Sustainable Solutions for the Urban Environment

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Written specially for Vikalp Sangam *What are the problems in the urban environment?* Before searching for sustainable solutions to urban environmental problems, it is necessary to define what those problems are. In the last decade, the two major themes for urban renewal, as seen in schemes such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) or the Atal Mission for Rejuvenation and Urban Transformation or Smart Cities, are improvement of urban infrastructure on one hand and reforming urban governance on the other. If these two are managed, then the city will become a key "driver" for the "inclusive growth" of the economy– as first spelt out in the 7th Five Year Plan (1985-90) and consolidated in the 11th (2007-2012)[1]. It is within this context that the four problems of urban environment emerge. As investment grows in the cities, whether for manufacturing or infrastructure or services, the population also grows and more and more settlements are converted from rural to urban. Consequently, the requirement for resources also increases exponentially. This, logically, gives rise to the four problems of water pollution, sanitation, air pollution, and solid wastes. It would be instructive to see how the largest initiative of urban renewal so far, of the JNNURM, has dealt with these so that the aspect of sustainability may be critically examined. **Performance of JNNURM in environmental management[2]** The JNNURMwas designed to address the problems of urban renewal in 7 mega cities, 28 million-plus cities, and 28 other cities that were State capitals orof religious/tourist significance. The environment-related schemes mandated the following activities with some governance reform elements:

- Universal coverage of services
- Door-to-door collection of solid waste
- 100 percent recovery of user charges
- Non-revenue / unaccounted-for-waterreduction
- 100 percent consumer metering with volumetric tarif
- Water recycle and reuse
- Exploration of public-private-partnership options

Table 1 (from the CRISIL study) illustrates what has been the performance of JNNURM in all the 63 cities for which it was intended during a seven period beginning in 2005. ***63 cities*** ***Table1: Investment proposed 2005-2012 inJNNURM***

Sector	*Rs crores*
Water supply	*29,892*
Sewerage	20,983
Urban transport	14,772
Drainage/Storm water drainage	*89,786*
Solid waste management	2,654
Others	*1,530*
Total	79,617

It is obvious that the heaviest investment proposed has been in water (37.5%) and sewerage(26.4%), followed by transport (18.6%). Solid waste management gets low priority at only 3.3%. It is also significant that the total budget for JNNURM was originally envisaged as Rs 150,000 crores, of which 75% (112,500 crores) was earmarked for infrastructure, but the proposed projects fell short of this target by 30%.The team from CRISIL studied in detail the projects sanctioned in 28 cities, which formed part of the service level benchmarking exercise launched by the Ministry of Urban Development, and their assessment of performance up to 2014 (when the JNNURM was extended by two years), in selected sectors that are of environmental concern for the purpose of this paper, is given in Tables 2 to 4. ***28 cities*** ***Table 2: Efficiency Water supply 2014***

Indicators	**Status**
Coverage	63%
Non-revenue water	41%
Metering > 90%	4 out of 28 cities
Daily hours of supply	4.5
Cost recovery	69%
Collection efficiency	68%

Table 3: Efficiency Sewerage 2014

Indicators	***Status***
Coverage	*61%*
Waste water recycling	**16%**
Cost recovery	61%

Table 4: Efficiency Solid Waste Management 2014

Indicators	**Status**
Household coverage	*49%*
Waste segregation	23%
Scientific management	1 out of 28 cities
Cost recovery	22%

The Tables above show the performance of JNNURM in sectors that impact the environmental status of a city does not exceed 70% even two years **after** the JNNURM was supposed to end; and the total averages around 39%. This would be a dismal record by any standard. Yet the CRISIL study recommends that, "A PPP approach to accelerating investments and improving service delivery has the potential to become a powerful mechanism for solving the urban infrastructure woes that plague cities in India". The appraisal by Grant Thornton[3], three years earlier and of 41 cities covered by the Mission, had revealed an even more damaging picture (Table 5). While the investment approved and priorities set was similar in pattern to that shown by CRISIL's study(water-30.7%, sewerage-21.6%, flyovers & roads-15.2%,solid waste management-3.4%), the actual expenditure for the sectors relevant to environment averaged 37%, with a maximum of 55% for urban transport and 54% for roads/flyovers/bridges. But the average completion rate of projects was only 12%, with a high of 39% for roads/flyovers//bridges. ***41 cities*** ***Table 5: Performance of JNNURM projects 2011***

Sector	**Approved Rscrores**	**Expenditure %**	**Total Projects**	**Completed Projects %**

Water supply	13,161	43	98	16
Sewerage	9,286	26	69	6
Roads/flyovers/bridges	6,553	54	76	39
Drainage/Storm water drainage	6,571	39	48	10
Urban transport	4,259	55	27	15
Solid waste management	1,455	21	24	0
Preservation of water bodies	59	20	3	**0**
Total	***42,904***	-	-	-

Promoting Private Sector Investment Interestingly, while the Grant Thornton study does not give the overall state of funds invested by the private sector, at least for the States of Andhra, Karnataka, and Rajasthan, for which figures have been given, the "matching share committed by private sector under PPP" is zero. And the sectors in which PPP initiatives have taken place are restricted tosolid waste management, transportation, and multi-level car parking. Nevertheless, the appraisal emphasises that, "Given the fact that more than USD1 trillion worth of investment is needed in the urbaninfrastructure sector, PPP is the need of the hour... the assistance in terms offunding, technical and operational expertise of the private sector needs to be sought…Demand has been created for private capital as well as greater interest of private sector in urbaninfrastructure development due to part-grant financing by the *Jn*NURM (which is likely to increasethe bankability of a number of large urban infrastructure projects)". Even the Committee set up by the Planning Commission[4]welcomed the progress made by JNNURM and recommended, in March 2012 at the official end of the JNNURM tenure, that JNNURM should be carried forward by:

- Building capacity of the Municipalities
- Establishing an efficient governance structure
- Promoting financial sustainability and accountability of ULBs
- Attracting more private investment, in particular, through PPP
- Adopting service level benchmarks and social audits

Performance of Public-Private Partnerships The strong bias exhibited by both public and private agencies towards inviting more private investment for urban infrastructure development through incentives goes against the grain of reality. As the Planning Commission reported in 2017**[5]**, "The12th plan has projected that roughly 48% of the investment in infrastructure would come from private sector. However, in urban sector, number of PPP projects are very low. Out of 2900 urban projects under JNNURM, only about 50 projects had some elements of PPP and there too, the capital investment by private sector was just about Rs. 1,000 cr." Furthermore, in a review of theurban water supply sector in 2011[6], the World Bank's Water and Sanitation Group observed that projects which were being developed during the 1990s and early 2000s were based on PPP structures envisaging private financing, but the trend changedafter 2005"with several urban water supply PPP projects being developed on the basis of availability of a substantial amount of public funding. More and more water supply PPP projects rely on schemes such as JNNURM and the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT)". Table 6 indicates this trend very clearly. The number of PPP projects from 1990s onwards has steadily increased from 5 in the 1990s to 13 during the JNNURM period. Almost all the projects in the 1990s followed the BOOT model – orbuild, own, and operate the project, and transferit to a public agency once profits had been made. However, in the 2000 to 2004 period, three-fourths of the projects were based on management contracts. After 2005, there was yet another change towards DBFOT (design, build, finance, operate, transfer), but the international firms had yielded ground to the domestic firms who were finding some local capital to invest. ***Table 6: Summary of PPP Projects in the Indian Urban Water Supply Sector***

Parameters	**1990s**	2000-04	2005 onward
No. of PPP projects in water	5	8	13
PPP model adopted	100% BOT/BOOT	75% management contracts 25% BOT/BOOT	38% management contracts 62% BOT/DBFOT and similar
Private operator mix	**100% international**	**65% international 35% domestic**	**65% domestic** **21% international** **14% local/regional**

The Best Case scenario of Andhra Pradesh

Within this context, it would be interesting to review the performance of the environmental projects under JNNURM in Andhra Pradesh by 2014[7], as given in Table 7. Andhra has been purposely selected because the Grant Thornton study approvingly remarked that, "Andhra Pradesh performance is sizeably higher (51%) than national average (39%) forUIG", and, "ULBs are way ahead in releasing their matching share against the share released byGOI and against the approved project cost". This actually represents a financial perspective of the city and its assumed efficiency of performance; even though the level of private sector investment under PPP in Andhra was zero in all the four cities that were chosen under JNNURM. ***Tables 7: Status of JNNURM projects in Andhra cities in 2014 (Rs Lakhs)***

Sector	***Hyderabad***	***Vijayawada***	***Vishakhapatnam***	***Tirupati***
Air	Flyover 3300*(C)**	BRTS 15100 *(70)***	BRTS 45170 *(76)*	-
	Flyover 1727(C)	Road repair 3625 *(C)*		
	Flyover 1101(C)	IRR 7424 (75)		
	Road wid 3510 *(90)*	-		

Water	Channel 2222 *(57)* Pipeline 9493*(C)* Diversion 8120*(C)* Storage 2981*(C)* Storage 3355 *(C)* Musirevl. 4427*(80)* Monitoring 990*(C)* Krishna II 60650*(C)* Distribn. 20496*(85)* Distribn. 31426*(65)*	Water sup 3548 (C) Augment 8858 **(88)**	Pipeline 6228 (C) Canal 339 *(C)* Augment 3976 *(C)* Distribn. 4600 *(C)* Augment 24074 *(84)* Pipeline 2340 (C) Distribn. 18508 *(76)* Water sup 4794 *(86)* Augment 8349 *(4)*	
Sanitation	Sewerage 24690 *(90)* Sewerage 14505*(C)* Sewerage 15602***(70)***	Sewerage 743 *(C)* Sewerage 949 **(C)** Sewerage 1985 **(C)** Sewerage 17815 ***(65)***	**Sewerage 3708 *(C)* Sewerage 24444 *(88)***	
SWM		Improve 5805 **(45)**		Manage 2329 **(0)**
Total	240,632] 79]***	79,436 [73]	154,678 [80]	8,498 [53]

All figures in Rs lakhs; **(C)* means completed; **_(xx)_ Physical progress in %;*[yy] Financial utilization in %** What does the above picture of Andhra, with the best performance of >70% financial utilization among States, reveal? All the flyovers and road repair projects in the four cities are ready. The laying of new water pipelines, and diversion and storage schemes have also been completed. But the bus rapid transport systems and water distribution schemes are at nearlythree-fourth of the target. Almost half the sewerage projects are incomplete. And solid waste management is way behind schedule. Impact on Environment Greater supply of water does not necessarily mean that the quality of water will improve, even though the per capita availability of water may increase (Table 8). In fact, it will increase the amount of waste water and the absence of adequate wastewater treatment capacity means that it would be discharged into existing water bodies, thereby further polluting the sources. Similarly, installation of sewers, especially in the older parts of the cities, may be a welcome move but if there is no sewage treatment it will only translate into more pollution of surface and ground water sources. The little attention being paid to solid waste management adds to the existing problems of a growing volume of waste that keeps step with the growth and modernisation of the city. As may be seen in Table 8, the small town of Tirupati, chosen because of its religious importance, with a resident population of less than 3 lakhs generates 340 gms of waste per capita per day. But the larger cities of Hyderabad and Vijayawada generate almost twice as much. As per capita investment grows it also encourages the growth of throw-away consumerism and the greater accumulation of waste materials that have to be eventually transported to landfills. ***Table 8: Patterns of resource use and misuse in urban Andhra***

	Hyderabad[8]	*Vijayawada [9]*	***Vishakhapatnam[10]***	***Tirupati[11]***
Population 2011	67,31,790	10,34,358	17,28,128	**2,87,482**
Per capita investment (Rs)	**3,575**	7,680	**8,951**	2,956
Water per capita supply (lpcd)	162	157	110	142
Access to piped supply (%)	**70**	**27**	**85**	**85**
Unaccounted water (%)	*40*	*60*	33	25
Sewer connected hhs (%)	*41*	30	26	*40*
Wastewater treated (%)	38	13	48	71
Solid waste per capita (kg)	***0.57***	***0.60***	**0.47**	**0.34**
Scientific disposal waste (%)	5	70	0	0
Public transport share (%)	44	*17*	20	NA

Note: All services supply data (row 3 onwards) are as of 2005, prior to JNNURM *Alternative Approach to Environmental Management* Two issues that are critical to an appreciation of how the urban environment needs to be managed emerge from the above discussion. Firstly, the approach to urban 'growth' that equates 'development' with the higher per capita use of natural resources can only make the environment worse as it results in the higher per capita production of wastes (gaseous, liquid, and solid). Secondly, the assumption that the private sector is willing to invest heavily in urban infrastructure is misplaced, as its only concern is to make profits out of management contracts that increase per capita consumption and the volume of user fees. We, therefore, need a different approach to urbanisation if we are to make cities sustainable, both financially as well as ecologically. The environmental principles of reduce-reuse-recycle are already well known, but the fundamental principle of "reduce" has not been applied to the imagination of cities. Instead of cities being seen as drivers or engines of growth, we have to pay far more attention to the use of *less* resource as being an indicator of 'development'. That will both generate real efficiencies of use (as opposed to efficiencies of profit) as well as less waste to manage. *Water pollution* For instance, the augmentation of water supplies, new storages, and new pipelines will only lead tohigherper capita consumption of water. But if the realistic norm of water supply is fixed at 100 lpcd, which is an adequate consumption figure, then all the four cities of Andhra Pradesh had enough water as of 2005, before JNNURM began (Table 8, 110 to 162 lpcd). The problem was with access to supply (27-85%) and unaccounted water (25-60%). Hence, it is the water distribution system that should be remedied and repaired, made more equitable, and protected from contamination. This is possible if there is a decentralised supply system that is more dependent on local water bodies that are under the care of line departments in each ward, rather than focusing on high investment in supply systems with expected private investment – which does not materialise. Unfortunately, the allotment under JNNURM for reviving local water bodies was a miserable 0.1% (Table 5). Even for Andhra Pradesh, the only allocation made in this respect was for revival of the Musiriver, and that was about 2% of the budget for Hyderabad (Table 7). The recent civic initiative in Belagavi**[12]** to revive its abandoned wells

is a pointer in the right direction. *Wastewater* Local protected sources of water with high access and a lower norm for consumption will also decrease the quantum of wastewater to be managed. As seen in Table 8, the percentage of households connected to the centralised sewer system for the four cities of Andhra Pradesh varied from 26 to 41%, while the current (2005) status of wastewater treatment ranged from 13 to 71%. Instead of seeking to construct more and more city-wide sewer lines with centralised sewage treatment plants, it would make much more sense to consider local treatment systems that do not pollute the local water sources. A further element to consider for fecal management is that it is commonly observed that fecal matter decomposes very quickly when exposed to sunlight and air. Experiments have shown that more than 70% of the fecal organic matter decomposes in a day under aerobic conditions at temperatures of 60°C[13]. On the other hand, under anaerobic conditions in presence of water (as obtained in sewers, soak pits and septic tanks, in the absence of sunlight), the rate of decomposition of fecal matter is extremely slow with volatile solids decreasing from 91 to 76% over the experimental period of 12 months[14]. Regrettably, there has been very little research on how rapidly *dry*fecal matter, separated from wash-water and urine, decomposes in open conditions and how much of the pathogens have been destroyed. The JNNURM (and now the Swachha Bharat scheme) focused on the construction of toilets and linking them to sewers under the assumption that open defecation causes disease. This assumption has not been established by any scientific study (as far as this author has been able to ascertain). But if sufficient research is conducted into the issue, then it should be possible to construct local dry fecal matter disposal systems that depend on aerobic decomposition and exposure to sunlight, some of which are detailed in the Practical Guide for DEWATS published by BORDA/WEDC*[15].* Solid wastes As may be seen in Table 8, scientific management of municipal solid waste in the four cities is negligible, even though Vijayawada claims a doubtful 70% achievementmainly in disposal at landfills. On the other hand, if solid waste management is considered through the lens of the three environmental principles it can be reduced at the primary stage itself without need for reusing and recycling. Considering that almost half of urban waste is organic in nature, proper segregation would also enable decomposition into manure in local management centres. Of the remaining waste, roughly one-quarter is rubble that mainly comes from construction activities. This could be reduced by redesigning construction in such a manner that what is now waste is largely reused in the project itself, instead of having to transport it to distant landfills[16]. The remaining one-quarter consists of recyclables such as paper, metals, and plastics. Unless the use of these materials is itself reduced through changes in production and consumption patternsand strict regulations on packaging and the production of non-degradables, their recycling paradoxically provides the impetus for even more production and consumption and, therefore, even more recycling. The currently popular slogan of “waste is wealth” further propagates this vicious cycle. For instance, the Minister of State for Environment recently acknowledged that more than 15,000 tonnes of plastic waste is generated daily in India, of which 6,000 tonnes remains uncollected[17].Organisations like the Plastic Pollution Coalition (www.plasticpollutioncoalition.org/) are beginning to document and analyse how a plastic-free world is possible. Air pollution More flyovers, more signal-free roads, more private cars, and more traffic only add to the air pollution load of cities. Public transport gets little attention in most cities. The modal share of public transport varies from 17 to 44% in the four Andhra JNNURM cities (Table 8). The BRTS has been allotted 19% of the budget in Vijayawada and 29% in Vishakhapatnam, but whether they will be able to achieve even the 44% of the modal share that Hyderabad has achieved is doubtful. The desirable share should be 80% if there is to be any significant impact on air pollution from transportation. At the same time, all modes of motorised transport are dependent on non-renewable sources of energy and cannot be considered sustainable. Some alternatives are outlined in the GIZ/ADB Guide for urban transport[18]. If cities are to become resilient, sustainable and livable they have to be planned such that work places, schools, markets, and centres of recreation are close at hand to residences, so that short distance travel is possible with priority being given on the roads to walking and cycling. Mega cities that are considered to be bigger drivers of growth are, on the other hand, also huge promoters of high-rise construction and long-distance commuting. The idea of ‘development’, thus, has to radically change along with cities as the ‘engines’ driving that development. The fundamental research question to be explored by concerned institutions in India is how is this to be achieved? The ongoing lively international debate on the nature of cities is something that Indian researchers would greatly profit from[19]. Conclusion The four major environmental problems of urban areas are water pollution, sanitation, air pollution, and municipal solid waste. The current approach to managing these problems, as implicit in schemes of urban renewal, is to provide universal services through increased supply, plug all leakages from the system, implement user charges to pay for all services, reuse and recycle, and encourage private sector investment in building infrastructure. However, the performance of these schemes indicates that their conceptual basis is flawed. Instead of increasing resource consumption and economic efficiency the focus should be on reducing resource use and changing lifestyles to ensure that the use and misuse of all resources is within the sustainable limits of natural ecosystems. The challenge before us is to promote research that will develop new social and technological solutions within these systemic limits. ---oo---

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