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How Do You Make a Smart City Clean?

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Executive Summary

This paper draws attention to two signature campaigns of the Bharatiya Janata Party government in India – Smart Cities and *Swachh Bharat* (Clean India) and identifies difficulties facing the task of making smart cities clean.

The paper begins by focusing on the under-powering of local governments, which are expected to provide many of the services that public-sanitation regulations prescribe. The paper then examines four formal categories of waste – the solid waste of households and businesses, construction and demolition (C&D), hazardous and bio-medical. All four categories are governed by admirable – but hitherto unattainable – rules spelt out by the central government and intended to ensure safe and productive disposal. In the final section, the paper examines the most difficult category of all – liquid waste and sewage. Sewage presents immense public-health threats, yet its disposal raises formidable cultural problems.

The paper offers no panaceas but provides a digest of the complexities of urban waste management and government's worthy pronouncements.

Introduction

Two signature programmes of the Narendra Modi government in India since 2014 are Smart Cities and the *Swachh Bharat* (Clean India) campaign. Smart Cities embraces the realisation that India is urbanising rapidly and that policy and investment must keep pace with the pressure of demography. The programme promises substantial financial support to 100 qualifying cities. *Swachh Bharat* aims to establish high-levels of public sanitation throughout urban and rural India, with special emphasis on the elimination of open defecation.[1] The two programmes are intended to complement each other, but in the Smart Cities campaign, discussion of public sanitation has been muted.

To middle-class residents and tourists, few things prove so memorably offensive as urban filth. The sight of household waste, sewage or dead beasts in the streets evokes disgust and fluttering plastic bags generate dismay. The poor of the cities, however, cannot afford such sensibilities and they may view 'waste' as a natural resource, potentially beneficial if they earn a little income from waste-picking, sorting and selling.

A number of obstacles hamper towns and cities in achieving and sustaining higher levels of public sanitation. These difficulties are amplified by the complexity and volume of modern waste and by the difficulty of galvanising the human skills and commitment needed to keep towns and cities clean. Nevertheless, at the national level, the government has proclaimed commendable rules intended to govern the treatment of various categories of waste. The difficulty, of course, lies in adhering to the rules, and it is fair to say that no jurisdiction in India is fully compliant.

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[1] Government of India, "Smart Cities Mission", 12 November 2018, http://smartcities.gov.in/content/ (12 November 2018), and Swachh Bharat Urban, http://swachhtoilet.org/?_xafvr=YjUyMjA5ZDM3ZDM4ZjY0NjljNGE3ZDM0ZDFmNTE5YmY0M2Q4Y2Y4YSw1YmI0Mzg3OTMwMDU3 (12 November 2018).

This paper focuses first on the limitations of local governments, which are required to deliver public sanitation. The paper then examines the existing rules for various categories of waste and identifies barriers to their adherence. In the final section, the paper examines the public-health and cultural challenges surrounding the control of liquid waste and sewage.

Local Government

Local governments have financial powers that allow them to collect household and commercial rates, seek grants and even raise capital through bond issues. However, they require well-paid, well-trained and committed staff to pursue opportunities, enforce regulations and spend funds effectively. Urban local government is a specialised area of administration. In many countries, administrators move up ladders of responsibility from one local jurisdiction to another by applying for contract jobs advertised by local authorities.

The 73rd and 74th amendments to the constitution in 1993 cemented urban and rural local-government institutions into the political system. However, local governments remain under the authority of state governments which often "subverted or even outright flouted the provisions" of the constitution, as the late K C Sivaramakrishnan, a champion of local government, argued.[2]

For the British and their successors after 1947, local governments were a way of transferring responsibility for the everyday expectations of most people's lives, for example, drains, street cleaning, water supplies, to local authorities, who could then be blamed when things went wrong. Local governments did not have – and even today often do not have – the legal, financial and human powers to fulfil the tasks confronting them. This is particularly true of the management of solid and liquid waste.

Municipal commissioners of major cities are officers of the national Indian Administrative Service but they are appointed by the government of the state in which they serve. Their tenure is rarely more than two years and municipal commissionerships are seldom regarded as plum postings. In smaller cities and towns, the chief administrator is appointed by the state government from the state administrative cadre, and tenures can be brief. The responsibility of these officers is ultimately to their state-government masters, not to the mayor, councillors and citizens of their town or city, who may have little say in their appointment.

States that had created a specialist municipal cadre within their administrative service executed the tasks of local government more effectively, according to a 2014 report.[3] It argued for a dedicated municipal service for every state, though it still envisaged such a service as being commanded by state governments. It proposed, however, that "postings will be done based on public announcement of openings and choices [made] to fit the individual and organizational interests."[4]

The need for skills and training is highlighted in various ways. Many towns and cities are able to collect less than half of their entitlements.[5] Municipal authorities are often confronted by recalcitrant rate-payers who must be served summonses and taken to court. It requires a confident

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2 Quoted in Sahil Gandhi and Vaidehi Tandel, "What Urbanisation Reforms Owe K. C. Sivaramakrishnan", *Economic and Political Weekly*, vol. 52, no. 22 (3 June 2017), p 27.

3 *Approach towards Establishing Municipal Cadres in India* (New Delhi: Ministry of Urban Development and the World Bank, February 2014), pp 11, 13.

4 Ibid, p 14.

5 Om Prakash Mathur, Debdulal Thakur and Nilesh Rajadhyaksha, *Urban Property Tax Potential in India* (New Delhi: National Institute of Public Finance and Policy, 2009), pp 17, 21, 60.

executive, knowledgeable about a municipality's powers, to pursue such cases and improve a town's revenue collection. As things stand in many local bodies, the uncertainty of funds leads to uncertainty of payment for the people who provide essential services, especially those related to public sanitation and the collection and disposal of waste.

The problems that confront local governments in matters of waste management range from financial to technical. For example, poorly informed authorities anxious for solutions to urgent waste problems sometimes prove naïve purchasers of quick-fix "solutions" to pressing problems of waste. They may, for example, buy bins that fall apart, incinerators that consume more ignition fuel than the waste they were contracted to consume and transport that will not fit down narrow alleys (*galis*). As consumers buy more elaborate products, local authorities must contend with an increasingly complex stream of waste, which requires more sophisticated techniques to mitigate it. There are grants for waste-management improvements available from state and national governments, but such possibilities require alert action and practised applications. Urban administration is a specialised field.

Strengthening the human services necessary for effective local government will take time. Meanwhile, local authorities have access to exemplary written guidance in improving public sanitation. This takes the form of rules laid down by the Indian government for different categories of waste. These are more than simply rules. They set out in some detail what is to be achieved and, sometimes, how to go about achieving it. And it is fair to say that no jurisdiction in India is able to conform to these requirements.

Rules, Guidance and Solid Wastes

Solid Waste Management Rules, 2016

The most obvious category of waste for most citizens is represented by the things that households and commercial enterprises throw away each day – and local governments are expected to remove. Even in big cities, at least 40 per cent of this volume at the household level will be "wet waste," vegetable and animal matter that will break down naturally over time and, treated appropriately, can become good fertiliser. Another 20 to 30 per cent of volume is made up of paper, plastic and glass, which can be recycled, if the economics make it worthwhile.

The Solid Waste Management (SMW) Rules of 2016 provide an admirable code and a precise list of 37 "duties and responsibilities of local authorities and village *panchayats* [village council]" in matters such as these.[6] The rules also present 50 pages of actions required by local authorities. The problem of course is compliance.

The rules, for example, lay down that local authorities must "arrange for door to door collection of segregated solid waste from all households including slums and informal settlements, commercial, institutional and other non residential premises." That is a huge task in itself, but having collected such waste, a local government must find ways of disposing of it.

The SWM Rules are clear about the ways to handle conventional waste flows. Plastics are to be segregated, sorted and recycled, as are paper, glass and metals. Wet waste is to be composted, and the process, the rules declare, should produce useful fertiliser and electricity from the methane resulting from the chemistry of composting. All this should be done as close to the source of

6 *Gazette of India Extraordinary*, Ministry of Environment, Forest and Climate Change. Notification. New Delhi, the 8th April 2016, pp 51ff.

collection as possible, so that garbage trucks and traffic congestion are minimised. After these steps have been taken, whatever remains is to go to a "scientific landfill." In such a structure, waste is laid on an impervious bed, from which pipes extract methane and leachate, and the contents of the landfill are regularly covered to minimise odours and dust.

If the rules could be followed, the result would be a picture of order and public hygiene. Such a picture may be found in rare corners of the country but the widespread reality is of localities struggling merely to keep streets cleared and to remove waste fairly reliably from middle-class neighbourhoods. Scientific landfills are expensive to set up and require skilled maintenance. Regular door-to-door collection requires a reliable work force, properly equipped and paid. Composting needs space and maintenance. The SWM Rules provide estimable but they do nothing to help local and state governments reach those targets.

Construction and Demolition Waste Management Rules

Rapid urbanisation is accompanied by surging growth of the construction industry. Rubble from excavation and from knocked-down buildings has to be deposited somewhere, as do the by-products of new work. In countries like Australia, Construction and Demolition (C&D) waste amounts to 40 per cent of the material that goes to landfill, yet most of this can be reprocessed for other uses.[7]

There were no specific requirements for the disposal of C&D waste until the Construction and Demolition Waste Management Rules were laid down by the central government in 2016. They estimated annual production of C&D waste at 530 million tonnes, most of which was dumped illegally on open ground and into water bodies or went to bloat poorly run dumps, a number of which are more than 40 metres high. The National Capital Region of Delhi appears to have the only three fully operational C&D reprocessing plants in the country, run by the embattled Infrastructure Leasing & Financial Services Limited as public-private partnerships with the local authorities.[8]

C&D waste is valuable but it requires investment to turn rubble into valuable commodities. The plants that can process C&D waste need land, investment and skilled staff. The rules of 2016 gave large cities 18 months to establish such centres; smaller cities and towns were given two years. The rules also mandated that in future construction undertaken by local governments, the builders would have to use at least 10 per cent of recycled C&D waste in the materials of the new building. As with other codes relating to waste, the principles and instructions were exemplary but an answer to the question of "How?" was not attempted.

Hazardous and Other Wastes (Management and Transboundary Movement) Rules

A report in 1990 noted that "hazardous waste management is a new concept for most Asian countries."[9] By 2016, India had 29 centres for the storage and destruction of the chemicals, fluids and contaminated by-products from industrialisation and manufacture. A 2018 strategy document estimated that the country had 41,000 industries producing close to 8 million tonnes of hazardous

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7 Tayyab Masqood, "Closing the loop on C&D waste", *BEN*, 28 September 2018, https://www.insidewaste.com.au/site/features/1054238/closing-loop-waste (2 October 2018).

8 Isher Judge Ahluwalia and Almitra Patel, "Cities at Crossroads: Reusing waste for building," *Financial Express*, 28 September 2018, https://www.financialexpress.com/opinion/cities-at-crossroads-reusing-waste-for-building/1326809/.

9 "Hazardous Wastes (Management and Handling) Rules, 1989", Ministry of Environment and Forests, 28 July 1989, http://envfor.nic.in/divisions/hsmd/notif.html, 14 October 2018.

waste a year.[10] Ramky Enviro Engineers, a company of the Hyderabad-based Ramky group, claims to handle 65 per cent of the hazardous waste processed in India annually – "more than a million tonnes" – in its seven centres.[11] This represents only a fraction of the hazardous materials produced by manufacturing units around the country.

The central government's rules of 2016 for hazardous waste extend to 68 pages and, like their counterparts dealing with other categories, are models both in their coverage of the problems and their detail about safe procedures.[12] However, the responsibility for enforcing the rules lies with state governments, their environment and labour departments and their Pollution Control Boards. The latter, however, have limited powers and capacity and often depend on the dynamism of individual bureaucrats and appointed chairpersons.

Bio-medical Waste Management Rules

Bio-medical represents another specialised category of waste, for which updated Bio-medical Waste Management Rules were proclaimed in 2016. The first iteration had been in 1998. Bio-medical waste includes some of the most dangerous long-term components of the modern waste-stream – antibiotics and the by-products of antibiotic production which provide a breeding ground for organisms resistant to antibiotic drugs. These new organisms are the "super-bugs", about which Britain's chief medical officer warned in 2017, "Our children and grandchildren may well die of resistant infections." Antibiotic-resistant organisms already lead to more than 500,000 deaths a year from infection worldwide.[13] Their spread will increase this death toll and limit some forms of sophisticated surgery, which depends on germ-killers for patient recovery. Random dumping of partially used antibiotics, as well as by-products of pharmaceutical production and antibiotic organisms deposited by human defecation, provide ideal breeding grounds for organisms that resist antibiotics. The easy availability and misuse of antibiotics in India are well known, and patients who do not take a complete course of drugs become laboratories in which drug-resistant organisms develop. Antibiotics are also widely used in chicken and fish farms, and in this way resistant strains can develop in food chains and water bodies.

In its media release announcing the bio-medical rules, the Ministry of Environment, Forest and Climate Change confidently asserted that the country generated 484 tonne of bio-medical hard waste a day, of which 447 tonnes were treated. That seemed optimistically low, given the calculation that India had 130,000 health outlets and only about 200 suitable facilities for disposing of medical waste.[14]

Some medical waste is valuable and is funnelled off by informal recycling enterprises for medical reuse or other purposes, all of them potentially dangerous if antibiotics and infection are involved.[15] A facility to deal with the disposable items of modern medicine – surgical steel, large amounts of

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[10] *National Hazardous Waste Management Strategy,* (New Delhi: Ministry of Environment and Forests, n.d. [2018]), pp 1, 3. The USA in 1995 was estimated to generate 279 million tonnes of hazardous waste. http://www.ehso.com/ehshome/wastefaqs.htm, 14 October 2018.

[11] "Hazardous Waste Management," Ramky, http://ramkyenviroengineers.com/index.php/industrial-waste/hazardous-waste-management , 15 October 2018).

[12] "Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016", Ministry of Environment, Forest and Climate Change, 4 April 2016.

[13] Sally Davies, "Antimicrobial Resistance: the End of Modern Medicine?", public lecture, Royal Institution, London, 8 March 2017, https://www.youtube.com/watch?v=2H_Ox1vVnTc.

[14] "New Bio-Medical Waste Management Rules Notified", 27 March 2016, http://pib.nic.in/PrintRelease.aspx?relid=138353, 1 October 2018.

[15] Sarah Hodges, "Chennai's Biotrash Chronicles: Chasing the Neo-liberal Syringe," Working Paper 44/08, GARNET, 2008, pp 1-28,

contaminated plastic, blood products – requires an autoclave (pressure-cooker purifier) and high-combustion incinerator. Such centres are relatively costly to set up and run. Hospitals and clinics are required to use them and to pay a fee to do so. However, in one example, a hospital *sold* its waste to a trader for ₹49 (S$0.934) a kilogram, instead of *paying* ₹39 (S$0.74) a kilogram to dispose of it legally in a medical-waste centre.[16]

The state of Kerala, which has probably the most comprehensive system of local clinics in the country, has a flourishing single facility, to which 50 vehicles bring an average of 37 tonnes of medical waste each day from all over the state.[17] Even allowing for Kerala's widespread health network, the state represents only 2.5 per cent of India's population. States with inferior health systems may produce less medical waste, but even if this were so, national production of medical waste is likely to be well in excess of 1,000 tonnes a day, not the 484 tonnes calculated by the ministry.

Liquid Waste

Dealing with the solid waste of a modern city or town is an immense task. But an even more pressing problem is processing the human waste of 450 million urban dwellers. An adult produces about 120 grams of faeces and day and 1.2 litres of urine. Urban India has therefore to dispose of about 50,000 tonnes of excrement a day and more than 500 megalitres of urine, enough to fill 200 Olympic swimming pools.[18] Those modest estimates are only for *urban* India.

The *Swachh Bharat* campaign's emphasis on the elimination of open defecation and the building of toilets highlighted the dangers to health that uncontrolled human waste pose. The connection between open defecation and childhood stunting and mortality has been convincingly argued and appears to affect the children of the rural well-off almost as much as those of the rural poor.[19] Reducing open defecation, therefore, appears as an urgent need to improve the prospects of future generations.

"We have no national accounts for the excreta we generate or the excreta we treat or do not treat," concluded a 2011 report to the Planning Commission. "We have no way of really estimating the load of sewage in our cities, because of the different ways in which people … dispose [of] sewage."[20] What is certain is that no Indian city or town is comprehensively sewered.

The Clean India campaign has put immense effort and finance into toilet-building. The campaign has been less interested, however, in the cultural obstacles that hinder acceptance of many of the methods available to neutralise urine and faeces and turn them to productive use. Beliefs and practices related to ritual purity and caste make some of the most effective stand-alone toilets almost impossible to popularise in either rural or urban India.

The desirable standard for managing urban liquid waste for a hundred years has been to provide flush-and-forget sewerage networks for household and commercial premises, with separate drains

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16 "21 Chennai hospitals in the dock for violating waste disposal rules", *Hindu*, 21 August 2016.

17 "Bio-Medical Waste Management System. Services Offered," IMAGE, http://imageima.org/services, 1 October 2018.

18 David Waltner-Toews, *The Origin of Faeces* (Toronto: ECW Press, 2016), p 22.

19 Diane Coffey and Dean Spears, *Where India Goes. Abandoned Toilets, Stunted Development and the Costs of Caste* (New Delhi: HarperCollins, 2017), pp 101-109.

20 *Report of the Working Group on Urban and Industrial Water Supply and Sanitation for the Twelfth Five-Year-Plan (2012-2017)*, Submitted to the Steering Group on Water Sector, Planning Commission, November 2011, p 6.

and pipelines for storm-water. Laying and maintaining such systems is disruptive and expensive, especially when such work takes place in established settlements. The western suburbs of Sydney, Australia, for example, were not sewered until the early 1970s. As well as the cost of establishing such systems in existing cities, sewers need sufficient water and efficient pumping stations to keep them flowing.

The question is flow to where. While storm-water can be diverted directly into water bodies, raw sewage needs to be treated to kill dangerous bacteria before being returned to the water system. The common method today is the sewage treatment plant (STP). However, STPs need space to take sewage through necessary stages to kill harmful bacteria. Ten hectares is about the minimum for a modest plant; a plant in Thiruvananthapuram occupies 40 hectares. STPs also need constant electricity to drive the processes, especially to stir water to maintain the aeration that breaks down sewage to make it harmless. Experience with STPs around India has not been encouraging. Mumbai, with a population of more than 18 million, has seven STPs, not all of them always working.[21] The area of greater Sydney, home to five million people, has 40 water-treatment plants of different sizes.[22]

A new city such as Amaravati, the nascent capital of Andhra Pradesh, which starts from scratch, can build a comprehensive sewerage network, storm-water lines and treatment plants. However, it is difficult to imagine a time when even the smartest of India's existing cities will be able to lay out, and service, thousands of kilometres of new underground piping.

Many buildings in expanding urban areas depend on what are euphemistically called "septic tanks," but are in fact large concrete or metal cesspits that gather the waste flushed from toilets in the colonies they serve. When they fill up or get blocked, these tanks have to be pumped out and cleaned, and deaths among those who do this work are frequent – about one death every five days according to the Safai Karamchari Andolan.[23] The labourers who do this work are invariably Dalits or poor Muslims, untrained and unequipped. To be properly equipped in such underground worlds of human waste and toxic gases, a worker needs to wear the equivalent of a space suit.[24] The deaths of five men dealing with a cesspit in a housing colony in New Delhi on 19 September 2018 briefly made such deaths significant news.[25]

If these cesspits are properly maintained, it is possible to empty them relatively neatly using a minimum of human handling. A tanker truck, known as a honey-sucker, with suction and pumping mechanisms sucks out the contents. But then, where to empty it? The destination should be an STP where the truck should pay a discharge fee which the owner will pass on to the body that contracted the service. In fact, the destination is more likely to be any convenient (and illegal) water body.

Kerala, which has long led the way in minimising open defecation, got its first modern sewage treatment plant, in 2013 in Thiruvananthapuram, the state capital. It was able to service only a fraction of the city's population because most of the city was unsewered.[26] Most human waste from

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21 Sandeep A. Ashar, "Centre halts Mumbai's biggest sewage plant plan", *Indian Express*, 11 February 2016, https://indianexpress.com/article/cities/mumbai/centre-halts-mumbais-biggest-sewage-plant-plan/, 2 October 2018.

22 Ibid.

23 Shalini Nair, "In most manual scavenging deaths, no FIR filed", *Indian Express*, 4 October 2018.

24 Rose George, *The Big Necessity. The Unmentionable World of Human Waste and Why It Matters* (New York: Holt Paperbacks, 2008), pp, 15-18.

25 Pallavi Rebbapragada, "Young, underpaid and overworked in Delhi: Workers' death at DLF complex reveals how society treats those who clean sewers", *Firstpost*, 13 September 2018.

26 "Muttathara sewage plant to be commissioned on November 27", *Hindu*, 20 November 2013.

Kerala's millions of toilets either leaches into the soil or is pumped out by honey-suckers and jettisoned wherever feasible. Kerala minimises human waste around dwellings but it is best not to ask about its rivers and backwaters.

Champions of smart cities might seek alternatives to the water-guzzling, flush-and-forget systems of managing human waste, and various options exist. However, the perfect toilet has not been invented. Since 1970, Sulabh International has built more than a million two-pit toilets, mostly in rural India. Built and maintained properly, such toilets can work well for ground-level dwellings with adequate space for construction.[27]

There are a number of other stand-alone designs either in operation or development. A promising example, supported by the Bill and Melinda Gates Foundation, is the Nano-Membrane Toilet, which is "able…on-site" to "convert human waste to water and ash".[28] Indian Railways claims it will have installed biotoilets in every one of its 50,000 carriages by March 2019. It has also demonstrated a faster, cleaner machine for sucking out the contents of a carriage's toilets and replenishing in the toilet system the inoculum, the cocktail of bacteria necessary to break down the collected excrement.[29] None of the current designs for stand-alone toilets, however, will provide in the next five years the hands-off characteristics required for high-density Indian cities.[30]

Any stand-alone toilet system requires maintenance. An egalitarian India must reject any technology that reinforces the outlawed, but still existing, practice of manual scavenging – delegating to the bare hands of Dalits and poor Muslims the task of cleaning up others' mess. To be acceptable, stand-alone systems need to be sealed, odourless and no more difficult to maintain than removing ashes from a cooking fire.

The most plausible, medium-term approach to improving sewage management is probably the cesspit-and-honey-sucker method, favoured by middle-class housing colonies. Such a system needs tough, honest authorities to ensure that excremental cargoes are carried to STPs by qualified carriers who pay dumping fees. There must also be efficient sewage-treatment plants, where excrement is converted into usable methane and compost. The technology must be accompanied by rigorous enforcement to ensure that honey-suckers are purpose-built and their workers are well-trained and equipped. Work on a honey-sucker can be relatively clean and safe, but it can easily slip into a mechanised form of manual scavenging.

Conclusion

Smart cities need smart local governments if they are to become clean cities. The national rules intended to govern the various categories of urban waste are worthy, but the means to achieve the Clean India goals are inadequate. Smart local governments need greater financial resources and the powers to draw on them effectively. They also need larger numbers of experienced administrators, who see career paths in local government, and elected representatives, who genuinely represent the neighbourhoods for which they are elected and can mobilise cooperation from their voters.

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27 "Two-Pit System," Sulabh International Social Service Organisation, https://goo.gl/EYi1T9.

28 "Reinventing the toilet – helping to solve sanitation issues in low income countries," Cranfield University, https://www.cranfield.ac.uk/case-studies/research-case-studies/nano-membrane-toilet.

29 Smriti Jain, "Finally! Indian Railways finds quick 10-minute solution to stinking toilets in its trains", *Financial Express*, 11 October 2018.

30 Assa Doron and Robin Jeffrey, *Waste of a Nation: Garbage and Growth in India* (Cambridge, MA: Harvard University Press, 2018), pp 155-60.

Researchers report promising examples[31] but there is a long way to go before smart and clean characterise most of urban India.

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[31] For example, Alappuzha, a city of about 250,000 in central Kerala, does well in various reports. "Alappuzha municipality shows the way," *Indian Express*, 6 October 2014. Lola Nayar, "Clean Up after Yourselves", *Outlook*, 11 April 2018. Swati Singh Sambyal and Sonia Henam, "Small Is Beautiful", *Down to Earth*, 1-15 July 2018, pp 30-31.