BUSINESS OPPORTUNITIES IN CREATION OF INFRASTRUCTURE FOR ENVIRONMENT PROTECTION IN INDIA

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1. Public demand for creating infrastructure for environment protection is increasing in India. For the first time in the history of Independent India, several thousands of crores of rupees have been allocated for improvement of environment and human life in cities and towns under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). The areas of business and investment include, among other things, management of domestic solid wastes and other wastes; sewage collection, treatment and disposal; prevention and control of water pollution of lakes, rivers and coastal areas, urban air pollution control, traffic management, green buildings, development of green areas etc. The program implementation is being done jointly by the Central and State Governments.

2. Central Government in the Ministry of Environment & Forests and other sectoral ministries have allocations of funds for infrastructure development for environmental protection, retrofitting, cleaner technology applications, waste minimization and energy conservation, rain water harvesting and water conservation, soil conservation and afforestation, waste land reclamation and/or remediation, cleanup of contaminated sites of waste dumps, monitoring of environmental quality, capacity building etc.

   Financial institutions from India and outside as well as technology providers are seen to be keenly interested in favor of investment in the projects on providing goods and services for environment protection in India based on public-private-partnership. The procurement processes conducted by the Government are in a transparent manner in public domain. Equal opportunities are available for local and foreign bidders as per free market policy and India's commitments to various multilateral environmental and trade agreements.

   Proliferation of curriculum and academic institutions in India dealing with environmental education, training and research are the source of supply of skilled manpower and human resources required for program planning and implementation.

   The gap between demand and supply for environmental protection and development is enormous. This sector can steadily grow more or less at the rate of 10 to 15 % per year in the coming years.

3. While there is rosy picture of investment and development of environmental infrastructure in India, there is grey side as well. The investment and procurement decisions are sometimes vendor driven due to lack of fool-proof system of procurement institutionalization. Once the environmental performance standards are laid down, the regulatory agencies practically do not play any role in selection or harmonizing the technology requirements suitable to the local needs and promote business of sustainable development. There is no bench-marking of technology requirements done by the regulatory agencies. Bid conditions are not harmonized with the need for environment protection. Enough emphasis is not given on technology performance and its capital costs and operative costs. Bid conditions by procurement agencies differ widely and that too without much environmental considerations.

4. As a result of mismatch between the supply of environmental goods and services and local requirements of environmental protection, one can see continued deterioration of environment and public health especially in urban areas. Rivers are polluted. Coastal areas are polluted. Ground water is contaminated. Air is unhealthy to breathe. Domestic and other wastes over flow the cities and towns. There is spread of asthma and other respiratory disorders among the children in cities. The cities have become un-livable to say the least. In spite of the above situations certain efforts are being made by the government departments especially concerning urban affairs, to allocate funds for infrastructure development for environment protection.

   This note is prepared in an effort to identify the areas of specific technology requirements and business opportunities and investment needs for environment protection in India. It is based on the perception of the author having decades of high level experience in the field of environment protection and no claim is made to the fullness of requirements raised as above which are so diverse and wide. It is felt important to flag the issues and provoke healthy discussion (and brain storming) in public interest and promote sustainable business and investment for environment protection.

5. **Vision:** The Eleventh 5 Year Plan visualized and included a clear commitment to pursue a development process that is environmentally sustainable. It is based on a strategy that not only preserves and maintains natural resources but also provides equitable access to those denied this currently. It recognizes that unless environment protection is at the core/center stage of all policy formulation, development if pursued may actually lead to deterioration in the quality of life. This will be discernible in the generally worsening quality of air in our cities and even our villages, in the increasingly polluted waters of our lakes and rivers, the loss of biodiversity, and the shrinking habitats of wildlife. Translating the vision of environmental sustainability will require that environment concerns are given a very high priority in development planning at all levels.

6. **Why protection?**

The Eleventh Plan laid great emphasis on achieving among other things, monitor-able socio-economic targets within the Environment and Forests sector to treat all urban waste water by 2011-12 thereby cleaning river waters. Cleaning of major polluted rivers by 2007 and stretches by 2012 was a Tenth Plan target. The Eleventh Plan set a target of treating all urban waste water by 2011-12 to clean river waters. As per Central Pollution Control Board's (CPCB) survey, the estimated wastewater generation in 2008 from class I & II towns in the country was around 36,000 MLD (1, 67,400 MLD by 2025) against which treatment capacity of only 7,650 MLD exists at present. Sewage treatment capacity of about 3,939 MLD (about 52%) has been created under the Ganga Action Plan-I (GAP) and National River Conservation Programme (NRCP). The available treatment capacity is hopelessly inadequate.

7. The National Ganga River Basin Authority (NGRBA) has now been setup, a fast track project approval mechanism is being put in place, and a change in the funding pattern from existing 70:30 to 90:10 is being considered. Therefore a target of 11,000 MLD [5,500 MLD each under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and NRCP] in treatment capacity should be the target for the Eleventh Plan. The Ministry of Environment and Forests and the Ministry of Urban Development could apportion the capacity that could be established as suggested by the Planning Commission.

8. Sanctioning and monitoring of works under NRCP and National Lake Conservation Program (NLCP) for improving the water quality of rivers and lakes, respectively is the objective which also includes reducing pollution load in major rivers through pollution abatement works. 150 major polluted stretches on 37 rivers have been identified by CPCB. NRCP only covers 40 polluted stretches. Recently M/s CRISIL Advisory Services had held one day seminar in Delhi for potential bidders and presented tender that are likely to be issued in near future for sewage treatment plants under the Ganga Authority.

9. **Adverse effects (surface water, ground water, soil)**

The disposal of untreated or partially treated sewage and industrial waste water is the main cause of water pollution in India causing and/threatening the structure and function of the recipient ecosystem. Adverse effects of water pollution on environment and health are very well documented. There is no need to emphasize remedial actions that must to be taken by all concerned agencies systematically over a period of time so as to achieve the goals of the Water

(Prevention and Control of Pollution) Act, 1974 and the Environment (Protection) Act, 1986.

10. Legal Provisions

Standards: It is mandatory under Indian law that nobody will discharge sewage or trade effluent (e.g. industrial waste water) without complying with the notified environmental standards laid down for its treatment and disposal. Schedule VI (see Rule 3A) notified under the Environment (Protection) Act, 1986 provides general standards for environmental discharge waste water. Some of the standards for important parameters are presented below:

Sr. No.	Parameters, mg/lit except pH	Standards			
		Inland Surface Water	Public Sewers	Land for Irrigation	Marine Coastal Areas
1	pH	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2	BOD	30	350	100	100
3	COD	250	---	---	250
4	Suspended Solids	100	600	200	a) 100: for process waste water b) 10% above influent for cooling waters
5	Oil & Grease	10	20	10	20

11. **Primary Water Quality Criteria:** In a water body or its part, water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for particular purposes. Among the various types of users there is one use that demands the highest level of water quality or purity and that is termed as “Designated Best Use” in that stretch of water body. Based on this, water quality requirements have been specified for the different uses in terms of primary water quality criteria. The Schedule I (see Rule 3) notified under the Environment (Protection) Act, 1986 at serial no. 93 in Table 1 provides stipulated primary water quality criteria for bathing water (water used for organized bathing). The table is reproduced as below:

CRITERIA		RATIONALE
Fecal Coliform, PN/100 mL:	500 (desirable) 2500 (Maximum permissible	To ensure low sewage contamination. Fecal coliform and fecal streptococci are considered as they reflect the bacterial pathogenicity.
2. Fecal Streptococci MPN/100 mL:	500 (desirable) 2500 (Maximum	The desirable and permissible limits are suggested to allow for fluctuation in

CRITERIA		RATIONALE
	permissible)	environmental conditions such as seasonal change, changes in flow conditions etc.
3.. pH:	Between 6.5 – 8.5	The range provides protection to the skin and delicate organs like eyes, nose, and ears etc. which are directly exposed during outdoor bathing.
4. Dissolved Oxygen:	5mg/lit or more	The minimum dissolved oxygen concentration of 5mg/L ensures reasonable freedom from oxygen consuming organic pollution immediately upstream which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediment.
5. Biochemical Oxygen Demand, 3 day, $27^{o}C$	3mg/lit or less	The Biochemical Oxygen Demand of 3mg/L or less of the water ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases.

12. In the coastal segment, marine water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for particular purposes. Among the various types of uses there is one use that demands highest level of water quality/purity and that is termed as "Designated Best Use" in that stretch of the coastal segment. Based on this, primary water quality criteria have been specified for the following five designated best uses:

13.

Class	Designated best use
SW-I	Salt Pans, Shell fishing, Mariculture and Ecologically Sensitive Zones.
SW-II	Bathing, Contact Water Sports and Commercial fishing.
SW-III	Industrial Cooling, Recreation (non-contact) and Aesthetics.
SW-IV	Harbor.
SW-V	Navigation and Controlled Waste Disposal.

14. **Economical effectiveness of technology:** Economics of each technology is identified in two parts: 1. Capital investment of the plant and 2. Operation and Maintenance (O&M) cost. The capital investment for a project is based on the type of technology being used. It is essential to use Best Available Technology Not Entailing Excessive Costs (BATNEEC). It has been observed with the experience of various local bodies that vendors are interested in in establishing of plants rather than operation and maintenance of sewage treatment plants.

O&M of these plants requires technical personnel with good experience and knowledge of legal provisions of environment. Also the revenues from O&M business are not as lucrative as those from construction of plant. Hence the local bodies either employ services of contractors who are willing to do the work at very low cost or these corporations are conducting O&M of these plants on their own; however they do not have the technical personnel to undertake the O&M.

The new generation of technology provides the balance between capital cost and O&M cost. As stated earlier, O&M component is essential for any technology. Use of better and new technologies for producing BOD < 5mg/lit at outlet has the following advantages:

- Process automation reduces dependence on personnel for making technical judgments.

- Reduced carbon footprint has been a requirement for all STPs as conventional methods of sewage treatment have been criticized for excessive use of power. There has been reduction in power consumption due to automation and used of PLC's in sewage treatment operations as the system is optimized to achieve the precise value of dissolved oxygen for best appropriate operation.

- In the current scenario where land resources are under tremendous pressure leading to escalated land costs, minimum use of land for such projects is desirable. Modern technologies such as SBR, MBR, MBBR, RO etc. require less area for construction.

- Due to the use of new technologies, the O&M costs are lower per cubic meter of sewage treated. In case of a new technology there are opportunities for local bodies to reuse the water for non-potable and industrial purposes. The revenue generated from sale of such water is 10-12 times more than the O&M costs.

- Efficient O&M of STPs is important to sustain the treatment of waste water. It is essential to consistently discharge treated waste water with minimum BOD. To achieve this, technology evaluation should be done in such a way that the technology in use should be more efficient, automated and require minimum manpower. Moreover the cost entailed during O&M should be low as much as possible so as to attract more private participation.

- Over the years millions of rupees have been spent by various government authorities for construction of sewage treatment plants at current BOD discharge concentrations; still these investments have not resulted in reduction of pollution of rivers due to inadequate capacities and inefficient O&M of existing plants.

15. **Remediation of Contaminated sites:** This is new and upcoming vertical in the business of infrastructure for environment protection. In response to the order of the Supreme Court of India, the Government of India in the Ministry of Environment & Forests in consultation with the Central Pollution Control Board has prepared inventory of the sites contaminated due to industrial hazardous wastes and other wastes. A National Action Plan is also prepared for remediation of the contaminated sites. This plan, among other things, is financially supported by The World Bank. Consultants have been appointed for preparation of detailed project reports (DPRs) so that the process of international competitive bidding could be started by the respective State Government or the State Pollution Control Board. At least eight (8) such bids are likely to be announced soon at an estimated cost of Rs. 1800 Crores i.e. approximately US$350 million. The first Tender is already issued by the Andhra Pradesh Pollution Control Board in April 2014 for remediation of a lake near Hyderabad at an estimated cost of Rs. 240 Cr. i.e. about US$40 million. Tenders are likely to be finalized in next few months.

The contamination of the sites is mainly due to disposal of untreated and/or partially treated hazardous wastes and other wastes such as industrial hazardous wastes, municipal solid wastes, industrial effluents, electronic wastes etc. The ingredients of the contamination include, Cr^{+6}, heavy metals, HCH, elemental Mercury, Brine & Hg Sludge, Lead, Cr, VOCs, Methylene Chloride, Arsenic, Flourides, Gypsum sludge & Iron Sludge, Asbestos, Zinc Sludge, Zinc scrap, DDT, Endosulfan, Dicofol, Ammonium Phosphate and Ammonium Sulfate, Thorium oxalate, Rare earths fluoride and Rare earths chloride, Thiozoles, Sulphamides and antioxidants. The contaminated sites are spread in several States in the country such as Uttar Pradesh, Orissa, West Bengal, Maharashtra, Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu, Andhra Pradesh, Karnataka, Punjab, Madhya Pradesh, Jharkhand, Chhattisgarh etc. Approximate area for probable site rehabilitation is estimated at 5,143,800 m^2 and approximate population likely to be affected 1.7 million. While approximate volume of waste to be removed or treated from the contaminated sites cannot be estimated at this stage, sources of the contamination are summarized below for illustration:

- The industries have buried waste in the area that has contaminated the groundwater with chromium.

- Leachate from the landfill has contaminated the groundwater with lead and other heavy metals.
- Pesticide manufacturers are dumping waste along roadsides, contaminating soil with HCH isomers.
- Pesticide effluents contaminating the drains with hexachlorocyclohexane.
- The groundwater is contaminated with Hexavalant Chromium from a legacy chemical factory closed in the 80's. Residents use the water for washing and watering.
- Leachate and runoff from dump sites is contaminating the agricultural soil.
- The Rushikulya River and Bay of Bengal are heavily polluted by mercury discharges in effluents from a chlor-alkali plant.
- The legacy site produced sodium dichromate; the soil and groundwater were contaminated with chromium VI and chromium sulphate.
- Waste from dye, textile, and edible oil industries are dumped directly into Noor Muhammad Kunta Lake, polluting the water, soil, and eventually food.
- A large industrial estate that includes pesticide, pharmaceuticals, chemicals, and steel facilities is dumping waste into a nearby lake.
- Informal e-waste recycling is polluting the air, soil, and water of Bangalore with heavy metals. Approximately 4000 backyard recyclers operate in Bangalore at Mysore Road.
- Effluent from tanneries and a common effluent treatment plant that is not working perfectly has polluted groundwater with chromium.
- 227,000 tons of chromate sludge from an abandoned chemical plant in TN lies untreated on site and has contaminated local surface and ground water.
- Contaminants from a large solid waste landfill have contaminated groundwater.
- Major chemical factories polluted the local drinking water with lead. This legacy pollution affects water sources used for drinking and washing. Total quantity of waste generated: 20,906.6 MT.
- An abandoned asbestos mine left large amounts of asbestos waste behind that is now contaminating the food, soil, and air of the local community.

- Industrial estate comprising of automobile manufacturing, food and chemical processing, textile and dye facilities.

16. **Municipal Solid Wastes (MSW):** Generally a person generates about 250 g of garbage every day. Going by the population spread in the cities and towns in India, thousands of tons of garbage is generated every day. Local civic bodies have engaged agencies for collection, transport and disposal of MSW, however, the situation is not satisfactory except very few places that can be counted on fingers. Environmental compliance for management of MSW was expected to be achieved by the January, 2005 but still it is not done. The problem is that environment protection is not given primary importance as political will at local level is inadequate. In-efficient functioning of the projects on MSW is mainly due to low tipping fee and false promises by vendors. This is leading to failure of project due to techno-economic un-viability. Added to this is passive approach in implementation of environmental regulations. Lack of application of knowledge, planning and project management expertise with the local civic bodies often results in to borrowed solutions that do not work at specific conditions prevailing at local level.

    There is public agitation due to smell, ground water contamination and other problems of public health and environment. The judicial pronouncements and public demand has triggered initiative from the Government and has increased budget allocations for the domestic waste management in the urban areas. There is scope for revamping the existing system and bringing in better technologies for management of MSW. Funds are available under JNNURM and NRCD/GAP for management of MSW, sewage collection, treatment and disposal. It is most important for the success of these programs that environmentally sound technologies (BATNEEC) are adopted for achieving most stringent standards for waste treatment, disposal and recycling/reuse.

17. **Water & Waste Water:** Importance of water and waste water management need not be over-emphasized. It is said that 70% of illness is linked to water. Ground water resources are depleting and increasing contaminated due to various reasons. By the year 2025 India may become “water scarce country” and by the year 2050 water for industry will become a serious issue. Major quantity of sewage generated from Class I and II cities in India remains untreated/partially treated. This is major source of water pollution of rivers, lakes and coastal areas. Needless to say, there huge gap between demand and supply of goods and services for drinking water supply, sewage collection, transport & treatment. Environmental and other regulations are in place and facilitate investments. In last five years business in this area was about 32 Billion US Dollars and in next five years it is expected to cross 40 billion USD. Of course, this business opportunity in India is not without the challenges.

18. **Conclusions:** Access to advanced technology is now available. There are examples in India where successful implementation in the last five years has improved the situations but it is not sufficient. There is plenty of scope and need for more applications in terms waste treatment, disposal and recycle/reuse.

The availability of funds for development of common infrastructure (based on public private partnership) for environment protection has been phenomenal. The effective utilization of these funds provides business opportunity to yield environmentally sustainable development over a period of time

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PS: The author is also Ex Member Secretary of Maharashtra Pollution Control Board and was Expert Member of Consultative Group for Environment, Forests and Wildlife Sector for the 11th Five Year Plan Mid Term Appraisal constituted vide Office Memorandum No. M-13033/2/2009-E&F, by the Government of India, Planning Commission (Environment and Forests Division) dated 29.09.2009. The information and data used in this paper from Planning Commission is gratefully acknowledged.