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A small improvement: small cities lag in expanding household water coverage across urban India

Nidhi Subramanyam

Department of City and Regional Planning, Cornell University, 106 West Sibley Hall, Ithaca, NY 14850, USA.
E-mail: ns684@cornell.edu

Abstract

This paper investigates how progress towards meeting the sustainable development goal of providing universal and equitable access to drinking water for all is distributed across the spectrum of urban settlements. The study measures how urban local governments ($N = 3{,}547$) in a rapidly urbanizing country, India, have increased their coverage of water supply to households between 2001 and 2011. I use theories on multilevel governance of urban services to develop a multilevel linear regression to model the city- and state-level factors associated with growth in water supply coverage. The results show that 68% of cities and towns have recorded water coverage growth, but the extent of this progress is unequally distributed across cities in different states and between cities of different sizes. Small cities and towns, which house over two-thirds of India's urban population, have recorded significantly lower water coverage growth rates as have cities in low-income states. These findings suggest that policies for urban water infrastructure development should focus on smaller cities and towns if we are to achieve spatial equity in access to water for all in an increasingly urban world.

Keywords: India; Multilevel governance; Small cities and towns; Spatial equity; Urban water coverage

Introduction

Goal 6 of the United Nations Sustainable Development Goals (SDG) hopes to achieve universal and equitable access to safe drinking water for all by 2030. Globally, many efforts are underway to meet this target, but it is unclear how these efforts are realizing the goal of *equitable* access. Equity is a relational concept (Fauconnier, 1999), and therefore, can be operationalized differently across contexts. Nevertheless, the scholarship identifies social equity, gender equity, inter-generational equity, and spatial equity as key dimensions of equity in water access across contexts (Phansalkar, 2007)[1].

[1] According to Phansalkar (2007), social equity refers to equity in access between different social groups living in the same locale. Gender equity entails equity between genders in sharing the costs of acquiring water and the benefits derived from its use. Inter-generational equity is equity in access across generations, and spatial equity refers to equity in water access between communities living in different regions.

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Spatial inequities in water access between rural and urban dwellers have been documented by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) through their Joint Monitoring Program (WHO & UNICEF, 2017) and have consequently been addressed through national policies. However, we know little about spatial inequities in water access between urbanites living in the broad spectrum of cities ranging from megacities on one end to newly urbanized villages or small towns at the other. Disaggregating the progress that governments are making towards attaining SDG #6 by urban settlement type (e.g., Cole *et al*., 2018) can help us target policies towards city categories and populations that have lower levels of access and thereby achieve spatial equity in water access in an increasingly urban world. To address this practical need of achieving spatial equity in water access through targeted policies, this paper investigates how progress towards meeting the SDG goal of providing safe water for all is distributed across cities of different size categories in urban India[2]. I measure how local governments have increased the coverage of water services to households across cities of different sizes and administrative categories. I also model the multilevel factors associated with progress in urban water coverage at the city level to identify areas for policy intervention.

This paper builds on prior research that has examined spatial disparities in access to basic services like water sanitation across urban India. Approximately 377 million urban Indians reside in over 4,000 cities and towns of different sizes; nearly 55% of them live in small cities and towns (Census of India, 2011). On average, about two-fifths of these urban Indians had access to treated tap water supplied by the local utility (municipality or equivalent) in their housing premises in 2011. However, if we disaggregate this figure by city size category, we find that only 41% of households in small cities and towns had access compared to 69% in larger cities. Previous studies have noted these disparities and have disaggregated inequalities by state (provinces) (Kundu, 2009; Kundu & Banerjee, 2018) as well as by the statutory status of cities (Mukhopadhyay, 2017). However, these researchers have not yet traced if small cities and towns have improved their water coverage at rates comparable to (or ideally higher than) larger cities, considering that they have much catching up to do. Nor have these studies tried to model the city- and state-level factors associated with improving cities and towns. My study attempts to fill this scholarly gap. I measure growth in water supply coverage across cities of different sizes and administrative categories. I also use a multilevel regression model to identify and discuss the influence of both city-level and contextual (state-level) factors in shaping growth in water supply coverage for urban households.

The paper proceeds as follows: a brief review of the literature, which identifies the multilevel factors associated with spatial disparities and improvements in urban service delivery, follows this introduction. I use this literature to develop hypotheses. Further, I provide a brief discussion of the variables, data sources, and modelling methods. The fourth section consists of the empirical results of the study, and the concluding section discusses the implications of the findings for policies focussed on improving water-sanitation coverage across urban India.

Literature review: multilevel factors linked to urban service delivery outcomes

According to the vast interdisciplinary literature on urban service delivery, factors at multiple governance levels shape service delivery outcomes in decentralized federal state systems. Within India's

[2] Focusing on one country limits generalizations, but it helps us overcome the difficulties associated with making comparisons across country contexts that have significant variations in city definitions and typologies.

federal state system, cities derive their powers, responsibilities, and mandates for water-sanitation service provision from their respective state (provincial) governments (Mathur *et al.*, 2011). Service delivery outcomes at the city level are, therefore, shaped by factors endogenous to the city as well as exogenous factors that depend on their respective state context.

Endogenous city-level factors that affect a city's ability to provide basic water-sanitation services include a strong tax base and a local government with the requisite human resource, technical, and social capacity to maintain the services. As a result of their small population size and lower household incomes on average, small cities tend to have smaller tax bases and, therefore, less capacity to pay for basic services (UN-HABITAT, 2006). Compared to larger cities, they lack government capacity (financial, human resource, and administrative) for effective service delivery. They are also unable to exploit economies of scale or density for infrastructure-intensive services like water supply and drainage that have significant fixed costs of production (Charron & Fernandez-Albertos, 2013). A lack of creditworthiness, inability to issue municipal debt, or meet the obligations of debt service further constrains small towns in developing countries (Humphreys *et al.*, 2018). Other studies have found that small towns located in the proximity of large metropolitan areas tend to have lower levels of poverty (The World Bank, 2011). They are also able to draw upon a regional labour force with higher human capital (Avellaneda & Gomes, 2015) or benefit from regionally focussed water infrastructure projects[3]. Therefore, we need to factor the influence of a city's spatial location in addition to its size and government capacity.

In India, too, metropolitan (or large) cities – those with over a million residents – have better coverage of basic services compared to non-metropolitan cities across all states. Vibrant economies have enabled some metropolitan cities to raise infrastructure development funds from domestic and international markets after neoliberalization (Kundu & Banerjee, 2018). Larger cities also generate a higher proportion of their revenue internally through property taxes and user fees (Mathur *et al.*, 2011; Shastri, 2011). Unlike small cities, local governments in larger cities have higher access to human capital, i.e., professional expertise to partner with communities or private capital in implementing governance reforms and infrastructure projects (Asthana, 2012; De Bercegol, 2017; Kundu & Banerjee, 2018). The literature suggests that there exists a strong relationship between city size and the availability of basic services with a higher proportion of households in large cities having access compared to the proportion in small cities. Based on these studies, I hypothesize that city-level factors such as the size of its tax base, its local government capacity, population size, and density are associated with growth in water coverage, with cities having bigger tax bases, higher government capacity, larger populations, or greater densities recording more growth in coverage. Additionally, cities located in the proximity of metropolitan regions will likely record more growth in water coverage due to lower poverty levels and higher access to regional human capital.

Although small cities have lower levels of water-sanitation coverage and lower capacities to improve these services, the intergovernmental structure can compensate for these deficiencies through fiscal transfers (Warner, 2013). The National Urban Renewal Mission (NURM) was one of the first nationwide grant-based funding policies to focus on developing water-sanitation infrastructure in cities. Launched in 2005 by the national government, the NURM had an outlay of about USD (26.7×10^9) in urban infrastructure for over ten years (Khan, 2017). Whereas this policy allocated 66% of the total funds to metropolitan (large) and medium-sized cities, which comprised only 42% of the total

[3] For example, the Water Board of the Indian state of Tamil Nadu (TWAD) frequently constructs combined water supply schemes that benefit wayside towns and villages in addition to the target city.

urban population (Kundu, 2009; Sivaramakrishnan, 2011), it also had a sub-component called the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) for smaller cities and towns. However, states decided which cities received funds through the UIDSSMT. The impact of this intergovernmental funding scheme on improving the coverage of basic services, independent of the effect of city size, remains to be seen. I hypothesize that intergovernmental aid through the NURM or UIDSSMT would have a positive relationship with improvements in water supply coverage.

In addition to city-level factors, contextual factors such as characteristics of the state's political economy also impact service delivery outcomes. Previous studies have found that urban households in economically advanced states generally have better access to basic services (Kundu, 2009). Similarly, states that are more urbanized have better coverage of basic services in urban areas (Kundu & Banerjee, 2018). States with a higher proportion of urban voters will likely prioritize improvements in urban services through policies, political commitments, intergovernmental aid, or technical support. Therefore, I hypothesize that a higher proportion of urbanization at the state level will be positively associated with an increase in water supply coverage at the city level. Mathur *et al*. (2011) further argue that municipal expenditures on basic services not only depend on state-level economic or urbanization factors but also on the devolution of service delivery mandates and revenue-raising powers to municipalities, i.e., the degree of fiscal decentralization in a state. In their view, municipalities in states with a higher degree of fiscal decentralization are better empowered to develop infrastructure, as they are less dependent on fiscal transfers from higher levels of the state. Based on these findings, I hypothesize that cities located in more decentralized states will record greater growth in the coverage of water services.

Based on this brief review of the literature, I hypothesize that growth in water service coverage to urban households would be unequally distributed across cities of different size categories and states in India, with small towns in less urbanized and poorer states recording less growth. As noted, both state- and city-level factors would be associated with the magnitude of growth in water coverage, with population, growth rates, city size (or local government capacity), density, and intergovernmental aid being important city-level factors.

Data and methodology

Study unit and area

As this paper measures and models growth in water supply coverage to urban households across various cities, I use urban local governments – cities and towns – as the unit of analysis. Decentralization reforms, implemented in the early 1990s, devolved the responsibility of providing and maintaining water services to urban local governments[4]. Since cities derive their powers and functions from their respective state governments in India's federal government system, I group cities and towns by states. However, I exclude cities within nationally controlled Union Territories from the dataset. The dataset includes all statutory cities and towns, which were enumerated by both the 2001 *and* 2011 national census in India[5].

[4] Although parastatals, state departments, or private utilities may build bulk water infrastructure, local governments remain primarily responsible for installing and operating household connections, and therefore, increasing service coverage.

[5] The dataset excludes cities from the northeastern states of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura due to the non-availability of data for all our variables.

Variable measures

Urban households across India rely on both surface and groundwater procured from a combination of public and private sources to meet their daily needs. This analysis is restricted to water obtained from publicly operated (municipal) sources, as it helps us measure progress in urban local governments' efforts to expand service coverage to all their residents. The dependent variable measures improvements in the coverage of public water supply. I measure improvements as the increase (or decrease) in the proportion of urban households whose primary water source was tap water accessed within the residence, between the years 2001 and 2011. Although some urban local governments supply water through public standpipes connected to groundwater sources (e.g., Lele *et al*., 2018), I focus on households' access to tap water within the dwelling since it denotes a high level of water access that encompasses both health (through safe quality) and overall well-being (through reduced collection time and costs) (Goff & Crow, 2014)[6]. The census data measures the dependent variable consistently across the two census periods at the city level for each city in the dataset.

Table 1 shows the descriptive statistics for all our model variables. As noted in the literature review, I expect both city-level and state-level factors to influence improvements in coverage. City-level factors that shape improvements in municipal water services are the availability of a high tax base and a local government with an enhanced capacity to execute and operate water infrastructure projects efficiently. Since consistent data on the tax base, municipal budgets, median income, or local government capacity are not available for all cities, particularly small towns, I use proxy measures. Studies have found that, on average, residents of smaller cities and towns tend to be poorer than their metropolitan counterparts (Ferré *et al*., 2012). Hence, I use city size as a proxy measure for the tax base and hypothesize that improvements in services would be significantly lower in smaller cities and towns. The Indian census does not officially define small cities and towns in the Indian context; what is small is relative and varies considerably from one state to another (Kudva, 2015). Nevertheless, see Table 2 for the size-based categorization of Indian cities that I adopt following other scholars (Shaw, 2013; Mukhopadhyay, 2017; Haque *et al.*, 2018).

However, not all small cities are governed by local governments with weak administrative capacities. Therefore, I repeat the model with another proxy measure for measuring local government capacity. I use administratively defined urban local government categories as a measure for local capacity. Urban local governments in India are categorized as municipal corporations, municipalities, or town councils (or *panchayat*s) for administrative purposes. Across all states, municipal corporations have larger, well-endowed municipal governments with greater powers and responsibilities compared to municipalities, and municipalities have higher local government capacity compared to town *panchayats* or councils. Administrative categories generally correspond to population size categories (see Table 2). However, in many states, smaller cities with considerable political, economic, or cultural significance may belong to a higher administrative category. For example, tourism centres like Tirupati in the state of Andhra Pradesh or the state capital of Goa – Panaji, are governed by municipal corporations despite being small-sized cities. Hence, the study uses the city's administrative category in addition to its size category as a measure of its local government capacity.

[6] Where municipalities may supply water through groundwater sources, the water is usually untreated and consequently unfit for drinking (Lele *et al*., 2018).

Table 1. Descriptive statistics of growth in water supply coverage to urban households across India, 2001–2011.

	Mean	SD	
Dependent variable[a]			
Improvement (growth) in water supply coverage to urban households between 2001 and 2011 (percentage points)	5.08	12.64	
Independent variables (city level)[b]			
Population, 2011[c]	83,543.56	370,393.90	
Population growth rate, 2001–2011 (percentage points)[c]	17.59	24.71	
Coverage of water supply to households in 2001 (percentage points)[a]	37.09	23.54	
Distance to nearest metropolitan city (in km)[d]	128.22	106.65	
Population density, 2011 (in persons/km^2)[c]	4,959.15	6,827.47	
Intergovernmental aid (rupees per 1,000 persons)[e]	305.5	1,281.2	
City size category			*Frequency* (%)
Metropolitan (large) city			44 (1.24%)
Medium city			43 (1.21%)
Small city			380 (10.68%)
Small town			3,091 (86.87%)
Local government category[c]			
Municipal corporation			145 (4.08%)
Municipality			1,534 (43.11%)
Town *panchayat* and others			1,879 (52.81%)
Independent variables (state level)[f]			
Proportion of urban population, 2001[g]	26.82	10.72	
State income in 2004 (NSDP per capita in rupees)[h]	26,623.97	14,122.11	
Index of decentralization[i]	0.22	0.34	

[a]*Source*: Houselisting and Housing Data from Census of India, 2001 and 2011.
[b]$N = 3{,}547$ cities.
[c]*Source*: Town directory of Census of India for 2011.
[d]*Source*: Authors' calculations using city-level geocoordinates obtained from 'India Place Finder' (http://india.csis.u-tokyo.ac.jp/).
[e]Website archive of the Ministry of Urban Development available at http://urbanindia.nic.in/.
[f]$N = 21$ states.
[g]*Source*: Primary Census Abstract tables of Census of India, 2001.
[h]*Source*: Tables from the Directorates of Economics and Statistics for each state available at https://data.gov.in.
[i]*Source*: Mathur *et al*. (2011).

The model uses the physical distance from the nearest metropolitan city measured as the crow flies (in kilometres) to capture the effect of spatial location on a city's ability to improve its services. Economies of scale and density associated with networked infrastructural services that have high fixed costs of production also affect a city's ability to expand water services (Charron & Fernandez-Albertos, 2013). Prior research in other countries, including India, has found higher costs of service delivery in concentrated urban areas and sparsely populated rural areas or small towns (Warner, 2006; Bassi & Kumar, 2012). I use population (logged to prevent skewness), density (also logged), and its squared-term to capture these increased costs at the lower and upper ends of the population density spectrum (Xu & Warner, 2016). I expect that improvements would increase with density but would diminish at very high densities, as cities incur more costs for service delivery. I also control for service needs measured as initial levels of water coverage (in 2001) and population growth rates. I expect water coverage to expand in

Table 2. City size categories based on population and their distribution by local government type in India.

City size class	Population	Distribution by local government type (%)[a]		
		Municipal corporation	Municipality	Town *panchayat* and others
Metropolitan city[b] ($n = 44$)	>= 1,000,000	100.00		
Medium city ($n = 43$)	500,000 to 999,999	93.02	4.65	2.33
Small city ($n = 380$)	100,000 to 499,999	15.53	81.32	3.16
Small towns ($n = 3,091$)	<= 100,000	0.06	39.53	60.41

[a]Local government type for each city was obtained from the Town Directory of Census of India for 2011.
[b]Indian urban policies define a metropolitan city as one with at least one million (1×10^6) residents. There are no policy definitions for small and medium cities.

tandem with population growth. I measure the impact of intergovernmental aid by including the amount of funds allocated towards water projects per capita for each city through the NURM or UIDSSMT program. I hypothesize higher amounts of allocations per capita to be positively correlated with growth in water supply coverage.

State-level factors that affect improvements in water coverage at the city level include state income, levels of urbanization, and the degree of decentralization. I measure state income as the net state domestic product (NSDP) per capita during the middle of the study period (2004) and expect it to be positively correlated with improvements in services. I also include a measure of decentralization at the state level, as I expect more decentralized states to have fiscally healthy municipalities that are capable of expanding access to basic services like water sanitation on their own. Following Mathur *et al.* (2011), I measure this variable as the proportion of a state's gross domestic product that is contributed by urban municipalities' internal revenues within a state and use data from the year 2007. Higher values of the measure of decentralization signify that urban local governments have high revenue-raising capacities, and therefore, are more likely to expand water service coverage to their residents.

Modelling methods

This paper investigates the different city- and state-level factors associated with the magnitude of growth (improvements or decline) in water supply coverage at the city level. Since the data are grouped at the state-level and multilevel factors affect city-level outcomes, I use a nested multilevel linear regression model with random effects to account for both city-level and state-level variance. As an elaboration of the standard ordinary least squares model, multilevel modelling helps us measure how relationships between city-level variables and the outcome variable, i.e., growth (improvements) in water supply coverage, vary from state to state. We estimate our model using the following simultaneous equations and maximum likelihood estimation:

$$\mathrm{IMP}_{cs} = \beta_{0s} + \beta X_{cs} + e_{cs}$$

$$\beta_{0s} = \Upsilon_{00} + \Upsilon\, Z_{cs} + e_{0s}$$

$$\Rightarrow \mathrm{IMP}_{cs} = \Upsilon_{00} + \Upsilon\, Z_{cs} + e_{0s} + \beta X_{cs} + e_{cs}$$

where

IMP_{cs} represents the improvement (or growth) in water supply coverage in city c in state s;
β_{0s} is the intercept or mean value of improvement in water coverage in a state s, independent of city-level effects;
X is a vector of city-level variables (local government capacity, spatial location, economies of scale, growth, and intergovernmental aid) that impact improvements (or growth) in water coverage through a vector of coefficients β;
e_{cs} is the city-level error term, which is assumed to be normally distributed with a constant variance σ^2;
Υ_{00} is the average improvement in water coverage across the dataset that is a state-specific effect;
Υ is the vector of regression coefficients for the effect of Z state-level variables (urbanization, income, and decentralization) on the adjusted improvement in coverage at the state level; and
e_{0s} is the state-level error term, which is assumed to be independent from the city-level errors e_{cs} and normally distributed with variance τ_{00}.

Results and discussion

Spatial inequities in improvements in water supply by city and state

The data reveal that the coverage of water supply to urban households improved in 68% of Indian cities between 2001 and 2011. The remaining cities and towns, which represent nearly a fifth of the large and medium-sized cities as well as a third of the small cities and towns, recorded declines in water supply coverage, i.e., the proportion of households relying on tap water. Figure 1 shows that a majority of the cities that experienced substantial declines in the coverage of water services are smaller cities located outside metropolitan regions in the central and northern states of the country. Declines in the coverage of tap water are indicative of the failure of local governments to meet the challenge of rapid urbanization in villages and small towns on the periphery of large cities and safeguard the well-being of their residents by expanding access to treated tap water for all. Inadequate coverage of municipal piped supply leads households to switch to alternative sources like borewells, open wells, or water purchased from tankers or private vendors as their primary source of water, which create economic burdens for households and environmental burdens for future generations (Prakash, 2014; Kundu & Banerjee, 2018; Mitlin *et al.*, 2019).

Table 3 shows the average improvements in water coverage by city size and local government category. In concurrence with the literature, the results show that, on average, small cities and towns had a smaller proportion of households covered by water supply in 2011. On average, these small cities and towns also recorded lower progress in expanding water coverage (the magnitude of an increase in the proportion of households covered by tap water) between 2001 and 2011. We observe a similar trend when we disaggregate growth in water coverage by local government category. Municipalities and town *panchayats* that correspond to small cities and towns have recorded lower levels of improvements in the proportion of households covered by tap water. These observations suggest that city size and local government category are predictors of improvements in the coverage of water supply to households. The multilevel regression model tests the significance of this relationship.

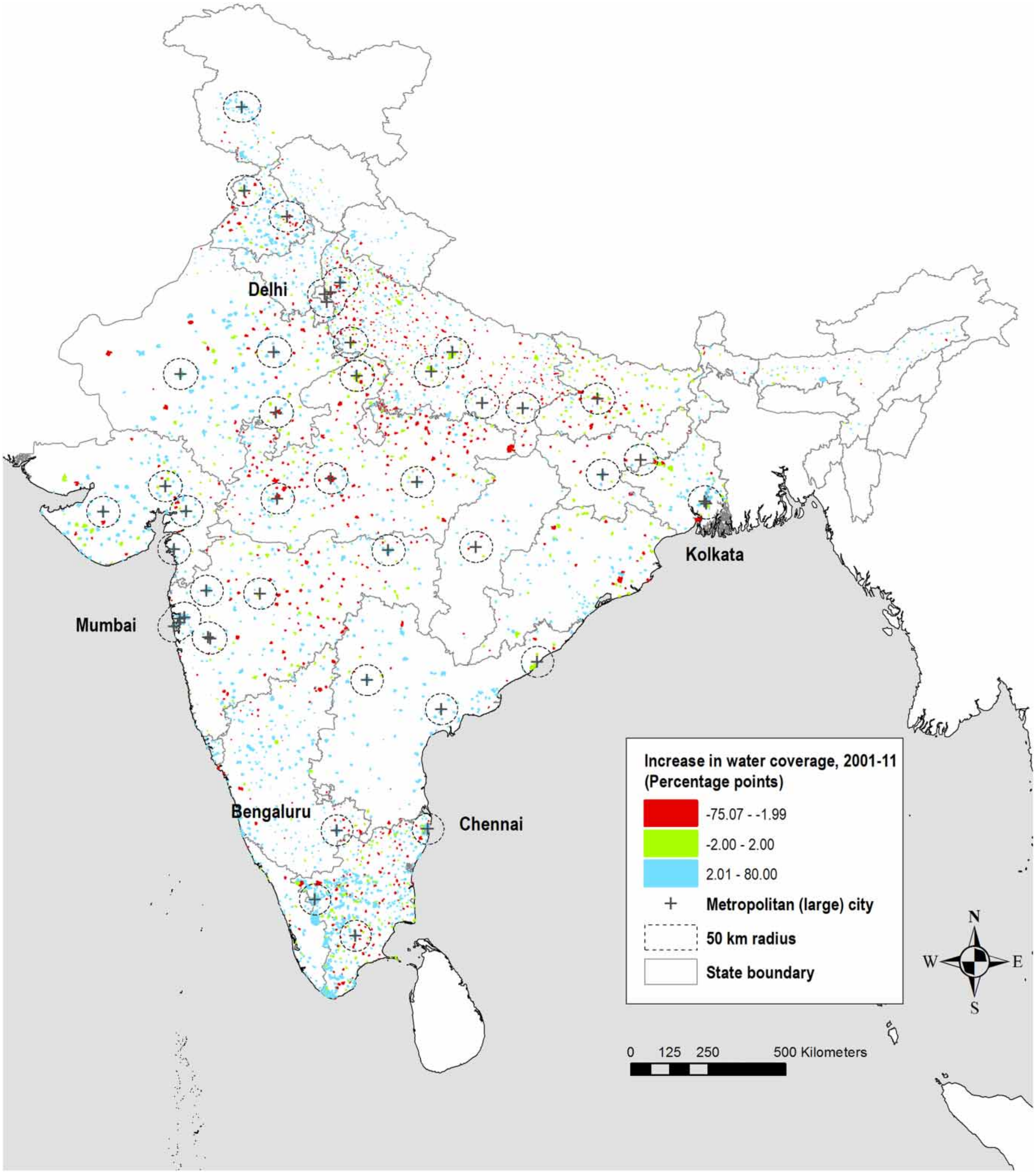

Fig. 1. Map showing water coverage growth by city in India between 2001 and 2011. *Source:* Prepared by the author using data from the Census of India's Houselisting and Housing Tables for 2001 and 2011 as well as city-level GIS shapefiles obtained from Meiyappan *et al*. (2018). Please refer to the online version of this paper to see this figure in color: http://dx.doi.org/10.2166/wp.2020.116.

Table 3. Average increase in household water coverage by city size and local government category in India, 2001–2011.

	% households covered by tap water in 2001 (Average)	% households covered by tap water in 2011 (Average)	Average increase in percent households covered by tap water between 2001 and 2011
City size category			
Metropolitan (large) city	61.69	68.90	7.22
Medium city	56.59	62.32	5.73
Small city	45.63	50.26	4.63
Small town	35.40	40.52	5.11
Local government category			
Municipal corporation	52.22	59.08	6.86
Municipality	43.93	48.95	5.02
Town *panchayat* and others	30.31	35.34	5.01

Note: $N = 3{,}547$ cities.
Data source: Houselisting and Housing Data from Census of India, 2001 and 2011.

Upon analysing improvements by state, I find that on average, cities in states with higher state incomes have recorded greater improvements in the proportion of urban households covered by tap water between 2001 and 2011. States that have recorded progress in expanding urban water coverage are Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, and Tamil Nadu in the southern and western regions of the country, and Haryana, Himachal Pradesh, and Punjab in the north. Most of these states (except Himachal Pradesh) also have a higher proportion of urban population. They are among India's more developed, high-income states. Figure 1 suggests that a city's spatial location, i.e., state context and proximity to a metropolitan region, and its size class are likely critical factors associated with improvements in its water supply indicators. The next section discusses the results from the multilevel linear regression model that identifies the factors associated with improvements in water supply coverage at the city level.

Model results

Table 4 presents the results of the multilevel regression model. Unsurprisingly, we find that initial levels of water coverage at the city level are negatively related to the growth in coverage. Urban infrastructure policies should, therefore, target cities with lower initial levels of coverage. Density, population, and population growth rates are not statistically significant predictors of improvements in water supply between 2001 and 2011. These variables could be insignificant because the variables for city size or local government category likely capture some of these population and density-related variations. The distance from the nearest metropolitan region is also an insignificant predictor of improvements in coverage after controlling for other factors.

However, local government capacity, which is measured either as city size or administrative category, is significantly associated with variations in the proportion of urban households covered by public water supply after controlling for population, growth rate, density, and initial levels of coverage. Across both

Table 4. Multilevel regression model results discussing improvement in household water coverage across Indian cities between 2001 and 2011.

	Model 1 (city size categories)		Model 2 (local government categories)	
	Coefficient	SE	Coefficient	SE
Dependent variable:				
Improvement (growth) in household water coverage at city level, 2001–2011 (percentage points)				
Independent variables				
City-level variables				
Ln (population)	0.070	0.334	0.018	0.331
Population growth rate, 2001–2011	−0.009	0.008	−0.009	0.008
Coverage of water supply to households in 2001	−0.173***	0.011	−0.173***	0.012
Distance to nearest metropolitan city	−0.002	0.002	−0.003	0.003
Ln (population density, 2011)	0.357	0.239	0.369	0.238
Ln population density squared	−0.156	0.111	−0.152	0.110
Intergovernmental aid	−0.034**	0.015	−0.034**	0.015
City size category (reference category: metropolitan (large) city)				
Medium city	−2.238	2.504		
Small city	−5.122**	2.011		
Small town	−5.432**	2.209		
Local government category (reference category: municipal corporation)				
Municipality			−4.062***	1.254
Town *panchayat* and others			−4.034***	1.540
State-level variables				
Percent urban population, 2001	−0.104	0.167	−0.104	0.167
State income in 2004	0.001***	0.000	0.001***	0.000
Index of decentralization	−2.011	3.949	−2.016	3.936
Constant	6.034	5.672	5.150	5.420
Between state variance	23.67	8.240	23.447	8.159
Within state variance	130.01	3.010	129.890	3.096
R^2 state level	14.91%		15.66%	
R^2 city level	8.22%		8.42%	
ICC	0.155		0.153	

Note: Standard errors are clustered at the state level. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$(two-tailed test).
$N = 3{,}547$ cities nested within 21 states across India.

the model specifications, small cities and towns have significantly lower levels of improvements (about five percentage points) relative to large and medium-sized cities. Thus, small cities and towns are lagging in making progress towards attaining SDG #6 of expanding water coverage to their residents. Large and medium-sized cities are governed by municipal corporations with higher revenue-raising potential and administrative capabilities to build and operate water-sanitation infrastructure relative to smaller cities. Statistically significant differences between large and small cities imply that policies for improving the coverage of water have hitherto favoured larger, metropolitan cities at the cost of smaller cities that house (and will continue to house) the demographic majority.

Contrary to my hypothesis, I observe that intergovernmental aid is negatively related to changes in the coverage of water services, and its impact is statistically significant after controlling for other factors.

Intergovernmental aid likely produces a downward effect on improvements when cities utilize aid for developing bulk water infrastructure or upgrading technologies instead of investing it in expanding coverage to households. To ensure that aid translates into expanded coverage, national and state governments should make conditional transfers. This study is currently limited by the lack of data on institutional configurations for water service delivery at the city level, which are also crucial in explaining coverage rates (Gupta *et al*., 2012). The available data also prevent us from examining if the coverage of tap water translates into adequate frequency or quality of water supply for urban households. Despite these limitations, the city-level variables in our model explain nearly 9% of the variation in improvements in water coverage.

The intra-class correlation (ICC) for the multilevel model denotes that nearly a sixth of the variance can be attributed to state-level factors. Unsurprisingly, state income is a statistically significant contextual factor influencing improvements in water coverage. For two cities that are identical in size (or administrative) categories, density, initial levels of water coverage, and the amount of intergovernmental aid, the effect of being in a state with an additional 1,000 rupees of NSDP per capita is a 1.0 percentage point increase in household water coverage during the 2001–2011 period. Thus, urban households not only have better access to water services in high-income states but their access is also expanding at a higher rate in these states. If we hope to reduce spatial disparities in water access between states, then we should direct future fiscal transfers and capacity-building processes towards cities in economically backward states. The model results further reveal that a state's level of urbanization or degree of decentralization does not have any statistically significant relationship with growth in water coverage in its cities.

State-level variables explain a little over 15% of the variation (or nearly twice as much variation as the city level portion of the model) in improvements in water services. The model results highlight that an increase (or decrease) in the proportion of urban households relying on tap water between 2001 and 2011 is driven as much by endogenous (city-level) characteristics such as local government capacity as it is by contextual (state-level) factors such as the level of economic development in the state in a multilevel governance system. Thus, policy measures that seek to expand the coverage of water infrastructure will have to consider both state- and city-level factors associated with variations in water access.

Conclusion

Global efforts for eliminating spatial inequities in access to safe water have so far focussed on measuring and closing the gaps between rural and urban settlements. However, a focus on this rural–urban dichotomy misses the needs of the many small cities and towns that lie in the middle (Tutusaus & Schwartz, 2018). Small cities and towns encapsulate spatial challenges inherent to both rural *and* urban places: they are too large for the decentralized, collectively managed infrastructural solutions pitched to rural settlements, and often lack the diverse user base or density required for cross-subsidizing expensive water networks as in large cities. Despite their demographic weight, we know little about the progress that small cities are making towards extending water coverage vis-à-vis larger metropolitan cities.

This paper aimed to measure whether progress towards meeting the SDG goal of providing safe water to all was equitably distributed across cities of different sizes in urban India. The findings show that more than two-thirds of the cities have made steady progress in expanding water coverage for their residents, i.e., the proportion of the population covered by tap water has increased between 2001 and 2011. The simultaneous decline of tap water coverage in about a third of the cities is worrying, as it suggests an increasing reliance on groundwater or water imported through tankers. If urban local governments do not step in with piped water supply systems, an indiscriminate abstraction of groundwater can cause irreversible water stress in the future. Upon disaggregating improvements in water coverage by city size and spatial location, I observe that on an average, larger cities and those in high-income states have recorded more significant improvements in the proportion of population covered by safe water relative to smaller cities or cities in low-income states. The results of a multilevel linear regression model further support the hypothesis that local government capacity – measured using proxies like city size and local government category – is significantly associated with progress in expanding water coverage after controlling for other relevant city-level and contextual (state-level) factors.

These results suggest that the achievement of universal and equitable coverage of water services is contingent on expanding water coverage in small cities and towns, especially those located in economically backward states and those with historically lower levels of coverage. Unfortunately, as rapidly urbanizing small cities and towns straddle the rural-urban divide, they have so far been overlooked by both rural *and* urban water infrastructure development policies, the latter being biased towards metropolitan cities. Current urban infrastructure policies are not tackling the coverage deficit in small towns either. The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) reforms succeeded the NURM in 2015. These reforms aim to provide universal coverage of water and sewerage services to all urban households. Although this reform has extended financial and technical support for developing water infrastructure to nearly 99% of the municipal corporations (large and medium-sized cities), it has only targeted 1% of the municipalities and town *panchayats* (small towns) across the country[7]. Thus, the AMRUT reforms are a missed opportunity for reducing spatial disparities in water access across the entire range of cities and towns. To correct for these vast spatial inequities in urban water coverage growth, governments at the state and national levels will have to develop new policies and make targeted investments in water infrastructure, service delivery, and institutional capacity building in smaller cities and towns. For example, states can help small towns overcome specific scale-related challenges (e.g., lack of economies of density) by creating an enabling policy environment for alternative governance arrangements. Some possible alternatives include co-operative or regional-level management of water infrastructure by a cluster of proximate local governments that share resources and expertise across jurisdictions (Warner, 2013). In addition to critical financial and technological investments in water infrastructure in small towns, we will also have to invest in human capital to help water managers operate water infrastructure efficiently and equitably (also see Asthana, 2012).

Future research that seeks to address spatial inequities in water access can identify the specific dimensions of local government capacity associated with improvements in the coverage of water supply at the city level in small cities. The community capitals framework, which identifies natural, financial, physical (infrastructural), human, political, and social capital that are the constituent dimensions of the capacity to govern water (González Rivas *et al*., 2014), can be a useful starting point. To understand how historical development trajectories of cities shape local institutional capacity and improvements

[7] The coverage criteria of the Mission provided on its website (http://amrut.gov.in/writereaddata/Coverage.pdf (Accessed 23 June 2019)) reveals that a big city bias is built into the Mission.

in water coverage today, future research can also investigate the ways in which rural, industrial, or regional development schemes have shaped specific legacies of water infrastructure planning in small cities and towns that have substantially expanded water coverage in the last two decades.

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