

Resource Recovery and Reuse (RRR) Project

Baseline Survey Report - Bangalore



2012

A. Official interest in project. Please consult a responsible person in the local waste authorities who can respond to the following questions and/or refer to their policies:

a.i.1. Is Resource Recovery & Reuse (RRR) from waste occurring in the city

Yes – there is RRR from waste occurring in the city. This is currently being driven by the

- ✦ BBMP (The Bruhat Bengaluru Mahanagara Palike (BBMP) (*Translation: Greater Bangalore Municipal Corporation*), is the new administrative body responsible for the civic and infrastructural assets of the city of [Bangalore, India](#). It was formed in 2007 by merging 100 wards of the erstwhile Bangalore Mahanagara Palike, along with 7 City Municipal Councils(CMC), one Town Municipal Council and 111 villages around Bangalore. (<http://www.bbmp.gov.in/>)
- ✦ BWSSB (The Bangalore Water Supply And Sewerage Board is committed to providing drinking water of appropriate quality in sufficient quantity and to treat the sewage generated to the required standards.) (<http://bwssb.org/>)
- ✦ Citizen interest groups and Strong Informal sector

All of the above groups and agencies are interested and there is significant effort. However there is a need to co-ordinate and better the effort as well to make the efforts institutional. Policy changes can have good impact. Some noteworthy examples are

- ✦ BBMP has setup a 15 ton capacity decentralized plant to process organic waste as well as recycle the plastic, metal etc . BBMP has established a decentralized one ton capacity aerobic composting unit at Malleshwaram market (West Zone) using organic waste convertor.
- ✦ Organic Municipal Solid Waste is being recycled to produce compost by the Karnataka Compost Development Center (KCDC) off Hosur Road and Terra Firma Biotechnologies Ltd (TFBL) near Doddaballapura. In addition to this smaller private/civil society players like Daily Dump (www.dailydump.org) also encourage citizens to generate compost from their kitchen waste
- ✦ Waste to Energy projects have been setup by Ramky Energy and Environment Ltd at Mavallipura. And Srinivasa Gayatri Resource Recovery Ltd (SGRRL) Integrated waste to energy project at Mandur. However both these projects are currently not running successfully
- ✦ Sewage from septic tanks is cleared out by Honeysuckers and is then treated and used as compost for growing crops. The Vrishabhavati carries sewage which is then used as nutrient rich water for crop production (<http://vimeo.com/23587361>)
- ✦ Plastics–bitumen mix is used for roads. Plastics are also recycled to make other plastic items
- ✦ Some of the areas where RWA's are performing Door to Door collection, the waste is segregated at source & the organic waste is composted in the community in a small scale. This is being facilitated and implemented by the BBMP

a.i.2. Are the authorities in charge of a) solid waste and those in charge of b) wastewater interested in a feasibility study for RRR options and related Sanitation Safety Plans in their city? Please note which authority confirmed interest (name, position, authority; or policy citation).

a) Yes, the SWMRT (Solid Waste Management Round table) is driving the BBMP effort for RRR from MSW. However there is no formal word on the same and there is no City Sanitation plan

b) Bangalore Water Supply and Sewerage Board (BWSSB): Yes.

The Chairman BWSSB has informally confirmed interest. The BWSSB has a challenge due to increase in area under its jurisdiction since 2007 when BMP became BBMP (refer earlier reference to BBMP). Of the area under the purview of the BWSSB about 50% has piped sewerage connections and for about 50%

there is onsite sanitation by way of soak pits and septic tanks. Honeysuckers are the current methodology employed for the disposal of onsite sanitation BIOME has been in conversation with the Chairman BWSSB and the honey-suckers have been discussed.

a.i.3. Is there private sector interest in innovative resource recovery models? Who? In what? Can this be documented/verified via examples?

Yes. There is interest. The private sector players are

- ⤴ Informal sector workers like – honeysuckers, rag pickers
- ⤴ Civil society engaging in business model – like Daily Dump(action research and advocacy), SAAHAS
- ⤴ Private players like Ramky that are working as PPP

Some of the examples are

- ⤴ Septage is sucked out by private tanker operators who then apply this nutrient rich water in fields. (<http://www.slideshare.net/zenrainman/honeysuckers-sanitation-solution-from-the-informal-sector>)
- ⤴ Composting products for kitchen waste and leaf litter have been developed and marketed by Daily Dump (www.dailydump.org)
- ⤴ SWMRT Solid Waste Management Round table supported by the KSPCB is also working with different communities on RRR (<http://www.deccanherald.com/content/201645/reduce-recycle-reuse-mantra-cleaner.html>)

a.i.4. Are there public complaints (e.g. newspaper reports) about uncontrolled waste reuse or actual or potential health risks (please provide any proof/documentation if yes)?

There have been complaints for problems like groundwater contamination due to dumping of waste. However no public complaints due to reuse could be found

a.i.5. What are the major constraints to waste use or waste-resource recovery relating to institutional/legal, cultural or perceptual aspects?

The necessary Institutional and Legal framework for waste-recovery and reuse either does not exist or is incidental. Most of the actual resource recovery and reuse is actually being achieved largely in the informal or semi-formal sectors. The Authorities are beginning to realize that for a growing city like Bangalore these solutions are important. However given the Public health dimensions of these issues, things move slowly. What is also missing is a strong chain of engagement with informal sector, research, action-research and advocacy that can overcome these constraints and strengthen the informal /semi-formal sectors to become vibrant and safe markets of waste reuse that can also be livelihood for many of the poor.

Bangalore already has a number of civil society players in Solid Waste, Water & Sanitation working with the informal sector, or doing advocacy or action research. However, abstracting lessons from all the work, setting the agenda from a larger policy and institutional/legal angle and bringing work together with much more rigorous scientific and public-health research is missing.

Culturally Indians have always reused and recycled. However economic growth, disposable incomes and consumption cycles are creating cultural shifts away from inherent frugal use or waste reuse as a life style - this is particularly true for a city like Bangalore. However there is a growing consciousness of environmental issues, "urban farming", waste recycling etc. in the city.

B. Project supporting policies (questions should be directed to health and relevant institutions)

a.i.6. Who is concerned about safety issues related to current formal or informal RRR activities? If anyone, which activities are of concern?

The KSPCB (Karnataka State Pollution Control Board) <http://www.kspcb.gov.in/> is concerned about safety issues related to current formal or informal RRR activities. This is mostly from a ground water perspective.

Sewage is treated in private sewage treatment plants and is then discharged into the sewers from where the BWSSB further treats it before discharging it into the lakes. The quality of treated sewage water is hence very important and is regulated by the KSPCB

a.i.7. Are authorities aware of (or practicing) the new WHO (2006) guidelines for safe wastewater irrigation, greywater and excreta use?

Not at present.

a.i.8. Do authorities use the WHO promoted Water Safety Plan concept or something comparable (name it) for safeguarding drinking water supply? Give the sources.

No Not at present

a.i.9. Are there policies, plans and/or strategies supporting safe RRR from selected waste streams? Which ones? What is encouraged? What not? Which organizations are involved in the preparation and implementation of regulation?

Most of it is done in project mode. A larger strategy or plan is missing.

BBMP

In recent years BWSSB has given high priority to wastewater treatment as the city is struggling with growing scarcity of drinking water. It is estimated that the requirement of wastewater treatment plant per one lakh population is about 10MLD. BWSSB has 12 secondary sewage treatment plants in all directions of the city, treating about 40% of BMR's sewage. Sewerage networks are directly linked to plants for treatment up to secondary level. Secondary treated water is used for construction purposes, the golf course and similar purposes.

There are two tertiary treatment plants of a total capacity of 70 MLD. The treated water is reused for purposes other than drinking and is supplied to Bangalore International Airport, Bharath Electronics Limited, Wheel Factory and other industries. BDA has set up tertiary water treatment plants using different technologies. It has established 1.5 MLD capacity tertiary treatment plant at Lalbagh that uses an extended aeration process. Another tertiary treatment plant with a membrane bioreactor of 1.5 MLD was set up at Cubbon Park.

a.i.10. Please list key sector policies with RRR section :TBD.

a.i.11. Do any comprehensive investment or feasibility studies exist for RRR from any waste streams which went beyond a small case study? :

There has not been any comprehensive feasibility study for the same. However there have been some larger projects that have been implemented and that are case studies in themselves

Energy from Waste

Municipal solid waste (MSW) generated is estimated to be in the order of 3,000 tonnes per day in BMR. M/s Ramky Consultants plan to produce energy from MSW in their energy recovery plant in Mavallipura, generating 10 MW from approximately 780 tonnes of waste. The technology is mass combustion that fully consumes waste

M/s Srinivasa Gayatri Resource Recovery Limited has entered into an agreement to produce 8 MW of power through incineration of refuse-derived fuel at Mandur in Bangalore. BBMP will supply 1000 TPD of MSW of which 300 tons will be utilized after segregation. The possibility of converting waste into energy need to be explored further to gain experience.

Usage of sewage as nutrient rich water

a.i.12. Aside for normal incinerators, are there special incentives, policies, or regulations that support the generation of electric or thermal energy from organic wastes (i.e., biogas or combustion/gasification of agro-industrial or domestic waste)?

No specific incentives for Waste-to-Energy projects exist at the city level. However, a developer of a waste-to-energy project can tap into schemes of Ministry of New and Renewable Energy (administered through the state nodal agency Karnataka Renewable Energy Development Limited) for financial incentives/subsidies towards biomethanation, and other waste-to-energy projects.

eg. Karnataka Renewable Energy Development Limited (KREDL) In association with Adichuchadagiri educational trust has set up a 250 kw biomass gasifier with 100% producer gas engine at Adichunchangiri institute of medical science, Balagangadharanatha Nagar, Bellur Cross, Nagamangala Taluk, Mandya District.

C. Local partner capacity

a.i.13. Is there a local office of WHO, IWMI SANDEC, or Swiss TPH in the city to facilitate research logistics, visa, conferences etc.? (leave answer blank; this will be answered by these institutions):
No

14. Give names and contact data of 2-3 key local organizations (NGO, university departments, research institutions, etc.) interested in RRR with likely capacity to coordinate other local institutions (multi-disciplinary teams) and host students also from abroad?

BIOME Environmental Solutions Private Limited / Biome Environmental Trust: www.biome-solutions.com ,

S3IDF: Small Scale Sustainable Infrastructure Development Fund: www.s3idf.org

SAAHAS: www.saahas.org

Daily Dump: www.dailydump.org

IISC: Indian Institute of Sciences

GKVK (UAS): University of Agricultural Sciences (<http://www.uasbangalore.edu.in/>)

Environment Management and Policy Research Institute (<http://empri.kar.nic.in/>)

15. Which local authority/institutions/university/business schools or research institute could be recommended to work with the project on data generation and knowledge exchange in the areas of:

- Sanitation and sanitation safety plans: STEM (Centre for Symbiosis of Technology, Environment and Management)
- Public health and risk assessment (epidemiological studies? QMRA?): Indian Institute of Science, Jawaharlal Nehru Centre for Advanced Scientific Research
- Environmental risk assessment: ATREE: Ashoka Trust for Research in Ecology and the Environment.
- Waste stream analysis and treatment options: SWMRT : Solid Waste Management Round Table
- RRR for energy : IISC: Indian Institute for Sciences
- Urban agriculture (soil fertility and irrigation): University of Agricultural Sciences: Department of Soil Science (GKVK)
- Institutional analysis : CSTEP: Center for Study of Science, Technology and Policy

16. Do any (multi-)stakeholder platforms or learning alliances exist from similar waste (reuse) projects or initiatives which could be linked to for the discussion of RRR business plans and/or SSP development?

For Municipal Solid Waste: SWMRT

SWMRT: a group of like-minded organizations and individuals whose vision is to bring the Municipal Waste Management Rules 2000 to life by promoting the all important basic step of segregating waste at source and adoption of the 3R's - reduce, reuse, recycle. Founded in October 2009, the SWMRT has converted more than 15,000 households and institutions who now recycle 320 tons per month of otherwise land-filled destined waste.

No formal platform exists for sewage

17. Do any local institutions have or had related RRR projects? Name project content or title and approx. year. Was SANDEC, Swiss TPH or IWMI involved in any of these?

- ✦ Daily Dump – sale of home composters, engaging with informal sector and action research (www.dailydump.org)
- ✦ SWMRT: http://swmrt.com/index.php?option=com_content&view=article&id=57&Itemid=83. Several such projects exist for composting of organic waste

No – the above organizations were not involved

18. Can ethical clearance/approval for medical research be easily obtained locally? What is the process? What are the guidelines?

The ease of approval is not known

The national guidelines and process: http://icmr.nic.in/ethical_guidelines.pdf

19. List international and national airlines reaching the city regularly.

http://en.wikipedia.org/wiki/Bengaluru_International_Airport#Passenger_airlines

D. Demand for RRR i.e. waste resource recovery in industry, farming, construction, etc.

20. Which waste-based products a) have already a demand by whom in and around the city, and b) which could have? Consider waste-derived fuel for cement kilns, irrigation water, nutrients, organo-fertilizer, biogas, etc., and as sectors e.g. urban and peri-urban agriculture, peri-urban agro-industry, parks and gardens, housing sector, aquaculture, forestry, cement industry, other industry.

Currently the most demand is for treated/untreated septage from domestic septic tanks as nutrients plus water for agriculture.

21. How big are the likely interested sectors approx.? e.g. in terms of size of (open-space) farming (number of farmer or area), number/size of industries actually/potentially interested in nutrient/water/energy?

These numbers are not officially known but can be estimated

22. Amount of rainfall per year (how many dry seasons/number of dry months) (important for wastewater reuse)

970mm of annual rainfall

| MONTH | DAYS | QUANTITY(mm) |
|-------|------|--------------|
| JAN | 0.2 | 2.70 |
| FEB | 0.5 | 7.20 |
| MAR | 0.4 | 4.40 |
| APR | 3.0 | 46.30 |
| MAY | 7.0 | 119.60 |
| JUN | 6.4 | 80.80 |
| JUL | 8.3 | 110.20 |
| AUG | 10.0 | 137.00 |
| SEP | 9.3 | 194.80 |
| OCT | 9.0 | 180.40 |
| NOV | 4.0 | 64.50 |
| DEC | 1.7 | 22.10 |
| TOTAL | 59.8 | 970.00 |

23. Number, size and perennial status of streams crossing city or peri-urban area; b) are they polluted by wastewater, c) are they used for formal or informal irrigation?

Arkavathi: An important source of water. It is drawn from the reservoir of TG Halli for use. The river has dried up due to extensive groundwater extraction.

Vrishabhavathi: The erstwhile drinking water supply lifeline of the city, has virtually been turned into a sewerage that carries highly polluted domestic and industrial wastes.

DakshinaPinakini : river dried up about three decades ago and only sewage water generated in Bangalore was flowing in the valley. This valley enters Tamil Nadu through Hosur. An estimated 3.5 tmcft of water (sewage) from Karnataka flows in the valley every year. This water though unfit for agricultural use in Karanataka becomes fit for agriculture use in TN as it undergoes natural purification.

The lakes of Bangalore are its official wastewater carriers. These drain into 3 valleys – Koramangala, Challaghatta, Vrishabhavati and Hebbal. All the lakes lie in these valleys and each lake is linked to the other through a series of water bodies and channels. Untreated waste water and sewage makes its way into the valleys through the lakes.

24. Would treated wastewater have a possible market? Why Yes or No. If Yes, for whom?

Currently Secondary treated water is used for construction purposes, the golf course and similar purposes. The tertiary treated water is reused for purposes other than drinking and is supplied to Bangalore International Airport, Bharath Electronics Limited, Wheel Factory and other industries.

It is expected that treated water would find similar process use in Industries,

With limited treatment septage can be used for agriculture

25. Which farming systems (like urban vegetable farming or peri-urban pineapple or firewood plantations) are most likely to use organic waste fertilizer, and on which crops?

Currently the usage is mostly crop neutral. However it is seen to be mostly used for Eucalyptus, banana, coconut and acacia plantations that are present around Bangalore

E. Ongoing reuse activities of interest for Sanitation Safety Plans (SSP)

26. Are there any public (or public-private) projects on RRR from any domestic (household or market waste; excreta, wastewater), or agro-industrial waste streams (cassava peelings, food processing waste, cotton husks, etc.) in operation?

In the light of organic content present in the garbage, aerobic composting is one of the preferred pathways to reduce the volume of waste for disposal into the secured landfill. Another route for

disposal is waste to energy either through refuse derived fuel (RDF) or direct mass combustion. Currently, the garbage generated in BMR is handled by the following agencies viz;

1. Ramky Energy and Environment Ltd at Mavallipura.,

Towards the north-eastern side of Bangalore, i.e., 20km from BEL circle, the composting facility of Ramky Energy and Environment Limited is operating under the Public-Private-Partnership (PPP) program in a total land area of 54 acres. The facility receives on an average 300 Mt/d of mixed garbage that is aerobically composted. In the second phase of waste to energy project utilizing 800 Mt/d garbage to produce 10 MW of electrical energy is being set up within the premises.

2. Karnataka Compost Development Center (KCDC) off Hosur Road.,

KCDC is an aerobic composting and vermi-composting facility operating under the control of Government of Karnataka for the past three decades and is one of the oldest facilities operating since 1974. The facility is located off Hosur Road and handles 100 Mt/d and it is being upgraded to take up 300 Mt/d of garbage

3. Terra Firma Biotechnologies Ltd (TFBL) near Doddaballapura.

This private facility is designed to handle 1000 Mt/d of garbage with the recovery of biogas to produce electrical energy.

4. Srinivasa Gayatri Resource Recovery Ltd (SGRRL) Integrated waste to energy project at Mandur.

This facility is under construction to take up 1000 Mt/d of garbage and convert the same into electricity. There is provision for land filling of ash generated following the combustion process along with other inert waste.

5. A few private sites near K. R. Puram, Budigere and Garvepalya on Sarjapur Road working on a small-scale

6. BBMP has setup a 15 ton capacity decentralized plant to process organic waste as well as recycle the plastic, metal etc . BBMP has established a decentralized one ton capacity aerobic composting unit at Malleshwaram market (West Zone) using organic waste convertor.

27. Is there an informal sector active in RRR from organic waste? (which waste for which purpose):

The solid waste management sector in Indian Cities is strange. All that the official Solid waste management system does is pretty much dump it in some landfill. During the collection of waste, poor people employed formally come in contact with a lot of organic matter rotting and mixed up with the rest of civilization's refuse. They sanitize our lives but we hardly thank them - the system stands on the foundation of people handling all the muck all mixed up. Along the formal chain, informally, a whole bunch of other poor people keep picking up the valuable stuff from what we think is our waste. And then making a livelihood out of it. And officially they don't even exist. The official system bleeds public money to manage waste. The informal system, captures whatever economic value there is of it, actually performs the waste management task and doesn't even get acknowledge that it exists.

Yes: In peri-urban Bangalore where there are no sanitation lines, honeysuckers (vacuum tanker trucks that pump sewage from septic tanks) draw out sewage and apply it in nearby fields

Vegetable waste is dumped in agricultural lands

Increasingly large volumes of waste are also home composted

Informal sector has also demonstrated that these can be viable and profitable businesses, however safety, health and environment risks have not been addressed. They also operate in the grey spaces between legality and illegality. It is important that regulations do not kill this sector or make it unprofitable

28. Are farmers or others using any domestic or agro-industrial waste products, raw or treated? Do they pay for it? Is the use regulated or informal? If regulated, by which regulation/authority?

Yes – they are using domestic faecal sewage and various forms of agricultural waste is used for nutrient capture by farmers. They mostly compost it on their site before use. They mostly do not pay for it. The use is unregulated and informal.

29. Name private entities actively working on reuse (which waste, which output; how big are these firms; web link).Are there e.g. compost producers in the private sector, community based, or NGO/Research projects?

www.dailydump.org

www.saahas.org

30. Are any reuse-related environmental or health issues known? Are they being addressed?

None as of now. The scale of reuse is still small

31. List all major RRR related projects (wastewater irrigation/aquaculture; organic fertilizer/composting, energy/biogas/fuel; ecosan) operating in the city over the last 5 years as well as (all) ongoing ones with their main external and local partners and if possible donor or provide web sites of those projects.

| | | | |
|--|-------------|------------------|---|
| Rajbaskar Power Generation Ltd | Munirabad | Hospet | No response from the company and status called Under Progress |
| SrinivasaGayithri Resource Recovery Ltd | Mandur | Bangalore East | |
| Ramky Energy & Environment Ltd | Mavallipura | Yelhanka | Incomplete Application |
| Satarem Enterprises Pvt Ltd | Bangalore | Bangalore | Incomplete Application |
| NSL Sugars Ltd, Recovery of Energy from Industrial waste | Koppa | Maddur | Recommended to MNRE |
| Organic Waste India (P) Ltd | Mandur | Biderahallihobli | Recommended |
| Terra Firma Biotechnologies Ltd | Gundlahalli | Doddabalapur | Recommended to MNRE |

32. Is there any <white elephant> project of significant RRR failure? Which, reasons?

Currently none of the projects have been completed and hence cannot be counted as successes

33. Is there irrigation with (i) polluted water/wastewater or (ii) treated or (iii) partially treated wastewater? (any info on locations, approx. number of farmers or ha). Is the use regulated - no? If yes, by which regulation/ authority)

There is irrigation with all of the above. However this is all carried out informally and no official information is available for the same. Most residential localities as well as office space on the outskirts of Bangalore treat and reuse their waste water for landscaping. The norms for the treated waste water are prescribed by the KSPCB

34. Is there agricultural use of (i) yes : fecal sludge or only (ii) feces or (iii) urine (fresh or treated) ongoing? (any info on locations, approx. number of farmers or ha) Is the use regulated? If yes, by which regulation/authority?

There is agricultural use of all of the above. However this is all carried out informally and no official information is available for the same.

35. Is there use of other organic waste (fresh or composted) ongoing? (any info on locations, approx.. number of farmers or ha) Is the use regulated? If yes, by which regulation/authority?

There is use of organic waste and compost in agriculture. However there are no official record for the same

36. Are waste products already used for energy recovery? If yes, which waste for which purpose and which approx. scale? .

No. Very small scale

37. Are there competing uses for the waste e.g. as fuel, livestock or aquaculture feed, which compete with RRR e.g. for nutrients or energy? If yes, which waste for which purposes and at which scale (small/medium/large)?

No

38. Are there major sources of alternative fertilizers that are likely to be cheaper than waste based products, e.g. like nearly free farm yard manure? chicken manure?

No

39. Are industrial fertilizer subsidized? Which ones, how much? Or what is the price e.g. for 50kg Urea or 50 kg NPK 15-15-15)?

Rs 550/- per 50 kg in the free market

Rs 450/- per 50 kg in the Taluk Society

Rs 650/- per 50 kg compost from oil extraction industry

F. Waste supply and management in the city

40. Population size of the city (with year of reference) and official city area.

Area: 800square km

Population: 9.59 million

<http://www.business-standard.com/india/news/population-boom-at-4668-bangalore-tops-urban-districts/431302/>

41. Solid waste collection coverage (percent of population serviced; year of reference)? 2008

| <i>Area/taluk</i> | <i>Generated in Mt/d</i> | <i>Collected in Mt/d</i> | <i>Collection efficiency</i> |
|------------------------|--------------------------|--------------------------|------------------------------|
| Bangalore Urban | | | |
| BBMP | 2,374 | 2,300 | 96.9 |
| Bangalore Rural | | | |
| Anekal | 10 | 6 | 60.0 |
| Doddaballapura | 38 | 21.7 | 57.1 |
| Devanahalli | 10.7 | 8 | 74.8 |
| Nelamangala | 16.2 | 15.5 | 95.7 |
| Ramanagar | | | |
| Channapatna | 24 | 20 | 83.3 |
| Kanakapura | 19 | 12 | 63.2 |
| Magadi | 12.4 | 9 | 72.6 |
| Ramanagar | 39 | 30 | 76.9 |
| Total | 2,543.3 | 2,422.2 | 95.2 |

42. Solid waste collection carried out by municipality or private sector or both? Is there any source separation going on? (how many households) Or any segregation after collection?

Door to door waste collection is initiated in most parts of BMR. But, the effective implementation is found to be only 50%. It is observed that the frequency of collection is not sufficient. In some parts of BMR the dustbins are still being used for primary collection of waste. Especially in slum areas the primary collection system is inefficient and needs improvement.

The Municipal Solid Waste Rules prescribe for segregation of waste at source. But in almost all areas under BMR, the waste collected is a mixture of organic, inorganic, recyclables and in some cases even the household hazardous wastes like CDs, batteries, metal scraps etc. Though some amount of segregation is happening at the disposal site, it is negligible. This has a major negative implication on soil and ground water quality.

43. Approximation of how much of the city is sewerage (percentage of households connected to sewerage)? Approximation of how much of the wastewater entering sewers is eventually treated and to which level (i.e. primary, secondary, tertiary)? Estimated percentage of treatment plants that work as designed?

The sewer system was introduced in 1992 for domestic and industrial wastewater through an underground drainage (UGD) system. The city generates approximately 1,000 MLD wastewater accounting for 80% of its daily water consumption from both surface and groundwater sources. Wastewater treatment is carried out at various locations adjoining to main sewage systems. BWSSB treats presently about 721 MLD of wastewater and provides tertiary treatment to 70 MLD. The remaining sewage is not handled by the BWSSB

In recent years BWSSB has given high priority to wastewater treatment as the city is struggling with growing scarcity of drinking water. It is estimated that the requirement of wastewater treatment plant per one lakh population is about 10MLD. BWSSB has 12 secondary sewage treatment plants in all directions of the city, treating about 40% of BMR's sewage. Sewerage networks are directly linked to plants for treatment up to secondary level.

44. How many households or estimated percentage of the city depend on on-site sanitation systems for fecal sludge storage? What kind of onsite FS systems are there in percent (pit latrines, public toilets, household septic tanks, Urine diverting dry toilets, etc.)?

50% of households rely on on-site sanitation systems for fecal sludge storage. These are mostly household septic tanks

45. Who is cleaning septic tanks and latrines? Are there trucks with vacuum pump (maybe called cesspit tank operators, honey suckers, etc.)? Are they operated by the public or private sector or both? Any number of trucks available?

These are cleared by honey-suckers. 78 registered + 300 informal

46. Is the municipality or private sector or both in charge of fecal sludge collection in the city? How many septic trucks are approximately operating across the city? Share of vacuum trucks vs. manual collection?

No manual collection. All septage is collected by the private sector honey-suckers only

47. Where are most on-site systems in the city? Only in slums/low-income class areas? Or also in high-class areas etc.?

Bangalore has a thick periphery. Mostly on site sanitation is in the periphery of Bangalore – this includes high rise apartments and layouts. This does not necessarily include slums

48. Where is the collected fecal sludge (FS) from on-site septic tanks deposited/dumped? Percentage estimates: In septage ponds, other treatment plants, in water bodies/ocean, in land depressions/environment, in farms for crop production, elsewhere (please specify)?

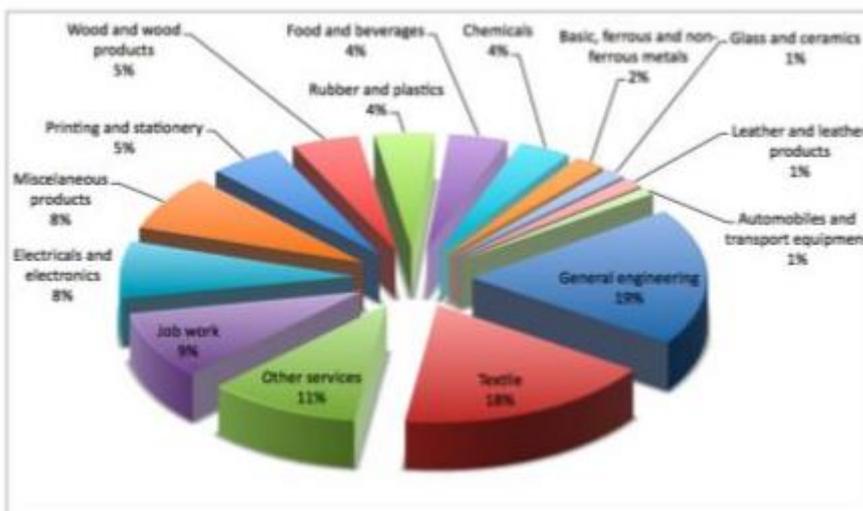
Official estimates are not available for the same – since all the operations are in the informal sector

49. What is the approximate FS quantity disposed of in official places per year vs. unofficial sites? 5 % vs 95%

The unofficial sites are more likely to be 95%

50. Please provide a brief description of the major commercial activities in animal husbandry, food industry and other agro-industrial (e.g. cotton) processing sub-sectors in the city? Who are the big players providing significant processing or agro waste?

About 10% of the total industry is of the types described above



51. Are there any data how much organic waste the major 5 to 10 companies operating in these sub-sectors generate e.g. per year?

No

G. Pollution and sanitation

52. What are the major environmental challenges in the city area? (waste, air/water pollution, flooding, diseases, water shortage, energy shortage, unsafe food production,

| Resources that need to be protected | | | | | | |
|-------------------------------------|--|---|--|---|---|---|
| | Air quality | Water quality | Forest and biodiversity | Land and soil | Water availability | Health |
| Urban development | Loss of forests, protected areas, Gurdobras, Daryankradis, Gorals, C & D Class lands and heritage trees. Inadequate implementation of Urban Forestry Programme. Inadequate protection of biodiversity hotspots | | | Delay in approval of Urban Master Plan and preparation of Master Plan | Depletion of ground water table beyond recharge | Water borne diseases |
| | Increasing per capita energy consumption | Encroachment of walkways and other green areas | | Land is overutilised continuously and the upstalling process of land | Exceptionally high levels of unaccounted-for water (UFW) | Lack of funding to government hospitals |
| | | Sewage pollution due to inadequate treatment facility | Sand mining in water bodies and quarrying. | | Destruction of vegetation and over-grazing in catchment areas | Diarthera among under 5 year olds |
| | | Overexploitation and commercialisation of lakes for recreation | | | | |
| Transport | No control over rising emissions of SPM, RSPM | | | | | Congestion increases commuters' exposure time to air pollution |
| | Absence of noise monitoring | | | | | Asthma in adults |
| | Use of adulterated fuel | | | | | Acute respiratory infection among under 5 year olds |
| Energy | Increased energy demand and high dependence of fossil fuels | | | | | |
| | Use of solid fuels for cooking and lighting at rural/periurban areas | | | | | |
| Industry | Limited over rising emissions of SPM, RSPM | Surface water pollution, exacerbated by lack of common treatment facilities | | Lack of industrial area space and common facilities | Depletion of ground water table beyond recharge | Water borne diseases |
| | Increasing reliance on DG sets and captive power generation | Absence of UGD in a large share of industrial areas | | Absence of industrial SW management | | Asthma in adults |
| | Non-collaborative industry-KSPCB relationship | | | Illegal dumping of hazardous waste | | Acute respiratory infection among under 5 year olds |
| | Absence of a common industry registry. Absence of a consent management information system for establishments registered by KSPCB | | | Brick making in tank beds | | |
| Waste | Uncontrolled burning of waste | Improper segregation of MSW and transport to the disposal site | | Inadequate treatment and disposal of MSW | | Backyard recycling of e-waste recycling impairs workers' health |
| | Unexploited potential of waste to energy options | | | Absence of adequate incineration facility at the TSDF | | Asthma in adults |
| | | | | Insignificant recycling and reuse of polythene bags | | Acute respiratory infection among under 5 year olds |
| | | | | Very small clinics, disposing BMW along with MSW | | |
| | | | | Lack of conservation of MSW landfill sites | | |
| Agriculture | | | | | Intense agriculture and irrigation in BMR | |

53. What kind of industries (e.g. beverage, chemical, textile, food, (sugar)) are there in the city and discharging waste? Is the industrial waste treated in each case? Which one not?

There are all kinds of industries in Bangalore discharging various wastes. The total hazardous waste generated in BMR from total of 1,042 hazardous waste generating industries identified is 23,756 metric tonnes per annum (MT/a).

All Industries are expected to treat and reuse their waste

| Industry sectors | Number of industries | | | |
|---|----------------------|-----------------------------|--------------|--------------------------------|
| | Subsectors | Sectors | | |
| | | DIC registrations 1996-2008 | Sector share | Estimated total (extrapolated) |
| General engineering | | 6,540 | 19.1% | 13,387 |
| Textile | | 6,086 | 17.8% | 12,458 |
| <i>Textile wet processing units thereof</i> | <i>above 60</i> | | | |
| Other services | | 3,580 | 10.5% | 7,328 |
| <i>Information technology (IT) industry thereof</i> | 2,100 | | | |
| <i>Biotechnology (BT) industry thereof</i> | 200 | | | |
| <i>IT-enabled services (ITES) sector thereof</i> | 245 | | | |
| Job work | | 3,190 | 9.3% | 6,530 |
| Electricals and electronics | | 2,706 | 7.9% | 5,539 |
| Miscellaneous products | | 2,671 | 7.8% | 5,467 |
| <i>Quarries thereof</i> | 1,800 | | | |
| <i>Stone crushers thereof</i> | <i>around 350</i> | | | |
| <i>Brick kilns thereof</i> | 27 | | | |
| <i>Mines thereof</i> | <i>around 5</i> | | | |
| Printing and stationery | | 1,731 | 5.1% | 3,543 |
| Wood and wood products | | 1,597 | 4.7% | 3,269 |
| Rubber and plastics | | 1,400 | 4.1% | 2,866 |
| Food and beverages | | 1,384 | 4.0% | 2,833 |
| Chemicals | | 1,244 | 3.6% | 2,546 |
| Basic, ferrous and non-ferrous metals | | 740 | 2.2% | 1,515 |
| Glass and ceramics | | 491 | 1.4% | 1,005 |
| Leather and leather products | | 484 | 1.4% | 991 |
| Automobiles and transport equipment | | 353 | 1.0% | 723 |
| Total | | 34,197 | 100% | 70,000 |

54. Are there any reports on the probability of chemical contamination (heavy metals) of organic and/or liquid waste streams? Could you cite related reports/papers? Radon, BU and GKVK papers

A 2009 study by [Bangalore University](http://www.bangaloreuniversity.ac.in/) revealed that in most areas radon is hundred times higher than the permissible limit of 11.83Bq/l (becquerels per litre). Almost 30% of the population solely depends on groundwater. (http://articles.timesofindia.indiatimes.com/2011-02-10/bangalore/28547846_1_radon-levels-radon-gas-radon-concentration)

In case of heavy metals, the water was contaminated with iron (Fe) at 0.92 mg/l; and lead (Pb) was 0.436 mg/l – this was found in the Bellandurlake (State of the Environment Report – Bangalore 3008)

55. Have any food safety/health issues been reported due to wastewater irrigation? By whom? Citation/reference?

1. Heavy metal (Pb, Cd, Cr, Ni) concentration in water sediments and fish was analysed from Madivala lake in the month of June 2008. There was an appreciable increase in metal concentrations in going from the water to the sediment samples. (Analysis of Heavy metals in Water, Sediments and Fishsamples of Madivala Lakes of Bangalore, Karnataka.)

2. Heavy Metals LS AND SAFETY OF FRESH FRUITS IN BANGALORE CITY, INDIA – A CASE STUDY (SeyedEsmaelMahdavian*, R.K. Somashekar Department of Environmental Science, Bangalore University, Jnanabharati campus, Bangalore, Karnataka, India)

H. Energy situation (per country if not per city) – needs sector expert assistance – Answers at a state level

56. Percent of rural/urban population with access to electricity from the grid?

As per 2011 census, Officially in Karnataka around 86.7% of Rural areas are electrified, while 100% of urban areas are electrified. However, in Urban area slums and low income settlement do not always have access to electricity. In Rural areas even when a village is electrified, not all households have access to electricity. Electrification definition in India need not mean every household is electrified in a region. Further, especially in many rural areas, even when there is access to the physical infrastructure of the electricity grid, electricity is not always necessarily available in the grids. The availability of electricity in the grid is a strong function of peak demand variations across rural and urban areas, and power availability in the state and from the central grid depending on generation issues in any period.

57. Please list the institutions/companies responsible for generation, transmission, and distribution of electricity in the country and elaborate briefly on their respective roles and responsibilities, including ownership.

Key generation entities: Public Utility (mentioned below) and Independent Power Producers. The key public utility is KPCL – Karnataka Power Corporation Limited. The role of these entities is to generate electricity and feed it into the high voltage grid.

The sole Transmission Entity is KPTCL – Karnataka Power Transmission Company Limited which is a public sector utility (owned by State Government).

The distribution companies are many as per geographical area (All are public utilities owned by the State government):

For Bangalore : BESCO (Bangalore Electricity Distribution company)

For Mysore: CHESCOM (Chamundeshwari Electricity Distribution company)

58. What entities regulate the energy sector? Please briefly describe their roles and responsibilities?

The State Level Electricity regulator is Karnataka Electricity Regulatory Commission (KERC), broadly its role is to facilitate and regulate tariff setting at all levels and protect the interests of all stakeholders in the electricity generation, transmission, distribution and consumption chain.

Central level policy guidelines are given to the state level Electricity regulators by Central Electricity regulatory commission (CERC)

59. Total installed electric capacity (MW) and annual electric generation (e.g. in Megawatt, MW) by fuel source? Please include a breakdown of renewable energy generation by source.

As on end of year 2011, the following is the total installed capacity of Karnataka with break up:

Total Installed Capacity: 12364 MW

Thermal (coal based): 5675 MW

Nuclear: 254 MW

Hydro: 3599 MW

Renewable Energy sources: 2836 MW (This includes, Wind, Small hydro power, Biomass Gasification and Biomass power) No significant waste-to-energy power projects.

60. Total electricity exported/imported?

Varies from year to year.

61. Are there gaps between supply and demand? If yes, how frequent, and how are the shortfalls met?

Karnataka definitely has a shortfall of electricity. Shortfall is managed by a combination of shutting power off to different areas (typically rural areas suffer more) and buying electricity from the central grid. In peak shortage times (especially summer as there is 30%+ dependence on hydro power) power cuts can be as frequent as every day. There is another 4000 MW of installed capacity in the pipeline in Karnataka – primarily coal based Thermal power.

62. Average price per kWh for electricity at the wholesale level (by major generator) and then at the retail level by client type (industrial, commercial, domestic)?

All tariffs for BESCOM (industrial, commercial, domestic, agricultural etc.) are available on: <http://www.bescom.org/en/services/bescom-tariff-plans.asp>

63. Are private companies allowed to generate, bank, transmit, and/or distribute energy? If yes, in both urban and rural contexts? Please elaborate on the structure of such if possible.

Electricity Act 2003 has delicensed generation of electricity. Wheeling and Banking, and Distribution of electricity in urban and rural context can also be undertaken by private parties. Wheeling and Banking agreements can be entered into with the utilities running the distribution infrastructure in the state. Most of the distribution of power is still dominated by public utilities though in specific states distribution is privatized. However, all Tariffs are regulated by the Electricity Regulatory Commission. All Electricity generation, transmission and distribution projects are subject to Environmental Clearance policies and all other necessary clearances such as from local government bodies, from the forest dept. etc.

64. Are there any organic waste-to-energy plants? If yes, what is the installed capacity (agro-industrial or domestic) thermal and electric, in MW? Please list ownership, kind of waste/source of fuel, capacity, and annual energy generation for each.

Some Private waste-to-energy projects are in the pipeline, but very little details of this is available from official sources. There is co-generation of electricity from bagasse in some sugar mills – but this is typically for captive consumption. However, in general this is a highly underdeveloped sector in Karnataka.

65. Please add information how the major organic waste-to-energy projects have been financed?

-NA-

Annex: Terminology

- **Biosolids** are stabilized (treated) excreta or the treated byproducts of domestic and commercial sewage, wastewater and faecal sludge treatment, which can be beneficially utilized as soil amendment and fertilizer after drying.
- **Business Model (in this context):** a model that contributes to cost recovery or profit from reuse, ideally supporting in this way the sanitation service
- **Co-composting:** Is the simultaneous composting of excreta with other organic waste. Alternatively, both components can also be composted separately and mixed later.
- **Domestic effluent: blackwater** (excreta, urine and faecal sludge, i.e. toilet wastewater) and **greywater** (kitchen and bathing wastewater)
- **Dried Sludge** is found on drying beds where biosolids from WWTPs are exposed to sun.
- **Excreta:** human faeces and urine (sometimes also called night soil)
- **Faecal Sludge:** Sludge of variable consistencies **collected from on-site sanitation systems**, such as latrines, non-sewered public toilets, septic tanks and aqua privies which store blackwater. The faecal sludge comprises of varying concentrations of settleable solids as well as of other, non-faecal matter. Faecal sludge consists of human faeces and urine (and flushing water) and has a high concentration of organic matter and nutrients. The term usually refers to fresh (watery) sludge.
- **Organic waste** - kitchen waste, plant material, human and animal excreta, agro-industrial, wood and food pressing waste
- **Peri-urban agriculture (PUA):** agriculture within approx. 30 Km around the build-up city area.
- **Reclaimed water or recycled water** is treated wastewater that can officially be used under controlled conditions for beneficial purposes (potable, non-potable)
- **Sanitation Safety Plan:** A manual to operationalize e.g. safe wastewater reuse like the Water Safety Plans operationalize the WHO Drinking Water Guidelines.
- **Septage:** A term used for the combination of sludge, scum and liquid pumped from a **septic tank** where household black water ends (on-site sanitation) if not flushed away in a sewer; Septage is largely similar to faecal sludge.
- **Sewage sludge: Sludge produced in wastewater treatment plants** as a result of the treatment process. It includes faeces, other waste products and the excess bacteria used in activated sludge treatment processes. The quantity of sludge produced depends on the treatment technique.
- **Sewage:** The spent and used water from a community that contains dissolved or suspended matter, including faeces and urine, and usually moves in pipes or sewers.
- **Sewerage:** a domestic drainage system involving sewers or pipes
- **Treated wastewater:** is wastewater that has been processed through a wastewater treatment plant up to certain standards in order to reduce its pollution or health hazard. If this is not fulfilled the wastewater is considered to be partially treated. What is called treated ww in low-income countries might still classify as untreated ww in high-income countries.
- **Urban agriculture (UA):** agriculture incl. aquaculture and livestock keeping within the build-up area, usually on open-spaces (backyards are not target of the study);
- **Wastewater:** All types of domestic, commercial and/or industrial effluent as well as storm water runoff, usually mixed and of different qualities, ranging from raw to diluted. The term does not imply any form of transport or treatment. It should be differentiated between raw wastewater and wastewater which entered natural water bodies (diluted wastewater, polluted stream water)