expenditure norms, the shortage being the highest (64 per cent) in the biggest size class of cities. If we compare across size classes we find that bigger cities have on an average higher proportions of ONM expenditures while both salary and establishment components show higher proportions in smaller cities. This is indicative to the fact that bigger cities are incurring more productive expenses than the smaller ones. We find that the overall average collection efficiency of property taxes is only 62 per cent which is the lowest in the smallest size class and the highest in the medium size class with little variation across cities. We find that only 27.5 per cent of the ONM expenditure requirements can be fulfilled by the own revenues once the potential for the latter is fully realised. This proportion is higher in bigger cities with moderately high variation across cities. As far as the ONM cost coverage is concerned we find that on an average the ULBs in Karnataka can finance 50 per cent of the ONM costs on basic services through their own revenues with a very high variation in the proportions across cites. We find that the ULBs on an average can reduce 27 per cent of their expenditures on ONM, labor and establishment to provide the same levels of services provided currently by them. We also find that there can be additional savings particularly on establishment and labor expenditures to operate at the maximum efficiency levels. We find that the extent of problem of unproductive spending and under-provision of services is more pronounced in smaller cities.

[1] The author would like to thank Mac Arthur Foundation for the Award of Grant to undertake this research. The author is grateful to Enid Slack for her detailed comments on an earlier draft of the paper. A part of the work was done when the author was a Visiting Fellow in Institute for Municipal Finance and Governance (IMFG), Munk School of Global Affairs, University of Toronto during February-May, 2012. The author would like to thank the IMFG team for the logistic support provided during her stay. The author would also like to thank the Directorate of Municipal Administration, Karnataka for the help and co-operation needed in data collection and several rounds of data cleaning. However the usual disclaimer applies.

1 Introduction

Urbanisation is mostly a post globalization phenomenon in the developing countries. A change in many Asian countries was visible during the 1990s with a shift of focus in national policies that linked urbanization to economic growth. This came with a recognition that economic growth required links between national and global economies and that this could be achieved through urban development. Subsequently, many Asian countries have explicitly or implicitly promoted urbanisation.

It is surprising that urbanization in Asia has been a much slower process than in most of the rest of the world. This is attributed to a set of factors pertaining to the problems of defining an area as purely urban in a transitional economy where the rural base dominates for ages. South Asia, in comparison with Asia's other sub-regions, lags behind in the level of urbanization. In many South Asian countries, where urbanization levels are low compared with other sub-regions, natural increase has accounted for the bulk of urban growth in recent decades. However, in the South and South-West Asia, urban areas account for 33 per cent of the total population and 76 per cent of the sub-region's gross domestic product[2].

Seven of the ten most populous cities of the world are in Asia, including Tokyo, Delhi, Mumbai, Shanghai, Kolkata, Dhaka and Karachi. Many of these mega-cities have grown initially on urban-based manufacturing industries, and later on the services sector. Many mega-cities are also the seats of power, either political power as national capitals or as major economic or financial centres.

60 per cent of Asia's urban population lives in urban areas with populations under one million. Small and medium sized towns serve as local 'economic growth centres', i.e., markets for rural products and urban services. All the categories, the bigger, medium and small cities, lack adequate infrastructure and services – unpaved roads, inadequate water supply and sanitation, untreated garbage, poor telephone and Internet connectivity, and erratic power supply being common in most south Asian cities, conditions being a bit better in bigger cities. But often bigger cities are more

[2] UN-ESCAP, UN HABITAT 2010.The State of Asian Cities 2010/11

constrained as far as financing the needs are concerned. The decentralization policies in these cities are encouraged to tackle these problems.

Challenges for infrastructure policy and investment in South Asia are discussed widely in the policy literature. The context is one in which the major economies (led by China and more recently India) have enjoyed increasingly rapid growth accompanied by substantial reductions in poverty. Infrastructure investment has played an important part in this growth, but the increasing demands related to growth have also highlighted shortfalls in the quantity and quality of infrastructure and this is increasingly seen as a binding constraint on accelerating growth further, particularly in India (Rao and Bird, 2010, 2011).

Urban infrastructure services are heavily supply-constrained, as is well known, mainly owing to serious lack of resources available to finance them. Recent analysis by the Planning Commission of India shows that 34 per cent of urban households do not have water taps within their premises, 26 per cent of them do not have toilets, 70 per cent of waste is not treated before disposal, and untreated sewerage and unregulated discharge from industries is a major source of water pollution.

Even the Zakaria Committee norms, formulated in 1963, are not satisfied in most of the Indian cities. Mohanty *et al* (2007) found that on an average for the period 1999-2000 to 2003-04 actual spending in 30 large municipal corporations in India is only about 24 per cent of the requirements established by the Zakaria Committee. While there was considerable variability in the sample, the extent of 'under spending' on urban services was over 75 per cent in 17 municipal corporations, and indeed over 50 per cent in all of them except for three: Pune (31.6 per cent), Nagpur (30.8 per cent), and Nasik (35.5 per cent). At the other extreme, spending in the Patna Municipal Corporation was estimated to be only 5.6 per cent of the normative requirement, and the shortfall was over 90 per cent in almost all municipal corporations in the poorest States of Uttar Pradesh and Bihar.

Ramanathan and Dasgupta (2009) estimates cumulative capital investment requirements for providing services at 2007 prices for the period 2006-2031 at Rs. 71,251 billion and O&M requirements at Rs. 10,031 billion. This works out to an annual average of Rs. 3,251 billion or about 25 per cent of the consolidated revenue receipts of the Centre and States.

Various ways of augmenting the resources of the municipal bodies in the country, including essential reforms in the property tax system and adequate exploitation of user charges and fees for various services delivered as well as ways of strengthening and improving central and state transfers to urban local governments, are explored in Rao and Bird (2010, 2011). With respect to financing urban infrastructure, judicious use of development charges and effective collections from public lands are recommended in general. In addition, development of the municipal bond market is also advocated for financing capital expenditures.

A recent study on the urban local bodies in the state of Jharkhand (Bandyopadhyay 2011) based on Ramanathan and Dasgupta (2009) norms estimates that the actual revenue expenditures can cover only 41 per cent of the revenue expenditures requirements. Actual capital expenditures can cover 3 per cent of the capital expenditure requirements on urban services.

Studies have attempted to provide empirical estimations of underutilization of revenue potentials. Bandyopadhyay and Rao (2009) in their study on five major agglomerations in India viz. Kolkata, Delhi, Chennai, Pune and Hyderabad which constitutes 15 per cent of India's total urban population finds that all the agglomerations have unutilized potential for revenue generation. The potential for the central cities of the agglomerations are estimated to be 79 per cent more than the actuals while the smaller ULBs in the agglomerations are estimated to have 25 per cent more. Bandyopadhyay (2011) estimates the total revenue potential for ULBs in the state of Jharkhand to be 77 per cent more than what is actually generated in the ULBs of the state. Another study (NIPFP 2009) based on 36 large municipal corporations all over India, each with a population of more than 1 million, accounting for 35 per cent of the urban population in the country shows that property tax potential can be estimated to constitute between 0.16 and 0.24 per cent of the country's GDP. The study pointed out that there remains huge untapped revenues on account of property tax in the country and to improve the situation, states should focus on improving coverage and collection efficiency. Property tax revenues could increase to an extent of three times as high as the present collections by bringing all cities to an 85 per cent coverage level from an average coverage ratio of 56 per cent and 85 per cent collection efficiency from an average collection efficiency of 37 per cent.

Bandyopadhyay and Rao (2009) also estimates the fiscal gaps for five major agglomerations in India. The main findings suggest that, except for five small urban local bodies in Hyderabad, the others are not in a position to cover their expenditure needs by their present revenue collections. All the agglomerations have unutilized potential for revenue generation; however, with the exception of Hyderabad, they would fail to cover their expenditure needs even if they realize their revenue potential. Excepting Chennai, larger corporations are more constrained than smaller urban local bodies.

From the above discussion it is clear that while there have been some sporadic efforts on the estimation of revenue potential for Indian cities, their expenditure needs and fiscal gaps, extensive research needs to be undertaken focusing on service delivery, which is totally ignored as far as studies at the local levels are concerned. In this study we choose Karnataka which is one of the better performing states in India to have a detailed analysis. The main reason for choosing Karnataka is that the state is one of the pioneers in undertaking the Service Level Benchmarking exercise mandated by the Ministry of Urban Development of India as a special drive on tackling poor service delivery conditions in Indian cities.

The main objective of the study is three fold. First, we review in detail the service delivery scenario in the cities of Karnataka, to estimate the shortfall in physical levels of services and their operations and maintenance (ONM) expenditures from the physical and financial norms respectively which are prescribed for Indian cities. Some estimations of ONM expenditure requirements are also attempted. Second, we analyse the sources of own revenues and the revenue expenditures in the cities and estimate the shortfall of resources to assess the extent of self reliance in the cities, that is to see how far the own revenues can cover the revenue expenditures. Some estimations of own revenue capacities are also attempted. Third, we attempt to judge the performance of the cities taking the service provisions as the outcomes with the resources used by them in an integrated framework and pinpoint some possible sources of mis-utilisation of resources.

In what follows we would like to give a brief introduction to the urban sector in the state of Karnataka in section 2; section 3 spells out the main services and the related issues, Section 4 is on finances focusing on local revenues and revenue expenditures; section 5 would bring in the service delivery and the finances together to build up a model to assess the performance of the ULBs through their efficiency scores in different size classes, Section 6 gives the concluding remarks.

2. The Cities in Karnataka

Indicators (median values) from the census data are derived for each category of ULBs (Table 1) in Karnataka. Municipal Services are the basic services such as Water supply, Roads, Street Lights, Sewerage and Sanitation, and solid waste management, the responsibility of which is given to the local governments in terms of Provision and Operation and Maintenance. Apart from solid waste management the coverage indicators for other services are available in the census.

Other than these coverage indicators, some indicators available from the census are also analysed which has some impact on the fiscal handles of the ULBs. These indicators are grouped according to their roles in determining the expenditures on the ULBs for service provision. However, there are possible overlaps across categories and each group can influence the other.

Cost indicators (Population, Population Density, Area, Number of Households and Household Size) determine the expenditure that local governments incur on account of provision of basic services. These indicators determine the cost of service provision by reflecting the extent of economies of scale in the city.

Demand Indicators such as Literacy Rate, Percentage of Households Availing Banking Facilities and Percentage of households having none of the specified assets[3].

[3] Census of India specifies radio, transistor, telephone, television, bi-cycle, scooter, moto-cycle, moped, car, jeep and van as the set of assets.

Table 1: Some Indicators (Median) in the ULBs of Karnataka: Socio-demographic, Demand, Services, Infrastructure and Employment

Categories	Indicators	CB	CMC	CT	M CORP	NAC	TMC	TP
Socio-Demographic / Cost	**no. of ULB**	1	40	44	6	8	80	89
	Population (No)	23779	113509.5	7823.5	588974	8297.5	32990	17923
	Number of Households	4150	22851	1621.5	116365.5	1886.5	6348	3318
	Household Size	5.7	4.8	4.7	4.6	4.7	5.1	5.2
	Area(sq km)	7.2	34.41	4.455	149.355	6.6	11.18	5.55
	Density (Persons per sq km)	3302.6	3707.4	1943.4	5178.3	1546.3	3369.3	3524.8
Demand	Households availing Banking Facilities (per cent)	-	41	-	53	-	-	-
	Households having none of the specified assets (per cent)	-	19	-	15.0	-	-	-
	Literacy (per cent)	77.85	70.58	72.10	75.72	73.90	66.07	64.52
Services	Road Length per 1000 Population(in km)	-	1.06411	-	1.20994	2.33299	1.15875	1.11170
	Street lights per 1000 population (Nos)	33	31	29	32	44	29	27
	Households having Closed Drainage (per cent)	39.1	24.7	7.9	52.9	66.6	9.2	6.7
	Households having Tap as source of drinking water (per cent)	60	81.6	56.9	78.5	96.8	78.9	80.5
Infrastructure	Domestic and Non Domestic Connections per 1000 Population	186.97	227.10	326.41	255.18	195.64	198.30	187.18
	Non Domestic Connections to Total Connections(per cent)	15.05	18.49	21.25	23.32	4.76	20.66	18.67
	Banks (Nos)	5	17	2	89	1	5	4.5
	Banks per sq km	0.69	0.49	0.45	0.60	0.15	0.45	0.81
	Electricity Available per 1000 population	110.8	186.5	184.8	195.7	195.7	156.5	161.1
	Toilet Facilities Available to population per 1000	950.6	945.8	961.3	970.4	949.2	924.7	910.3
Employment	Main Other workers in working population(per cent)	90.57	82.20	84.18	86.30	90.97	69.65	62.17
	Main non-agricultural workers in Working Population (per cent)	99.85	98.33	98.77	99.43	99.53	94.82	91.71
	Main Other workers as a percentage of main workers	99.23	89.93	93.17	93.24	98.47	77.65	72.94
	Main non- agricultural Workers to Total Main Workers (per cent)	99.84	98.16	98.64	99.39	99.50	94.40	90.52
	Total Main Workers to Total Population (per cent)	36.99	32.01	36.81	30.78	25.57	31.68	32.11

Source: Census of India, 2001; CB: cantonment Boards, CMC: City Municipal councils;CT: Census Towns, MCorp: Municipal corporation, NAC:notified area committee; TMC: Town Municipal corporations, TP: Town Panchayat are indicative of the income levels of the people residing in the jurisdiction of the local bodies, which are among the factors determining the preferences of inhabitants of a city and thus influence demand for Municipal services

Infrastructure indicators, namely Toilet facilities, Electricity connections (apart from those provided by local government in street lights), Banks per sq km etc. These indicators give an idea about the infrastructure in a city which is provided in collaboration with the state government agencies or private public partnership.

Touching on the Employment indicators the composition of total working population and main working population are analysed. Emphasis is given on the categories like other workers and non agricultural workers which are most relevant as occupations of the urban population. For each category of cities the median value of a variable is considered. For the main analysis we divide the urban local bodies (ULBs) of Karnataka into three size classes for convenience and record the summary statistics related to population, population growth rates and area through Figures 1 and 2 below.

Figure 1 Population Statistics in Different Size Classes of Karnataka ULBs

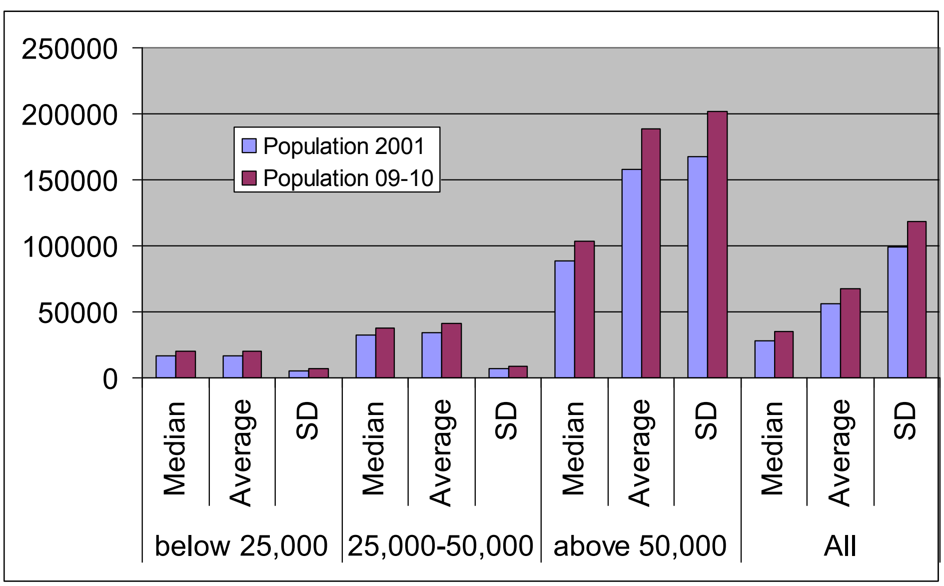
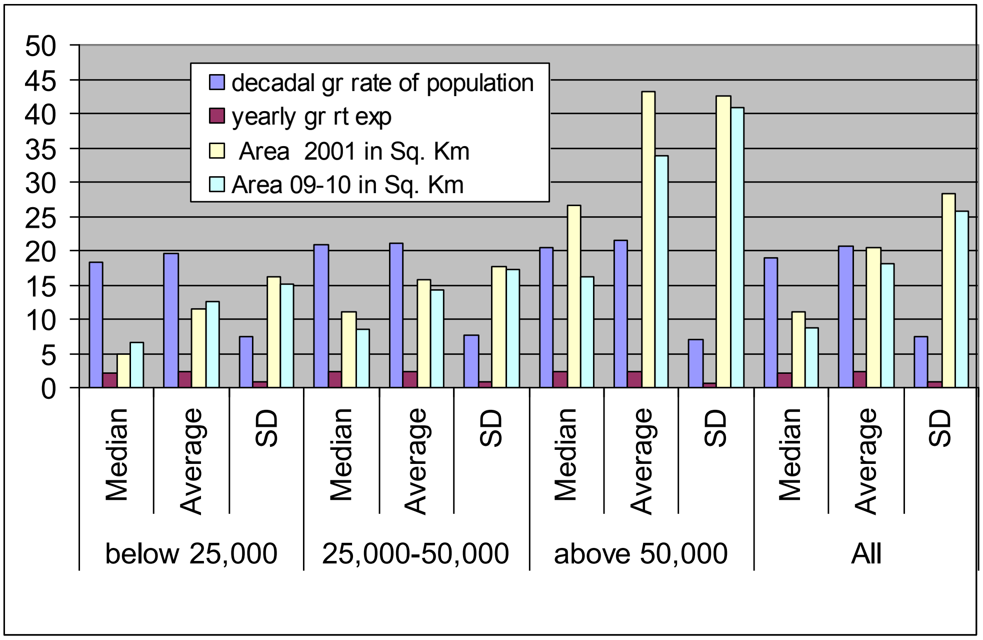


Figure 2 Growth Rates of Population and Area in Different Size classes of Karnataka ULBs



We find that the average decadal growth rate of population is around 19 per cent which is lower in the smallest size class of below 25,000 population but more or less the same in the other two size classes which is around 20 per cent. The annual exponential growth rate of population on an average is around 2.2 per cent which is higher in the two size classes above 25,000 population, with not much variation across the cities. Some of the ULBs have contracted in area which is reflected in the falling averages for 2009-10 figures for area (Figure 2).

2 Service Delivery

This section gives a detailed account of the issues related to service delivery in the ULBs of Karnataka. We start with the functions assigned to the ULBs of Karnataka, give an outline of the service level benchmarking, discuss the latest physical and financial norms on urban services in India[4], estimate the service wise shortfalls from physical and financial norms and derive the expenditure requirement estimates of the ULBs on basic services. For actual expenditures and service levels provided we use the data for the year 2009-10 collected from the individual ULBs by the Directorate of Municipal

[4] The state does not have separate norms.

Administration (DMA) of Karnataka followed by subsequent enquiries. We consider 213 ULBs of Karnataka excluding the Cantonment Boards, Census Towns and Notified Area committees for our analysis.

Eighteen functions are transferred to the urban local governments vide 74th constitutional amendment in India. The core functions include:

- Roads and bridges
- Water supply
- Public health, sanitation conservancy and solid waste management
- Burials and burial grounds, cremation grounds and electric crematoriums
- Public amenities including street lighting, parking lots, bus stops and public conveniences

The welfare functions include:

- Safeguarding the interests of the weaker sections of society
- Slum improvement and upgradation
- Urban poverty alleviation
- Provision of urban amenities and facilities such as parks, gardens and playgrounds
- Promotion of cultural, educational and aesthetic aspects
- Cattle pounds and prevention of cruelty to animals

The development functions include

- Urban planning, including town planning
- Regulation of land use and construction of buildings
- Planning for economic and social development
- Fire services
- Urban forestry, protection of the environment and promotion of ecological aspects
- Vital statistics including registration of births and deaths
- Regulation of slaughter houses and tanneries

We would mainly consider five major services viz. water supply, sewerage/sanitation, roads, street lighting and solid waste management for our analysis.

Service Level Benchmarking

As part of the ongoing endeavour to facilitate critical reforms in the urban sector, the Ministry of Urban Development has now adopted National Benchmarks in four key sectors—Water Supply, Sewerage, Solid Waste Management and Storm Water Drainage. Investments in urban infrastructure have, however, not always resulted in corresponding improvements in levels of service delivery. There is, therefore, a need for a shift in focus towards service delivery. This is especially the case in water supply and sanitation. A Handbook of Service Delivery Benchmarking has been developed by the Ministry of Urban Development through a consultative process to provide a standardised framework for performance monitoring in respect to water supply, sewerage, solid waste management services and storm water drainage, and would enable State level agencies and local level service providers to initiate a process of performance monitoring and evaluation against agreed targets, finally resulting in the achievement of service level benchmarks identified. The Ministry of Urban Development would facilitate the adoption of these benchmarks through its various schemes and would also provide appropriate support to municipalities that move towards the adoption of these benchmarks.

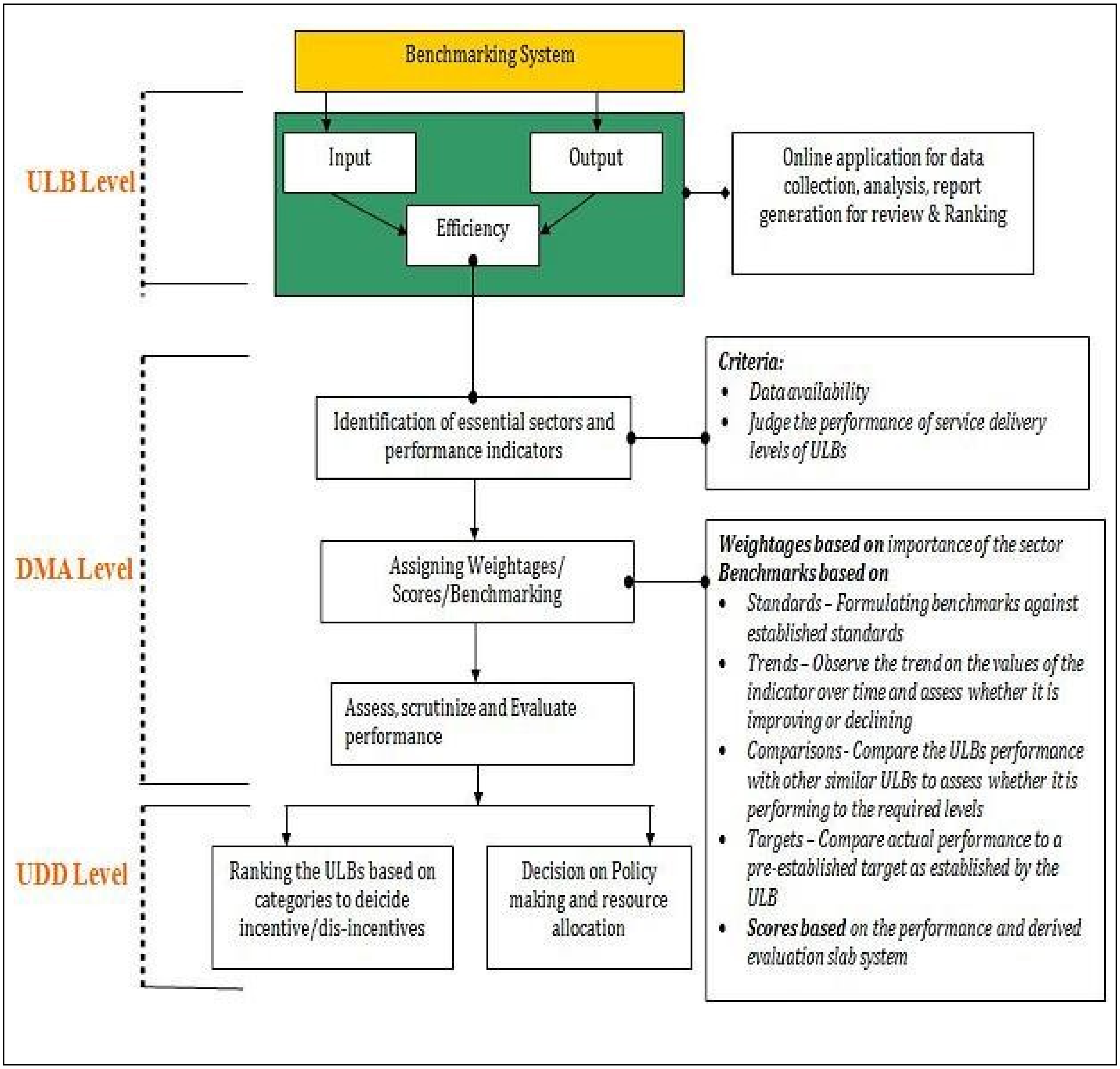
Benchmarking is a management technique that organizations use for regular monitoring and reporting of various programs, departments or work units. It is concerned with not only how much is being done, but also how efficiently, of what quality and to what effect. It also serves as a tool for strategic decision making and long term planning.

In the context of urban local bodies, benchmarking can be defined as the process of determining how efficiently and effectively the concerned agencies are delivering the services and the effort of the agencies in improving the mobilization of own resources and to measure whether this resources are being utilized in an optimum manner or not.

It also provides an assessment of the quality of work the local body is doing and how successful it has been in satisfying community needs and expectations.

Service Level Benchmarking (SLB) application provides ULBs with a tool for monitoring the inputs and outputs associated with each service, evaluating their performance level and taking corrective actions to improve their performance and hence the service. It also helps ULBs in identifying resources and how to improve the same.

SLB Methodology



Source: Ministry of Urban Development, India

Norms in Services for Indian Cities

The idea of benchmarking can be coupled with the norms and standards of urban services developed for Indian cities based on engineering calculations and city level characteristics. The literature on norms on service delivery for Indian cities dates back to Zakaria(1963) which estimates the norms and standards for the essential services in different size classes of cities. Subsequently Report of Working group III (1995), Pricewaterhousecoopers 2001, NIUA (2007) and many other state level estimates were generated updating Zakaria (1963) norms adjusting for current price levels. But with time the change in lifestyle has an enormous impact which has altered the definition of standards for municipal services which made the norms designed in 1963 somewhat inappropriate.

The High Powered Expert Committee in 2011 (HPEC 2011) has estimated the Physical and Financial (per capita investment costs and Operation and Maintenance Costs) of Urban services over the 20 year period from 2012 to 2031 (at 2009-10 prices). The estimation is done separately for 6 class sizes of population, which are classified as following (Table 2):

Table 2: Classification of Cities by Population

Size Class	Population
IA	>5 Million
IB	1-5 Million
IC	100,000-1 Million
II	50,000-100,000
III	20,000-50,000
IV+	<20,000

Source: HPEC, 2011

The population is projected for a sample of cities till 2031 using the population data taken from Census and the size class-wise UN population growth rates. It is to be noted that the lowest class provided by UN is below 50,000. Therefore, growth rate of this class is used for the classes II to IV+.UN estimates are only available up to the year 2030. Population figures for 2031 are projected assuming the same annual growth applied to the period 2025-30.

The service standard benchmarks (physical norms) used are prepared by Ministry of Urban Development. For the services of water supply, sewerage, and solid waste management, service standards (24x7 water supply, underground sewerage systems with complete coverage, 100 per cent collection, treatment, and disposal of solid waste for all cities) as specified by the Ministry are the same for all city size classes.

For the sectors like storm water drains, street lighting and roads the Committee felt the need for differential standards, as these sectors' needs depend on city size Sector-specific experts were consulted to make some adjustments in service standards prepared by the Ministry of Urban Development to accommodate these needs. Table 3 presents the details of the service standards for each of the eight sectors. The financial requirements have been estimated using these services norms

Table 3: Physical Norms

Service	Physical Norms	
Water Supply	100 per cent individual piped water supply for all households including informal settlements for all cities • Continuity of supply: 24x7 water supply for all cities • Per capita consumption norm:135 litres per capita per day for all cities	
Sewerage	Underground sewerage system for all cities and 100 per cent collection and treatment of waste water	
Solid Waste	100 per cent of solid waste collected, transported, and treated for all cities as per Municipal Solid Waste 2000 Rules	
Storm Water Drains	Drain network covering 100 per cent road length on both sides of the road for all cities	
Street Lighting	Illuminance: 35 Lux (35 lumens per sq. km) for all road categories in all cities • Spacing between street lights: 40 m for major roads, 45 m for collector roads, and 50 m for access road spaces	
Urban Roads	Size class	Road Density (km per sq km)
	IA	12.25
	IB	12.25
	IC	12.25
	II-IV+	7

Source: HPEC, 2011

Per Capita Investment Costs (PCIC):

To estimate the PCIC of Water Supply, Sewerage and Solid Waste Management the approved projects under the Urban Infrastructure and Governance (UIG) and Urban Infrastructure Development Schemes for Small and Medium Towns (UIDSSMT) Schemes of the JNNURM during the period 2006 to 2009, together with projects funded by the World Bank were studied. Each sector has been divided in sub sectors. For example, in case of water total PCIC consists of production and distribution costs. Similarly for Solid waste management, costs calculated separately for collection, transportation, processing and disposal have been clubbed to arrive at total PCIC for each class size.

The methodology adopted for Roads, Street Lighting and Storm water drains was different. For these services, unit costs for each class size are taken from the project data. These unit costs for each service are multiplied with the volume/production of service in their respective class sizes. For example in case of roads, cost per sq km is multiplied with total road length. This is then divided by population density of respective class sizes to estimate the PCIC of that service. The PCIC are presented in Table 4.

Table 4: PCIC norms (INR, per capita)

Size Class	Water Supply	Sewerage	Solid Waste Management	Urban Roads	Storm Water Drains	Street Lighting
1A	3517	3360	900	23460	4140	2491
1B	4395	3841	393	23460	4140	1606
1C	5924	3411	410	29325	5175	1258
II	4957	5316	236	16800	2100	207
III	5901	5649	204	22400	2800	107
IV+	5901	6648	204	22400	2800	107

Source: HPEC, 2011

Per capita Operation and Maintenance (PCOM) Costs:

The O&M cost considered for the estimation exercise includes the cost of O&M of physical assets and material costs for the respective sectors. The O&M computation takes into account both the cost of O&M of existing assets as well as of new assets that will be created over the 20-year period.

In water supply, sewerage, and solid waste management, per capita operations and maintenance costs (PCOM) are computed using (i) unit cost from project data, (ii) estimates of production volume for each sector, and (iii) the population covered. For the remaining sectors, the PCOM is assumed to be a percentage of the PCIC.(For street Lighting it is assumed to be 2.2 per cent of PCIC, for storm water it is 1.5 per cent of PCIC and it is assumed to be 2 per cent of the PCIC for all roads covering both existing and new assets. The O&M norms are presented in Table 5.

Table 5: PCOM Norms (INR, per capita)

Size Class	Water Supply	Sewerage	Solid Waste Management	Urban Roads	Strom Water Drains	Street Lighting
1A	797	414	269	421	62	90
1B	613	373	189	421	62	55
1C	491	290	135	527	78	54
II	491	290	113	276	32	4
III	368	207	113	368	42	3
IV+	245	145	113	368	42	3

Source: HPEC, 2011

Physical Levels of Services and Expenditure Requirements: Some Estimations

This section deals with some estimations related to service delivery in the ULBs of Karnataka. First, we would analyse two basic summary statistics of the *actual levels of services provided* and *the shortfalls from the norms of these services*. We consider the median for the average levels and the coefficient of variation (CV) as a measure of 'spread' within a size class. For water supply, we consider the per capita levels of water supply, number of days of water supply in a week and number of hours of water supply in a day. For solid waste management we consider collection and transportation efficiencies, which respectively can be defined as the percentage of garbage *collected* of total amount of garbage *generated* and the percentage of garbage *transported* of total garbage *collected*. For roads we take the urban road density as the indicator for analysis which is defined as the road length per square feet area of the ULB.

Second, we analyse some basic summary statistics for the *actual expenditures on these basic services* and *the shortfalls from O&M norms for each service* and *also for all the services together*. The expenditure requirements, taken together for all the services for one ULB, would give a simple measure of expenditure needs on service provision for that ULB. The norms from HPEC (2011) are taken for comparisons.[5]

[5] It is to be noted that the analysis is subject to some data constraints. We cannot verify the street lighting physical norms as the data on distance between two poles for the ULBs are not available. For financial norms we only confine ourselves to O&M norms as the capital expenditure data as annual expenditures are nt recorded as they are lumpy in nature and are incurred generally on specific project related outlays.

Table 6 Summary: Physical Levels of Services

Size Class		Below 25000		25000 to 50000		Above 50000		All	
		Median	CV	Median	CV	Median	CV	Median	CV
Water Supply	per capita supply (LPCD)	102	1.3	74.6	0.7	96	0.6	90	1.1
	Norms Coverage (%)	76	1.2	56	0.6	72	0.6	69	1.1
	Days of Supply in a Week	3	0.5	3	0.5	3	0.5	3	0.5
	Hours of Supply in a Day	1	0.8	1	1.2	1	1.4	1	1.1
Solid Waste Management	Collection efficiency	75	0.2	88	0.04	100	0.1	85	0.2
	Transportation Efficiency	71.4	0.2	88	0.06	100	0.8	83	0.5
Urban Roads	Road Density (KM per Sq KM Area)	5	1.13	6.3	1.1	9	2.2	6	2.5
	Norms Coverage (%)	71.6	1.1	90	1.1	84	2.6	82	2.6

Table 6 above summarises the physical levels of services and their coverages/shortfalls in terms of the respective norms in different size classes of cities and the state as a whole. We find that there is no pattern across the size classes as far as physical levels of water supply is concerned, the median for the state as a whole being *90 litres per capita per day* and the highest being recorded in the smallest size class at 102 lpcd. A look at the CVs imply that for the smallest class the distribution of the average is the most scattered implying that there is a wide range of per capita levels of water supply in this size class. This supply covers 69 per cent of the norms prescribed. On an average Karnataka ULBs get water supply for three days a week, which is uniform across size classes. On an average each day has a one hour supply of water which is also uniform across size classes but variations differ in each size class a little and the CV increases with size class, the highest variation being recorded in the largest city size class. If compared with 24x7 water supply norm, the indicators are not too encouraging.

For solid waste management, both the collection and the transportation efficiencies increase with size class of cities, the median being recorded at 85 and 83 per cent for the entire state respectively. The variation in each size class is minimal as far as these indicators are concerned. The norm being 100 per cent we can infer that the solid waste management indicators are closer to the norm than those of water supply.

As far as road density is concerned the bigger cities are closer to the norms but higher variations in bigger size classes are also noticed. On an average for the state 82 per cent of the norms are being covered for this indicator.

If we compare the services in a particular size class of city we find that in the smallest size class it is water supply which has the minimum shortfall from norms, in the medium size cities it is road density which is closest to the norms and in the largest city size class it is the solid waste management which performs the best with zero shortfall from norms.

Table 7 Summary: Expenditures on Services

Services	Indicators	Below 25,000		25,000 to 50,000		Above 50,000		All	
		Median	CV	Median	CV	Median	CV	Median	CV
Water Supply	ONM cost per Capita (INR)	168	1.3	213	0.6	228	2	203	1.5
	Coverage of Norms (%)	55	1.2	58	0.6	46	2	53	1.3
Solid Waste Management	ONM cost per Capita(INR)	8.5	2.7	14.2	1.5	14.5	1.5	11	3.5
	Coverage of Norms(%)	7.5	2.7	13	1.5	12	1.4	9.3	3.2
Urban Roads	ONM cost per Capita(INR)	35.60	1.7	36.10	1.6	20	1.5	33	1.7
	Coverage of Norms(%)	71.6	1.1	90	1.1	84	2.6	82	2.6
Street Lighting	ONM cost per Capita(INR)	43.4	1	37	1.5	39	0.8	42	1.2
	Coverage of Norms(%)	1447	1	1238	1.5	211	1.5	1151	1.4
All Services	ONM cost per Capita(INR)	364	1	390	1	352	1.4	372	1
	Coverage of Norms (%)	45	1	46	1	36	1.2	43	1

Table 7 above summarises the operations and maintenance (ONM) expenditures and their shortages from financial norms on all of the basic urban services in the ULBs of Karnataka. We find that in water supply the ONM expenditures actually incurred cannot cover the norms prescribed for the same in all the size classes. On an average there is a shortage of 47 per cent for cities in the state as a whole, the highest per capita expenditure being incurred in the biggest size class with the highest shortfall from norms at 54 per cent. The variation within a size class is high in the biggest size class of cities. For solid waste management only 9.3 per cent of the norms prescribed for ONM expenditures are being covered with a very high variation across cities. For urban roads 82 per cent of the expenditure norms on ONM are being covered with a high variation across cities. The case for street lighting is different as we find that the expenditures incurred are 1051 per cent more than that prescribed by norms. This can be attributed to the fact that the state is changing over to the low energy intensive bulbs for street lighting. As the ONM includes the cost of bulbs we get such unusually high figures for expenditures in this transition period as the low energy bulbs cost on an average 20 times more than the usual ones and the norms do not include additional the costs of changing over. On an average for all the services there is a shortage of 57 per cent of the ONM expenditure norms, the shortage being the highest (64 per cent) in the biggest size class of cities.

4. Finances

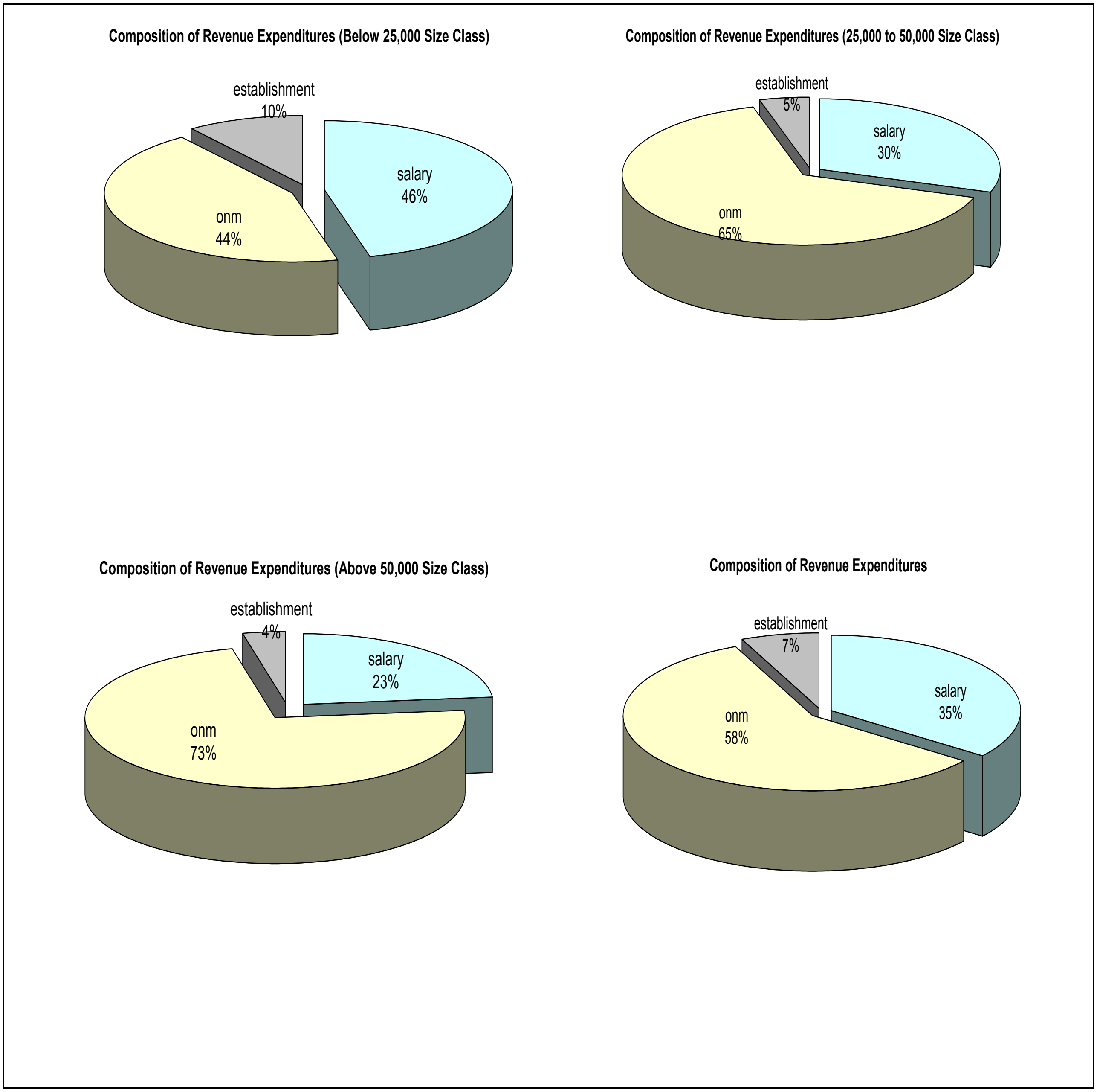
After analysing the issues related to service delivery, we look at the financial indicators of the ULBs in Karnataka. We touch upon the main expenditure heads and major sources of revenues in the ULBs of Karnataka. We analyse the composition of revenue expenditures and own revenues of the ULBs. The idea is to find out whether the low expenditure levels on service provision is due to lower levels of revenue collections. We also attempt to estimate the own revenue capacities of the ULBs.

The major tax sources comprise of the tax on Land and buildings, advertisement, toll on vehicles, additional stamp duty, water tax; non tax collections are mainly from user charges on services, rental income from municipal properties, fees and fines, developmental charges, License fee (building, trade, hotel), building betterment fee, birth and death registration fee, food and adulteration fee, slaughter house fee, compounding fee, etc.

It is to be noted that we confine our analysis to the own revenue heads and revenue expenditures. The main focus would be to judge the self reliance of the ULBs for which one of the indicators which is important is the coverage of revenue expenditures from the own revenue sources. It has been the mandate of various urban reform agendas in India to enable the ULBs to cover the revenue expenditures from their own source revenues. We analyse the facts with the help of two sets of charts below where we have recorded the average value of each component in the composition of revenue expenditures and own revenues in percentages.

Figure 3 below shows the composition of revenue expenditures in various size classes of cities and for the state of Karnataka as a whole. The major components of revenue expenditures are operations and maintenance expenditures for service

Figure 3 :Composition of Revenue Expenditures



provision, the salaries of different categories of regular employees including the contractual payments and establishment which is the running cost of maintaining the establishment of the ULB. A productive and useful way of allocating the resources would be to have a greater share of operations and maintenance than any other component.

We find that the ONM component is higher than the other two components in all the size classes and thus in the state as a whole, followed by the salary and the establishment components. If we compare across size classes we find that bigger cities have on an average higher proportions of ONM expenditures while both salary and establishment components show higher proportions in smaller cities. This is indicative to the fact that bigger cities are incurring more productive expenses than the smaller ones.

Figure 4: Composition of Own Revenues

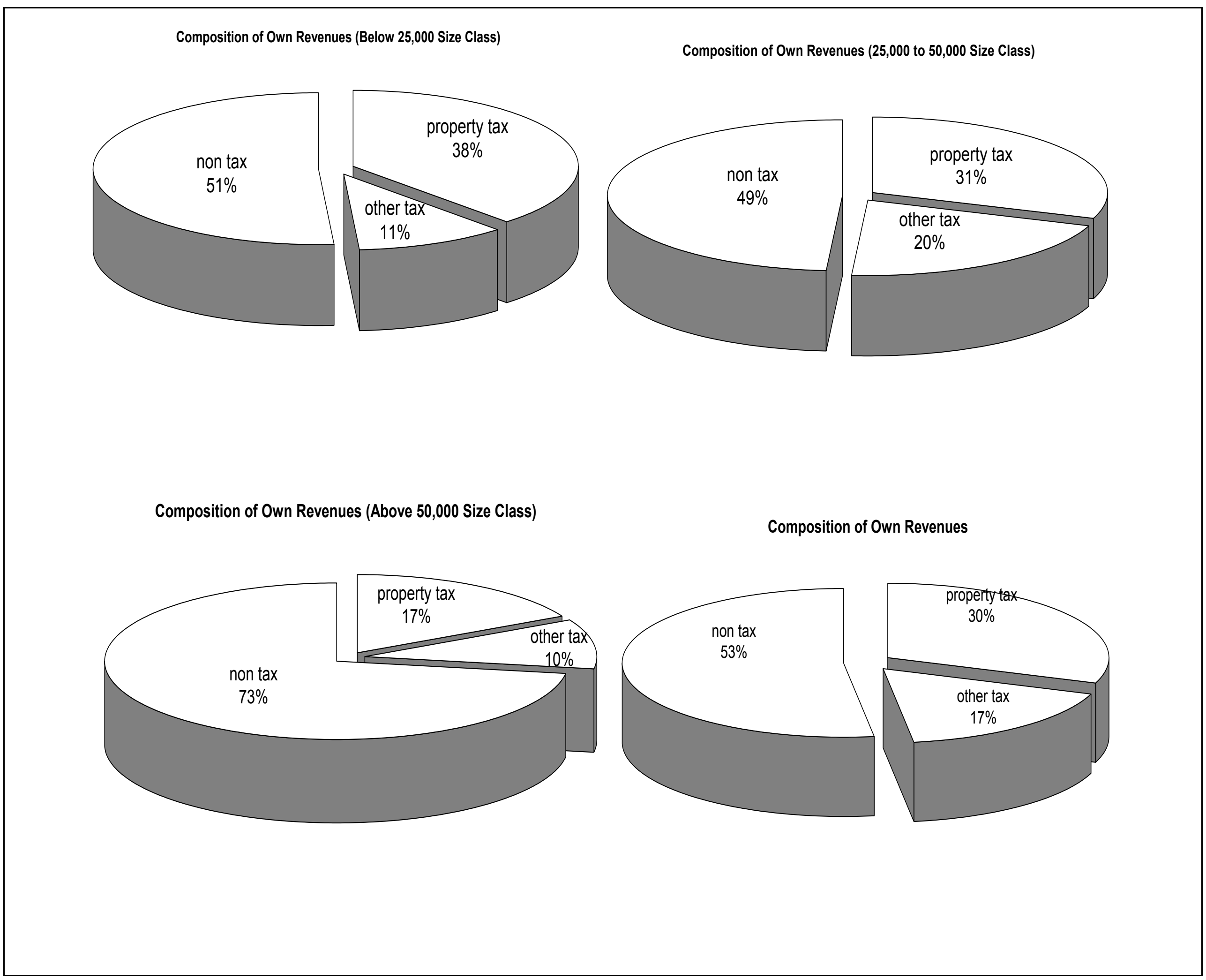


Figure 4 above gives an idea about the composition of own revenues. We find that for the cities of Karnataka as a whole tax and non tax components are on an average more or less equal with non tax with a slightly higher proportion. For non tax and other tax components it is difficult to find a pattern across size classes of cities. Property taxes show the highest proportion in the smallest size class and the lowest in the biggest size class.

We also attempt a quick evaluation of the performance of the ULBs of Karnataka on the basis of some simple indicators. One way to assess is to see whether the own revenues can cover the revenue expenditures, if not, what is the percentage of shortfall? Then we can ask whether the own revenues are sufficient to cover the ONM costs of basic services provided by the ULBs. Table 8 below summarises the findings.

Table 8 Some Financial Performance Indicators

	Indicators	Below 25000		25000 to 50000		Above 50000		All	
		Median	CV	Median	CV	Median	CV	Median	CV
1	Own Revenue to Revenue Expenditure Ratio (%)	13	0.5	31	0.21	112	3	27	5.3
2	Own Revenue to ONM Expenditure ratio (%)	24	1.4	52	0.65	200	2.5	50	4.4
3	Water Charges to ONM Expenditure on Water (%)	15	0.8	11	0.7	12	0.9	13	0.8
4	Collection Efficiency of Property Taxes (%)	53	0.6	65	0.4	58	0.6	62	0.5
5	Own Revenue Capacity to Actual Own Revenue (Index)	116	2.6	116	0.2	141	2.6	116	3
6	Own Revenue Capacity to ONM Requirements	23.5	2	27.5	2	27.5	2.2	27	2.2

We find that on an average only 27 per cent of the revenue expenditures can be covered by own revenues in the ULBs of Karnataka with a high degree of variation (CV = 5.3). Only the own revenues of the biggest size class can cover fully the revenue expenditures and has a surplus of 12 per cent, but with a high variation in the size class. The smaller two size classes can cover a small proportion with hardly any variation within the size class (Row1, Table 8).

As far as the ONM cost coverage is concerned we find that on an average the ULBs in Karnataka can finance 50 per cent of the ONM costs on basic services through their own revenues with a very high variation in the proportions across cites. Only the biggest size class of cities have a surplus over the ONM costs (Row2, Table 8).

We also attempt to see whether water charges collection can cover the ONM expenditures on water. We find that only 13 per cent of the ONM expenditures on water can be covered by water charges, which is more or less uniform across size classes with very little variation in each size class and also across size classes. (Row 3, Table 8).

We have also analysed the performances of the ULBs in Karnataka from the collection efficiency ratios of property taxes which can be an important indicator of performance evaluation of the units. Collection efficiency ratio is defined as the ratio of the amount of tax actually collected to the amount demanded. The tax demanded and collected can be for the current and arrears which are recorded separately. Here we consider the total of current and arrears for the collection efficiency ratios calculations. We find that the overall average collection efficiency is only 62 per cent which is the lowest in the smallest size class and the highest in the medium size class with little variation across cities (Row 4, Table 8).

We have also attempted an estimation of own revenue capacities. In the absence of data on incomes of the cities we have taken the collection efficiency ratios as the reference for the estimations. We take 100 per cent collection efficiency in arrears collection and 90 per cent collection efficiency in current collections of property taxes which has been the basis for many reforms agenda on Indian cities. We find that on an average own revenues can increase by 16 per cent if the arrears collection is fully appropriated and current collection is at least 90 per cent of the current demand for property taxes, the non tax and other taxes being the same as before. The highest increase of 41 per cent is recorded in the biggest size class (Row 5, Table 8).

Having estimated the own revenue potentials we would like to know how much of the expenditure requirements on ONM can be covered once this potential is realized. We find that only 27.5 per cent of the ONM expenditure requirements can be fulfilled by the own revenues once the potential for the latter is fully realised. This proportion is higher in bigger cities with moderately high variation across cities (Row 6, Table 8).

5. Performance Evaluation of ULBs in Karnataka: A Benchmarking Framework

In this section we would like to develop a model in a benchmarking framework based on the principles of economic optimisation. The objective would be to assess the performance of the ULBs in Karnataka in an economically viable manner. The service level benchmarking framework provided by the Ministry of Urban Development is an effort to monitor the service delivery mechanism. Our effort would be to attempt an in-depth analysis of performance taking the ULBs as the decision making unit (DMU) by bringing in the expenditures on various accounts as *inputs* and provision of services as *outputs*. This analysis attempts to bring together the financial parameters and the service delivery of the ULBs in the spirits of Eeckaut et al (1993), Borger et al (1994), Grossman et al (1999) which analyses the efficiencies of municipalities in different countries or explain the factors affecting these efficiencies. The main objective of our analysis is to assess the performance of the ULBs in service delivery and resource utilization in an integrated manner. We also pinpoint the possible sources of cost savings by identifying the sources for mis-utilisation of resources.

The benchmarking exercise is based on the theory of production. Production is an act of transforming inputs into outputs. Outputs are in general desirable outcomes. Hence, more output is better. At the same time inputs are valuable resources with alternative uses. The objective of a decision making unit (DMU) is either to produce as much output as possible from a specific quantity of inputs or to produce specific quantity of output using as little input as possible. An input output combination is a feasible production plan if, given the state of technological knowledge, the output quantity can be produced from the associated input quantity or vice versa.

The performance of any DMU can be evaluated in terms of relative productivity or the efficiency of the unit concerned. Productivity is a descriptive measure of performance without any reference to the optimal achievable target whereas efficiency is a normative measure assessed with reference to the production frontier.

Efficiency by its simplest definition of the output version refers to the ability of a DMU to produce the maximum levels of outputs with a set of inputs. With a change in prices of inputs or a shift in technology or otherwise there can result a change in the input mix used by the DMU which in turn affects efficiency. When we refer to the DMU's ability to produce as much as it can without taking any possible impact of input-prices, it is called productive or technical efficiency (TE), whereas when the effect of prices of inputs is taken into consideration while measuring efficiency it is termed as price or allocative efficiency.

We would derive the technical efficiency scores of the ULBs as a measure of performance. This measure of efficiency is particularly useful in the absence of market prices for inputs or outputs as in the cases of problems in public economics and public policies. So, one of the advantages of this tool is that it can be applied to any economic activity in any sector even with constraints in availability of data on market prices. The application of efficiency analysis in public service delivery is particularly useful because of this advantage.

Technical efficiency is an index which is expressed as the ratio of actual production and the potential productive capacity of a DMU using the same amount of resources. There are various ways to measure the technical efficiency. Once the decision making unit in a sector performs an economic activity transforming a set of inputs to a set of outputs and a frontier of production can be conceived of considering all the decision making units in the sector, we can apply the concept of technical efficiency to assess the performance of the units. While the basic principle of measurement of technical efficiency is the distance of the point of operation of a decision making unit from that projected on the frontier, two factors viz. the way the frontier is constructed and the way the distance is measured, make one method of estimation different from the other.

The parametric approach requires the imposition of a specific functional form for a production frontier and some assumptions like independently and identically normally distributed errors which have to be uncorrelated with the independent variables. In contrast the non parametric approach does not require any functional form. It is based on a set of behavioral assumptions regarding production. Taking information from data on inputs and outputs the Data Envelopment Analysis (DEA) method generates a discrete piecewise frontier by optimizing on *each* individual observation given the set of Pareto efficient DMUs or the peers. The technical efficiency scores are derived as the ratio of the actual output to the ideal output specified by the generated frontier.

For each family of parametric or non parametric specifications, the estimation can be done through mathematical optimization or econometric techniques. The distance between the point on which a decision making unit *actually* operates and the point on the frontier on which it *should have* operated can be measured as a radial or a non radial characterization. In this discussion we would mostly like to base our analysis on radial measures, We would consider the nonparametric method of DEA which uses a linear programming principle for assessing technical efficiency and is deterministic in nature.

Nonparametric Optimisation Approach: Data Envelopment Analysis (DEA)

DEA is based on mathematical programming. In the early fifties Koopmans and Debreu independently conceive of the notion of technical efficiency in an optimization framework in two different but related contexts. Koopmans (1951) defines a point in the commodity space as efficient whenever an increase in the net output for one commodity requires a decrease in that of the other. Debreu (1951), from the perspective of cost of resources, introduces the concept of *coefficient of resource utilization* as a measure of TE for the economy as a whole and interprets any deviation of this measure from unity as a deadweight loss for the society on account of inefficient utilization of resources.

A few years later Farrell (1957) observes that the efficiency of a DMU which can reflect the ability to achieve the maximum level of output attainable by the state of technology or to use the inputs in optimal proportions, given their respective prices, can be analysed in a diagrammatic framework of radial contraction of inputs/expansion of outputs from an observed point to the frontier. The main contribution of Farrell in his seminal work is to provide a simple but structured intuition to derive efficiency at the DMU level using the principles of programming in a diagrammatic framework with iterative search for peer groups and a piecewise discrete frontier. An assumption of constant returns to scale (CRS) technology in production is made. Hoffman (1957) suggests that the dual simplex method, an algorithm to solve a linear programming (LP) problem, can be applied to obtain Farrell's measure of efficiency. Farrell in his later work with Fieldhouse (Farrell and Fieldhouse 1962) attempts to solve the problem using the dual simplex algorithm where the case of increasing returns to scale is also considered. But the problem is that the objective function is a fractional one and thus the tools of LP are not sufficient to provide a satisfactory solution.

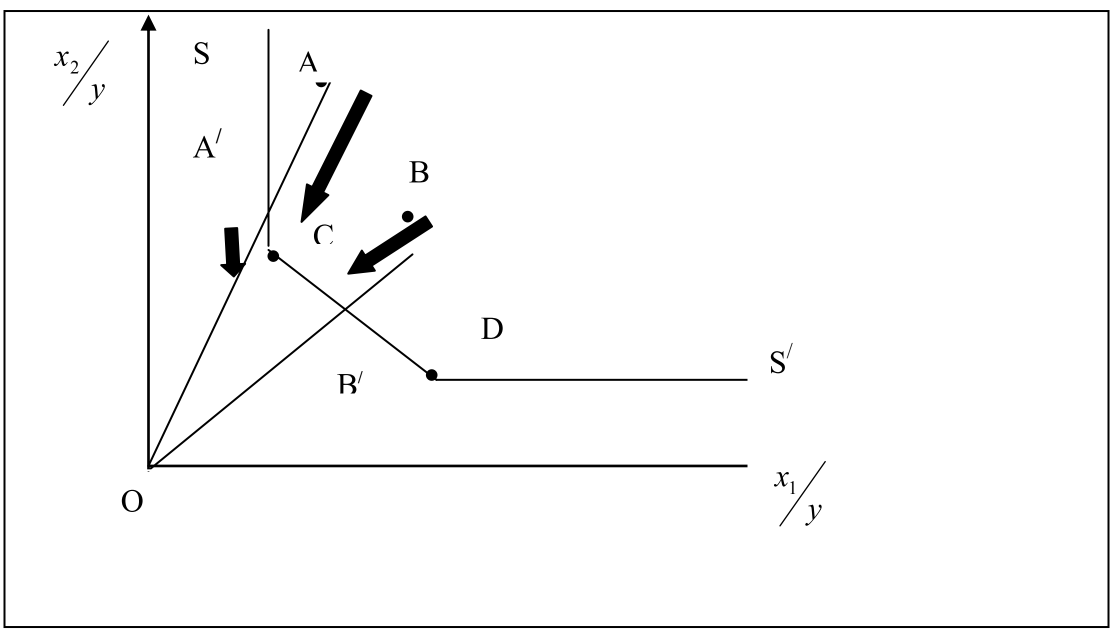
Charnes, Cooper and Rhodes (CCR 1978) contributes to convert the fractional programming into a linear programming by selecting suitable weights which are nothing but the virtual prices of inputs and outputs. In their subsequent work in 1979 and 1981 a generalized DEA in a multiple-output multiple-input framework is established under a CRS assumption. The imposition of a CRS structure for the production technology implicitly assumes that producing units operate on optimal scales. As the different ULBs operate in different market structures, externalities and the different financial restrictions this assumption can be a handicap analyzing real situations.

The variable returns to scale (VRS) model is developed by Banker, Charnes and Cooper (BCC 1984) which is able to decompose the *technical inefficiency* and *scale inefficiency* by defining and estimating the former at a given scale of operation under the assumption of a unique optimum (Maindiratta, 1990). BCC (1984) is the most general model in DEA which is used widely in economics and management literature which incorporates a constraint in the CCR 1978 framework to accommodate VRS and thus integrates the concept of technical and scale efficiencies together in a standard LP model.

The next challenge is to incorporate unrealized output potential and/or avoidable input waste explicitly in the framework for analyzing efficiency. In case of technical efficiency there are two distinct dimensions: firstly, whether the DMU has selected the correct *technique* of production or not, i.e., choosing the correct ray (in two-dimension input-plane), and secondly, if the correct technique is chosen whether the *scale* has been selected optimally or not (i.e. the exact location on the ray). Since an efficient DMU has to achieve both, the exact sequencing of choice does not have much bearing on the final outcome. To select an appropriate scale one seeks the maximum equi-proportionate increase in all outputs or decrease in all inputs which is known as radial efficiency. However, the radial projection of an observed input-output bundle onto the frontier does not necessarily exhaust the potential for expansion in all outputs or reduction in all inputs. In this case one needs some non radial movement along with production frontier to reach the efficient point. This movement calls for a change in input (output)-proportions. Hence, two types of slacks are encountered (a) input slacks and (b) output slacks. Figures 5 and 6 explain the notions of input-oriented and output-oriented technical efficiencies with corresponding illustrations of radial as well as on-frontier movements to illustrate the notion of both technique related inefficiency and scale related inefficiency[6].

Suppose we have four ULBs A, B, C and D of which C and D are the efficient ULBs. Now with the help of observed input-output data the piecewise linear isoquant ($SS^{/}$) can be constructed (Figure-5)[7] ULBs A and B represent two inefficient ULBs. So, the extent of their technical inefficiency will be $\frac{OA^{/}}{OA}$ and $\frac{OB^{/}}{OB}$ respectively. But it is not the ultimate efficient point because one could reduce the input x_2 by the amount $CA^{/}$

Figure-5 Input Oriented Radial and Slack Efficiency



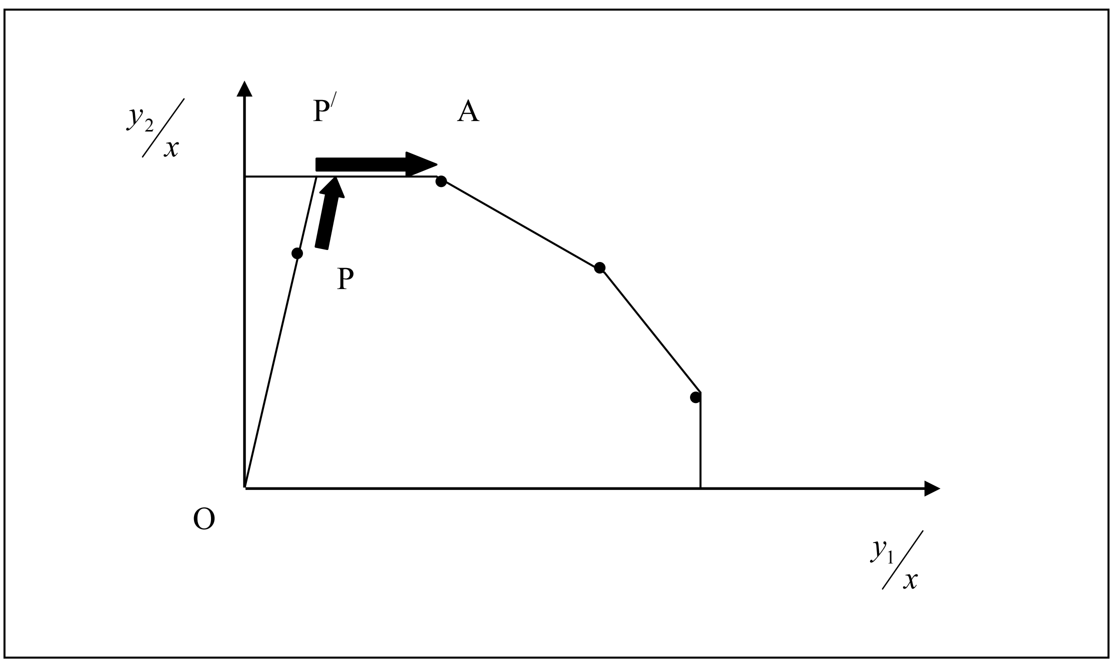
[6] For output-oriented technical efficiency the interpretation of radial and slack inefficiencies will just be reversed.

[7] Here x_1 & x_2 indicate two inputs and y represents one output.

and still produce the same output. Therefore, this movement along the isoquant is known as the input slack. On the other hand in case of DMU B only radial movement is enough to ensure efficient input-output combination. No slack movement is required here. Similarly the concept of output slack can be described.

Similarly consider Figure-6[8] where a DMU operates at P, a point inside the production possibility frontier. The position is clearly inefficient as through a radial movement the DMU may operate at $P^{/}$ and produce greater amounts of both y_1 & y_2. This distance from P to $P^{/}$ is called the radial inefficiency. However, it is interesting to note that even at point $P^{/}$ the DMU has scope to increase its output by using the same level of inputs. A movement along the frontier from $P^{/}$ to A will help it to increase the amount of y_1 without sacrificing that of y_2, and, hence, the value of total output would certainly be higher at A compared to that at $P^{/}$. This distance from $P^{/}$ to A is known as output slack inefficiency.

Figure-6 Output Oriented Radial and Slack Efficiency



[8] Here y_1 & y_2 indicate two outputs and x represents one input.

Formulation of Standard DEA Problem

In the traditional DEA model, production technology with the following properties is hypothesized:

i) The production possibility set is convex, ie if (x^0, y^0) and (x^1, y^1) are both feasible input-output bundles then $(x^/, y^/)$ is also a feasible bundle where $x^/ = \lambda x^0 + (1-\lambda) x^1$, $y^/ = \lambda y^0 + (1-\lambda) y^1$, $0 \le \lambda \le 1$.

ii) Inputs and outputs are freely disposable ie if (x, y) Є T then $(x^/, y)$ Є T when $x^/ \ge x$ and $(x, y^/)$ Є T when $y^/ \le y$.

iii) When a sample of input-output bundles (x^i, y^i) is observed for N ULBs, N=1,……,N, we assume further that (x^i, y^i) Є T for i=1,2,…..,,N.

iv) The technology satisfies variable returns to scale.

We select $T^v = \{(x,y) : x \ge \Sigma\lambda_j x^j ;\ y \le \Sigma\lambda_j y^j ;\ \Sigma\lambda_j = 1;\ \lambda_j \ge 0, j=1(1)n\}$, the smallest of all the sets satisfying assumptions (i) - (iv). This is the inner approximation of the underlying technology set.

Let there be N ULBs each producing m outputs from n inputs. DMU t uses input bundle $x^t = (x_{1t},\ldots,x_{nt})$ to produce output bundle $y^t = (y_{1t},\ldots,y_{nt})$. We use vector of virtual prices of inputs and outputs u_{it} and v_{jt} respectively and get the average productivity of DMU t as :

$$AP_t = \frac{\sum_{j=1}^{m} v_{jt} y_{jt}}{\sum_{i=1}^{n} u_{it} x_{it}}$$

The production relation has to satisfy the constraint stated as $\sum_{j=1}^{m} v_{jt} y_{jt} \le \sum_{i=1}^{n} u_{it} x_{it} \forall t$ along with non-negativity restriction on virtual prices. So, the problem is:

Max: $$AP_t = \frac{\sum_{j=1}^{m} v_{jt} y_{jt}}{\sum_{i=1}^{n} u_{it} x_{it}}$$

Subject to: $$\sum_{j=1}^{m} v_{jt} y_{jt} \le \sum_{i=1}^{n} u_{it} x_{it} \ ;\ \forall t = 1,2,\ldots\ldots\ldots, \Lambda$$ **………………....Model-1**

$u_{it}, v_{jt} \geq 0$.

This is a fractional programming problem. A price normalization constraint can be incorporated by virtue of which it can be written as:

Max: $\sum_{j=1}^{m} p_{jt} y_{jt}$,

Subject to: $\sum_{j=1}^{m} p_{jt} y_{jt} - \sum_{i=1}^{n} w_{it} x_{it} \leq 1 \quad \forall t = 1,2,..........,$ **....................Model-2**

$$\sum_{i=1}^{n} w_{it} x_{it} = 1, \; w_{it}, p_{jt} \geq 0 \quad \forall t = 1,2,..........,N$$

This is a standard Linear Programming Problem and here $w_{it} = \lambda u_{it}$ and $p_{jt} = \lambda v_{jt}$ with λ>0.

Therefore, the dual of Model-2 can be written as:

Min: θ

Subject to: $\sum_{t=1}^{N} \lambda_t y_{jt} \geq y_{jt}; \forall j = 1,2,..............., m$

$$\sum_{t=1}^{N} \lambda_t x_{it} \leq \theta x_{it}; \forall i = 1,2,..............., n$$ **....................Model-3**

$$\lambda_t \geq 0; \forall t = 1,2,................, N$$

Where: θ is free.

From Model-3 one can estimate θ which is nothing but the input oriented technical inefficiency score of t^{th} DMU under CRS assumption. Again if we define $\phi = \frac{1}{\theta}$ and $\mu_t = \frac{\lambda_t}{\theta}$ then minimization of θ is equivalent with maximization of ϕ. In terms of redefined variable the LP problem (Model-3) now becomes

Max: ϕ

Subject to: $\sum_{t=1}^{N} \mu_t y_{jt} \geq \phi y_{jt}; \forall j = 1,2,..............., m$

$$\sum_{t=1}^{N} \mu_t x_{it} \leq x_{it}; \forall i = 1,2,..............., n \qquad \textbf{.....................Model-4}$$

$$\mu_t \geq 0; \forall t = 1,2,................, N$$

Where: ϕ is free.

The score generated from the expression $\frac{1}{\phi}$ is nothing but the output oriented technical efficiency of the t^{th} DMU under CRS. These two models consist of the first generation model of efficiency score measurement proposed by CCR.

The (in)efficiency measurement with additional constraint $\sum_{t=1}^{N} \lambda_t = 1$ in Model-3 and $\sum_{t=1}^{N} \mu_t = 1$ in Model-4 gives as the BCC model which considers the VRS assumption instead of CRS assumption.

Both CCR and BCC models calculate only radial (in) efficiency. For radial and slack calculation together one has to use the third generation models given below as extensions of Model-3 and Model-4.

Model 5 is the input version of the efficiency with slacks given as:

Min: $$\tilde{\theta} = \theta - \varepsilon \left(\sum_{j=1}^{m} s_j^+ + \sum_{i=1}^{n} s_i^- \right)$$

Subject to: $$\sum_{t=1}^{N} \lambda_t y_{jt} - s_j^+ = y_{jt}; \forall j = 1,2,..............., m$$

$$\sum_{t=1}^{N} \lambda_t x_{it} + s_i^- = \theta x_{it}; \forall i = 1,2,..............., n \qquad \textbf{.....................Model-5}$$

$$\sum_{t=1}^{N} \lambda_t = 1$$

$$\lambda_t, s_j^+, s_i^- \geq 0; \forall t = 1,2,................, N; \forall j = 1,2,..............., m; \forall i = 1,2,..............., n.$$

Where: θ is free.

Model 6 below gives the output version of the same as follows:

Max: $$\tilde{\phi} = \phi + \varepsilon \left(\sum_{j=1}^{m} s_j^+ + \sum_{i=1}^{n} s_i^- \right)$$

Subject to: $\sum_{t=1}^{N} \mu_t y_{jt} - s_j^+ = \phi y_{jt}; \forall j = 1,2,..............., m$

$$\sum_{t=1}^{N} \mu_t x_{it} + s_i^- = x_{it}; \forall i = 1,2,..............., n \quad \textbf{.....................Model-6}$$

$$\sum_{t=1}^{N} \mu_t = 1$$

$$\mu_t, s_j^+, s_i^- \geq 0; \forall t = 1,2,..............., N; \forall j = 1,2,.............., m; \forall i = 1,2,..............., n.$$

Where: ϕ is free.

s_j^+, s_i^- , indicates the output and input slack and ε is any pre-assigned positive number, however small. Positive sign means output should be increased and negative sign means input should be decreased.

Estimating the Productive Efficiency of ULBs in Karnataka: Results

We use model 5 for our analysis. The input version of the efficiency models is particularly useful here because the main purpose of this analysis is to focus on the expenditure management of ULBs.

Model 5 is executed as a two stage model. First, the input efficiency scores are derived and then a stage follows where corresponding to these efficiency scores the optimal slacks are estimated for each ULB. The details are given in a note in Appendix 1.

Table 9 Summary Statistics of Variables: Input Oriented Efficiency model

		Median	Average	SD	Max	Min	CV
OUTPUTS	twaters (litres)	2950000	8460819	21627106	200000000	12370	2.6
	troadlength (KM)	55	113	202	1773	4	1.8
	tstreetlights (nos)	1650	3524	7469	61523	210	2.1
	tswtransported (tons)	10	24	73	900	1	3.0
	parkarea (sq mts)	13646	115930	523453	5632000	2	4.5
	lroadscleaned (KM)	16	65	284	3600	0.3	4.4
INPUTS	onm (INR)	13346500	38650055	130438933	1569443000	867000.0	3.4
	laborcost (INR)	7313000	540232266	7401955836	108000000000	197000	13.7
	perempl (No)	44	98	210	1961	7.0	2.1
	establishment (INR)	672000	10967211	101032896	1400000000	20000.0	9.2
	tcapacityvehicles (tons)	15	221	1505	16240	1.0	6.8

Table 9 above gives the summary statistics of the input and output variables used to generate the input efficiency scores for the ULBs in Karnataka. We use the latest data available for 2009-10 for all the variables. This is a six output five input model with outputs as:

twaters: Total annual water supplied in a ULB,
troadlength:Total roadlength in a ULB,
tstreetlights:Total no. of streetlights in a ULB,
tswtransported: total daily solid waste transported after collection,
parkarea: Total area developed and maintained as parks in a ULB,
lroadscleaned:Total length of roads cleaned daily in the ULB.

The input vector is given by:
onm: total onm expenditures on basic services,
laborcost: total cost on wages, salaries and contractual payments on labor
perempl: Total no. of permanent employees in the ULB,
establishment: total cost of running the establishment of the ULB,
tcapacityvehicles: Total capacityof vehicles for solid waste management of a ULB.

It is to be noted that inputs chosen cover the running operations and maintenance costs, laborcost, human capital stock as number of permanent employees, size or capacity of vehicles to perform a service like solid waste management and the establishment cost. These are the major inputs which go into the provision of important services spelt out in the output vector.

Figure 7 below gives the distribution of efficiency scores of ULBs. Efficiency scores can vary between 0 and 1. We find that more than 50 per cent of the ULBs have efficiency higher than 0.73 and the remaining 50 per cent of the ULBs are distributed in the lower range between 0.27 and 0.73. The efficiency scores of all the ULBs are tabulated in Table A1 in the Appendix 2.

Figure 7:Distribution of Input Oriented Efficiency Scores of Karnataka Cities

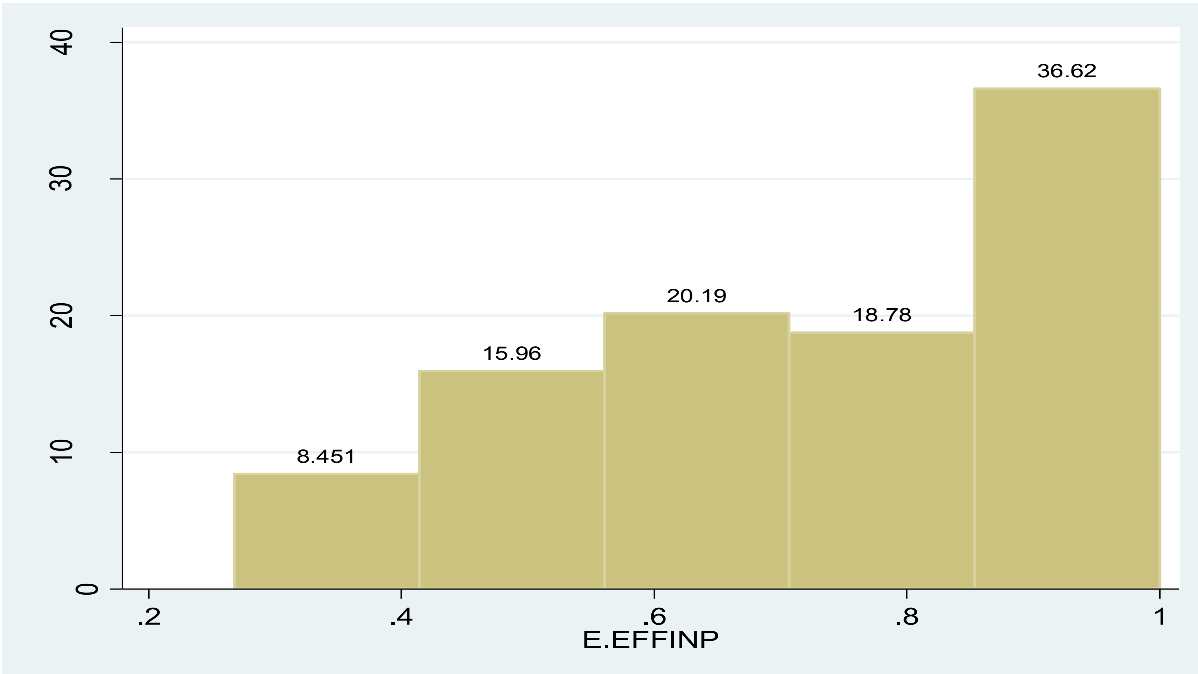


Table 10 :Summary : Input Oriented Efficiency Model of Karnataka Cities

	Below 25,000	25,000 to 50,000	Above 50,000	All
No. Of ULBs	88	75	50	213
Inefficient ULBs (Nos)	64	58	31	153
Inefficient ULBs (%)	72.7	77.3	62	71.8
Median	0.76	0.67	0.77	0.73
Average	0.76	0.69	0.77	0.74
SD	0.2	0.24	0.22	0.22
Max	1	1	1	1
Min	0.3	0.27	0.34	0.27
CV	0.27	0.35	0.28	0.3

Table 10 above summarises some useful statistics. We have grouped the efficiency scores for each size class to generate these statistics from the optimization model results which is applied to all the cities together. We find that there is not much difference in the average and the median and the variation across cities and within a city size class is also minimal. On an average the ULBs in Karnataka can save upto 27 per cent of the inputs to achieve the maximum efficiency in the prescribed model (Table 10). That is to say the cities can provide the same levels of services by utilizing resources lesser by 27 per cent of what they currently use. Though we do not get any uniform pattern for the average efficiency scores across size classes, we find that the highest efficiency score is recorded for the biggest size class of cities and the lowest score in the medium size class. The medium size class also records the highest percentage of inefficient ULBs in the group.

We also attempt an analysis of additional cost saving through slacks in inputs or higher levels of outputs through slacks in output after attaining the maximum efficiency. These slacks locate the sources and quantum of input savings additional to what has been recorded in the radial efficiency scores. Table 11 below summarises the variables in which slacks are recorded. For each size class the number and percentage of ULBs having slacks in important input and output variables in the model are recorded. We find that among the input variables the highest proportion of ULBs record slacks in establishment expenditure and the lowest proportion of ULBs record slacks in ONM expenditure. This is true for all the size classes of cities also. As far as the output slacks are concerned on the whole the highest proportion of ULBs record slacks on the length of roads cleaned.

Table 11 ULBs with Slacks in Input-Used /Output- Produced among Inefficient ULBs

		Below 25,000		**25,000 to 50,000**		**Above 50,000**		**All**	
		No	%	No	%	No	%	No	%
OUTPUTS	twaters	32	50	25	43	11	35	68	44
	troadlength	43	67	24	41	10	32	77	50
	tstreetlights	28	44	26	45	16	52	70	46
	tswtransported	43	67	22	38	8	26	73	48
	lroadscleaned	33	52	39	67	22	71	94	61
INPUTS	onm	9	14	10	17	3	10	22	14
	laborcost	31	48	10	17	5	16	46	30
	perempl	15	23	12	21	5	16	32	21
	establishment	33	52	27.5	47.5	15	48	75	49
	tcapacityvehicles	13	20	28	48	20	65	59	39

From the above analysis it is clear that many of the ULBs can further save resources/increase outputs after reducing the inputs to have a radial contraction of 27 per cent on an average to attain 100 per cent efficiency. We can quantify these slacks by taking the values of the slacks in the respective variables as a percentage of the values of the variables used in the model.

Table 12 Quantum of Slacks in Input-Used /Output- Produced among Inefficient ULBs (%)

		Below 25,000		25,000 to 50,000		Above 50,000		All	
		Average	CV	Average	CV	Average	CV	Average	CV
OUTPUTS	twaters	47	2.5	445	6	51	4	188	8
	total roadlength	47	2	28	3	11	3	32.	3
	streetlights	22	5	14	2	14	2	17	4.
	swtransported	49	2.8	19	2.8	6	3	28	3
	length of roads cleaned	109	5.8	83	2	62	2	89	5
INPUTS	onm	2	3.7	3	3	2	5	2.3	4
	laborcost	13	1.7	4	3.5	2.2	4	7.	2
	perempl	4.	3	4	2.9	3	4	4	3
	establishment	17	1.5	11	1.6	10	1.7	13	1.6
	tcapacityvehicles	5	3	11	1.6	11	1.5	10	2

Table 12 above presents the summary statistics on the quantum of slacks in inputs and outputs in our model. We find that after a radial contraction of all inputs by 27 per cent on an average the ULBs in Karnataka, the quantum of slacks is the highest for establishment expenditures (13 per cent) and lowest for ONM expenditures (2.3 per cent) and this is true for all size classes of cities. For outputs the quantum of expansion potential is the highest for water supply (188 per cent) and the lowest for street-lighting (17 per cent) but this does not hold for all the size classes of cities[9]. In most of the resources and services, the quantum of slack is higher in smaller cities indicating to the fact that mis-utilisation of resources and under-provision of services are more pronounced in the smaller cities.

6. Concluding Remarks

The paper analyses the performance of the ULBs in the state of Karnataka in India in the light of the problems encountered in the city level management in South Asia. One of the major difficulties in the cities in this region has been the inefficiency in service delivery and misallocation of resources of the cities. The paper throws some light on different aspects of performance in Indian cities: be it own revenue generation, expenditure management and service delivery. The paper also attempts to build up an

[9] It is to be noted that the input slack in percentages cannot exceed 100 as the optimization exercise in production involves minimization of inputs and the potential reduction in inputs cannot exceed the amounts of inputs used in the model whereas output slacks can exceed 100 as output expansions are determined from the model and the potential expansion can exceed the amount of outputs produced

integrated framework for analysis of performance in the cities in India bringing in all the aspects of performance together.

It is to be noted that there has been a shortfall in the norms for physical levels of services for all the services in all size classes of cities. We find that own revenues can finance only 27 per cent of the revenue expenditures and 50 per cent of the ONM expenditures on major services. We also find that there is a shortfall of more than 50 per cent of the ONM expenditure norms prescribed for Indian cities on the major services in the cities of Karnataka. We estimate the expenditure requirements on major services and the own revenue potentials of the ULBs and find that there can be a possible increase of 16 per cent in the own revenues which can cover 27 per cent of expenditure requirements on major services.

After a detailed analysis of the expenditures, revenues and service delivery we attempt to fit a DEA model to derive the technical efficiency scores of the ULBs. These scores can give an indication of the possible overspending or under-provision of services by the ULBs in a benchmarking framework. We find that the ULBs on an average can reduce 27 per cent of their expenditures on ONM, labor and establishment to provide the same levels of services provided currently by them. We also find that there can be additional savings particularly on establishment and labor expenditures to operate at the maximum efficiency levels. We find that the extent of problem of unproductive spending and under-provision of services is more pronounced in smaller cities.

Two important points need special mention. First, it has been found that the performances of the smaller cities are more discouraging than the bigger ones. Though in India there has been specific reform agendas targeted for small and medium towns there is a tendency of neglecting these cities. It is to be noted that the performance of the smaller cities are crucial for that of the bigger cities. This dependence has to be respected and smaller cities need more attention.

Second, the mis-utilisation of resources in establishment and laborcost is very common for India cities. It is in the establishment expenditures and contractual payments in the laborcost component we find more leakages as the monitoring of these expenditures are difficult. Sometimes whether some part of these categories of expenditures are justified or not becomes a question. It is because of the administrative inefficiency we get inefficient usage of inputs. The misutilisation of labor as permanent employees indicate that the ULBs of Karnataka have overstaffing problems, if we take into account the levels of services produced as the benchmarks. That is to say to provide the current levels of services, the employment base could be narrower. All these mis-utilisation issues have to be resolved with proper planning and monitoring which is not there in Indian cities. The service level benchmarking as an endeavor of the Ministry of Urban Development is most welcome at this point of time as an effort to initiate the monitoring of services provision in a systematic framework.

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Appendix 1

A Note on Input Efficiency Model[10]

Min: $\tilde{\theta} = \theta - \varepsilon\left(\sum_{j=1}^{m} s_j^+ + \sum_{i=1}^{n} s_i^-\right)$

Subject to: $\sum_{t=1}^{N} \lambda_t y_{jt} - s_j^+ = y_{jt}; \forall j = 1,2,..............,m$

$\sum_{t=1}^{N} \lambda_t x_{it} + s_i^- = \theta x_{it}; \forall i = 1,2,..............,n$ **…………………Model-5**

$\lambda_t, s_j^+, s_i^- \geq 0; \forall t = 1,2,..............., N; \forall j = 1,2,.............., m; \forall i = 1,2,.............., n.$

Where: θ is free.

****

However, the presence or absence of weakly efficient DMUs makes the procedure a little different.

A DMU is efficient iff

$\tilde{\theta}$ =1 and s_i^- ⋆ ≠ 0; and (or) s_j^+ ⋆≠ 0 for all i and j;

A DMU is weakly efficient iff

$\tilde{\theta}$ =1 and s_i^- ⋆ = s_j^+ ⋆=0 for some i and j;

We do not know before the calculations whether weakly efficient DMUs are present. In the absence of weakly efficient DMUs, we can estimate the optimal slacks using eq 5.3 in the second stage.

Min: $\theta = \tilde{\theta}$

Subject to: $\sum_{t=1}^{N} \lambda_t y_{jt} \geq y_{jt}; \forall j = 1,2,..............,m$

$\sum_{t=1}^{N} \lambda_t x_{it} \leq \theta x_{it}; \forall i = 1,2,..............,n$ **…………………5.1**

$\sum_{t=1}^{N} \lambda_t = 1$

$\lambda_t, \geq 0; \forall t = 1,2,..............., N; \forall j = 1,2,.............., m; \forall i = 1,2,.............., n.$

Where: θ is free.

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[10] Ray SC (2004) Data envelopment analysis theory and techniques for economics and operations research.Cambridge University Press (Pp 35-36), Cambridge ; Joe Zhu (2003): Quantitative Models for Performance Evaluation and benchmarking: Data Envelopment Analysis with Spreadsheets and DEA Excel Solver, Kluwer Academic Publishers (Pp 5-9)

Max: $$\left(\sum_{j=1}^{m} s_j^{+} + \sum_{i=1}^{n} s_i^{-} \right)$$

Subject to: $$\sum_{t=1}^{N} \lambda_t y_{jt} - s_j^{+} = y_{jt}; \forall j = 1,2,..............., m$$

$$\sum_{t=1}^{N} \lambda_t x_{it} + s_i^{-} = \tilde{\theta} x_{it}; \forall i = 1,2,..............., n \qquad \textbf{....................5.2}$$

$$\sum_{t=1}^{N} \lambda_t = 1$$

$$\lambda_t, \geq 0; \forall t = 1,2,................, N; \forall j = 1,2,..............., m; \forall i = 1,2,..............., n.$$

Where: θ is free.

****

$$s_j^{+} = \sum_{t=1}^{N} \lambda_t y_{jt} - y_{jt}; \forall j = 1,2,..............., m$$

$$s_i^{-} = \tilde{\theta} x_{it} - \sum_{t=1}^{N} \lambda_t x_{it}; \forall i = 1,2,..............., n \qquad \textbf{....................5.3}$$

Appendix 2

Table A1: Efficiency Scores of the ULBs in Karnataka

Sl no	ULB	Input Efficiency Scores
1	Afzalpur	1
2	Aland	0.600485282
3	Alnavara	0.372469076
4	Alur	0.692001473
5	Anekal	0.391944057
6	Ankola	0.34854772
7	Annigeri	0.396670809
8	Arakalgud	0.463033612
9	Arasikere	0.425046846
10	Athani	0.469462295
11	Aurad	1
12	Badami	0.267654689
13	Bagalkote	0.610659762
14	Bagepalli	1
15	Bailahongal	1
16	Bangarpet	0.67974928
17	Bankapura	1
18	Bannur	0.663859143
19	Bantwal	1
20	Basavakalyana	0.584984124
21	Basavanabagewadi	0.515723808
22	Beelagi	0.875304534
23	Belgaum	1
24	Bellary	1
25	Belthangadi	1
26	Belur	0.821359487
27	Bhadravathi	1
28	Bhalki	0.393483913
29	Bhatkal	1
30	Bidar	1
31	Bijapur	0.877046519
32	Birur	0.617137823
33	Byadgi	1
34	Challakere	0.387033212
35	Chamarajanagar	0.592901
36	Channagiri	0.617379176
37	Channapatna	0.531787969
38	Channarayapatna	0.661097558
39	Chikkaballapur	1
40	Chikkanayakanahalli	0.666857991
41	Chikkodi	0.913105557
42	Chikmagalur	0.471594631
43	Chincholi	1
44	Chintamani	0.339075552
45	Chitradurga	0.512030525

46	Chittaguppa	1
47	Chittapur	0.466822296
48	Dandeli	0.581750689
49	Davangere	1
50	Devadurga	1
51	Devanahalli	0.753726144
52	Doddaballapur	0.603940119
53	Gadag Betegeri	0.888378722
54	Gajendragad	0.851757122
55	Gangavathi	0.693351082
56	Gokak	0.791622627
57	Gowribidanur	0.461725794
58	Gubbi	0.725705106
59	Gudibande	1
60	Gulbarga	1
61	Guledgudda	0.327032065
62	Gundlupet	0.418173539
63	Gurumitkal	1
64	Haliyal	0.973973086
65	Hanagal	0.662912254
66	Hanur	0.850671528
67	Harappanahalli	0.684869388
68	Harihara	0.719963047
69	Hassan	0.707509606
70	Haveri	1
71	Heggadadevanakote	0.809991218
72	Hirekerur	0.829358105
73	Hiriyur	0.470877128
74	Holalkere	0.507967606
75	Holenarsipura	0.300608662
76	Honnali	0.892688886
77	Honnavar	0.576278878
78	Hoovinahadagali	1
79	Hosadurga	0.727447908
80	Hosakote	0.294540384
81	Hosanagara	0.723127062
82	Hospet	1
83	Hubli Dharwad	1
84	Hukkeri	1
85	Humnabad	0.817517188
86	Hunagund	0.87148942
87	Hunsur	0.817596961
88	Ilkal	0.450680815
89	Indi	0.744151872
90	Jagalur	0.561785776
91	Jamakhandi	0.441093502
92	Jewargi	0.338496002
93	Jog Kargal	1
94	K.R.Nagar	0.567094543
95	K.R.Pet	1
96	Kadur	0.824872796

97	Kalagatgi	0.465246435
98	Kamalapur	1
99	Kampli	0.580769045
100	Kanakapura	0.578597458
101	Karkala	1
102	Karwar	0.8735714
103	Kerur	0.653439475
104	Khanapur	0.650212304
105	Kolar	0.942043148
106	Kollegal	0.747127458
107	Konnur	0.643856116
108	Koppa	0.736632418
109	Koppal	0.540031382
110	Koratagere	1
111	Kottur	0.820212088
112	Kudachi	0.678726023
113	Kudligi	0.42530363
114	Kumta	0.53999589
115	Kundagol	0.298041466
116	Kundapur	0.620280104
117	Kunigal	0.667145045
118	Kushalanagara	0.72343212
119	Kushtagi	0.929059586
120	Lakshmishwara	0.382373584
121	Lingasugur	1
122	Maddur	0.798192975
123	Madhugiri	1
124	Madikeri	0.538407015
125	Magadi	1
126	Mahalingapur	1
127	Malavalli	0.551566293
128	Malur	1
129	Mandya	1
130	Mangalore	1
131	Manvi	1
132	Molakalmur	1
133	Moodabidri	0.616161695
134	Mudagal	0.768371325
135	Mudalagi	0.728651278
136	Muddebihal	0.690034253
137	Mudhol	0.738386468
138	Mudigere	0.493871345
139	Mulbagal	0.451427224
140	Mulgund	0.782288787
141	Mulki	0.572023715
142	Mundagod	0.508034006
143	Mundargi	0.708025651
144	Mysore	1
145	Nagamangala	0.564371793
146	Nanjanagud	0.488642792
147	Naragund	0.46562626

148	Narasimharajapura	0.656931406
149	Naregal	1
150	Navalgund	0.37781851
151	Nelamangala	0.935512348
152	Nippani	1
153	Pandavapura	0.563832453
154	Pavagada	0.974227661
155	Periyapatna	0.758718667
156	Puttur	1
157	Rabkavi Banhatti	0.647527044
158	Raichur	0.888157094
159	Ramadurg	0.853467281
160	Ramanagaram	0.55287467
161	Ranebennur	0.573565772
162	Rayabagh	1
163	Robertsonpet	1
164	Ron	0.348973828
165	Sadalaga	0.769409712
166	Sagar	0.518933808
167	Sakleshpura	0.680600629
168	Saligrama	1
169	Sandur	1
170	Sankeshwar	1
171	Saragur	0.51260523
172	Saundatti	0.801861788
173	Savanur	0.439343397
174	Sedam	0.897733821
175	Shahabad(CMC)	1
176	Shahapur	0.463381403
177	Shidlaghatta	1
178	Shiggaon	1
179	Shikaripura	0.673051396
180	Shimoga	1
181	Shiraguppa	0.8330567
182	Shirahatti	1
183	Shiralakoppa	0.655718452
184	Shringeri	0.672077641
185	Shrirangapatna	0.927500185
186	Siddapur	0.707773715
187	Sindagi	0.675323588
188	Sindhanoor	0.718244339
189	Sira	1
190	Sirsi	0.558658163
191	Somwarpet	0.49591436
192	Soraba	1
193	Srinivasapur	0.416883088
194	Sullya	0.880430742
195	Surpur	1
196	T.Narsipur	0.914094635
197	Talikote	0.598099575
198	Tarikere	0.367690064

199	Tekkalakote	0.746076709
200	Teradal	0.789954094
201	Thirthahalli	0.768935418
202	Tiptur	0.347141991
203	Tumkur	0.692431944
204	Turuvekere	0.722542801
205	Udupi	1
206	Ullal	1
207	Vijayapura	0.970651338
208	Virajpet	0.842466396
209	Wadi	0.553134217
210	Yadgir	0.71026863
211	Yelandur	1
212	Yelburga	0.74838059
213	Yellapur	0.581849336