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MAJOR INITIATIVES AND ACHIEVEMENTS IN THE PROMOTION OF 3Rs IN INDIA - COUNTRY ANALYSIS PAPER

DR. MANJU RAINA
DIRECTOR
MINISTRY OF ENVIRONMENT & FORESTS
GOVERNMENT OF INDIA
NEW DELHI
INDIA

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Manju Raina, Ministry of Environment and Forests, India

I. BACKGROUND

India has provided for the protection and improvement of the environment in its constitution and environmental considerations have been integrated into decision making at all levels. The Indian national strategy on waste management is in line with the principle of sustainable production and consumption. The management strategy that stipulates the hierarchy of reduction in waste generation, re-use and recycling options ahead of ultimate disposal has been the core objective as specified in the National Environmental policy – 2006 and also in National Hazardous Waste Management strategy of the Ministry of Environment & Forests, Government of India published in the year 2012.

According to World Bank estimation, the urban authorities in Asia spend about 50-70 percent of their revenues on waste management and the effect of neglecting the environment is costing an average of 5 percent of GDP. As for India, it is believed to be losing as much as 5-6 percent of its national income for pollution control. At this crossroad of unplanned urbanisation and sustainable development, the 3Rs concept, Reduce, Reuse and Recycle if implemented, could be the missing piece in solving the Asian waste puzzle. However, it would be unfair to state that Reduce, Reuse and Recycle (3Rs) activities are unknown to South Asian countries and are not practiced on regular basis.

Many South Asian countries have made progress on the legislative front and also share common interest in tackling solid waste issues. Perhaps, most noteworthy is India's recent review and finalisation of National Environment Policy (NEP) which stresses on adoption of cleaner technology, strengthening the informal sector of collection and recycling of various materials, developing and implementing strategies for recycle, reuse and finally environmental friendly disposal of waste.

2. THE LEGAL AND REGULATORY FRAMEWORK FOR ENVIRONMENTAL PROTECTION IN INDIA

The policy and legislative framework forms the backbone of any institutional and implementation system. At the national level, there are numerous provisions in the Indian legislative structure to have a bearing on the State's management of environmental resources. Some of the environmental legislations in India are listed below:

- Water (Prevention and Control of Pollution) Act, 1974
- Air (Prevention and Control of Pollution) Act, 1981
- Environment (Protection) Act, 1986
- Biomedical Waste (Management and Handling) Rules, 1998,
- Municipal Solid Wastes (Management and Handling) Rules, 2000
- Hazardous Wastes (Management and Handling) Amendment Rules, 2000
- Batteries (Management Handling Rules) 2001
- Hazardous Waste (Management, Handling and Transboundary Movement) Rules 2008
- Plastics (Manufacture, Usage & Waste Management) Rules, 2009.
- National Green Tribunal Act, 2010.
- E-waste (Management and Handling) Rules, 2011

3. MAJOR INITIATIVES, ACTIVITIES AND ACHIEVEMENTS ON THE 3Rs IN INDIA

The developing countries with rapidly growing economies face serious waste related problems and growing resource demand at the same time. Thus, it is a challenge for the developing countries to promote environmentally sound waste management and the 3Rs as a concerted effort. While promoting environmentally sound waste management is the largest challenge for such countries, it is also necessary to promote efficient use of resources through activities of reducing, reusing and recycling as well as enhancing technologies and know-how on the 3R activities. Major activities of India in this regard are summarized below:

3.1 CLEAN TECHNOLOGIES

Adoption of Clean Technologies and cleaner production strategies is considered to provide a balance between Development and Environment through economic benefits by way of increased resource efficiency, innovation and reduced cost for environmental management. In India, a scheme on adoption of clean technology and promotion and establishment of waste minimization circles in small and medium scale industries is being implemented by the Ministry of Environment and Forests, Government of India, with the following objectives:-

1. Development and Promotion of Cleaner Technologies.
2. Development of tools and techniques for pollution prevention.
3. Formulation of Sustainable Development Strategies.

Clean Technologies, as distinct from ‘‘end-of-pipe” abatement technologies minimize the generation of waste streams in the production processes and utilize waste from other consumption goods and production processes, rather than treating the waste after generation. Clean technologies are less intensive in use of raw materials and energy than conventional technologies, which rely on pollution abatement after generation. For this reason, they may also offer significant cost advantages to the producer. Table I below describes some of the recycling / reuse options adopted by the industrial sector in India.

Table 1: Reuse and Recycling Options adopted by Indian Industrial Sector

S. No.	Industrial solid waste	Source	Recycling/reuse Practices
1.	Fly Ash	Coal based thermal power stations	• Fly ash bricks • Cellular Concrete • Portland Pozalana Cement • Road Construction • Land Reclamation
2.	Steel and blast Furnace Slag	Iron and Steel Industries	• Blast furnace Slag Cement • Road aggregate
3.	Lime sludge	Fertilizer, Sugar and Paper Industries	• Lime Pozzolina mixture • Cement manufacture
4.	Phospho gypsum	Phosphatic fertilizer Industries	• Cement manufacture • Gypsum Board • Partition Pannels • Ceiling tiles
5.	Red mud	Aluminium Industries	• Cement Manufacture • Brick manufacture • Light weight structural blocks
6.	Press mud	Sugar industries	• Composing • Biogas Production • Manure
7.	Bagasse	Sugar industries	• Cellulose for Pulp and Paper • Cattle feed

			• Coal substitute in boilers
8.	Fleshings and Shavings	Tanneries	• Biomethanation • Animal feed • Glue making

The objective of the scheme is to provide support to introduction of cleaner production and cleaner technologies through setting up of demonstration projects and initiation of relevant R&D activities. A brief of some of such projects which have been completed are as under:

(i) Pilot demonstration of Clean Technology for landfill gases recovery at Okhla site, New Delhi.

The project was sanctioned jointly to The Energy and Research Institute (TERI), and Jamia Millia University, New Delhi. The main objective of the project was the Municipal Solid Waste (MSW) generated in the major cities of India, normally disposed of in unsecured landfills where it gradually decomposes to produce methane (CH_4) and carbon dioxide (CO_2), both considered as potent Green House Gases (GHGs). The landfill gases (LFG) contain carbon dioxide, methane, volatile organic carbon and odorous compounds that can adversely affect public health and the environment. The objective of the pilot demonstration project was to capture and recover the landfill gas currently being emitted from Okhla landfill site by using Clean Technology (CT) and thereby to utilize the energy and reduce the risk of uncontrolled methane emissions from landfill, which is a potential GHG.

(ii) **Recycling of Marble Slurry Waste for environmental improvement in Rajasthan.**

The Indian Environmental Society has implemented a pilot project on Recycling of Marble Slurry by setting-up a small scale project on Recycling of Marble Slurry at RICCO Industrial Area at Amberi, Udaipur. The aim of the project is to demonstrate the use of slurry as resource and not waste. The Society with the support of Ministry of Environment and Forests, Govt. of India has taken initiative to upgrade the technology and established unit to make bricks from Marble Slurry. The Society developed the technology for recycling of waste and the bricks produced from the slurry, which have been tested by the Central Building Research Institute, Roorkee. These bricks have been found as an excellent construction material and offer a viable option to replace the traditional bricks. The results of testing have shown that the bricks produced from the Marble Slurry are much better in quality, having more comprehensive strength and less water absorption capacity. The cost of the Marble Slurry is also comparable to the traditional bricks. The Society has also developed the tiles from the slurry and this could be another use of Marble Slurry Waste.

(iii) **R&D application in Technology Up-gradation of CETP in Tannery Cluster in Dindigul, Tamil Nadu.**

The tanning industry is one of the oldest industries with more than 2000 tanneries in India. Out of this nearly 900 tanneries are located in Tamil Nadu. The tanneries in clusters have established Common Effluent Treatment Plants (CETPs). The cluster of tanneries in Dindigul numbering about 60 established a CETP with a capacity of 2500 m^3/day. The CETP is built up with conventional treatment systems such as physio-chemical treatment, open anaerobic lagoons and aeration system. The open anaerobic lagoons due to degradation of organic matter in the effluent exit methane and hydrogen sulphide. This caused emission of green house gases and odour in the surrounding area. With a view to control methane emission, odour and minimize sludge generation, Central Leather Research Institute (CLRI) has developed an improved Upflow Anaerobic Sludge Blanket (UASB) system with sulphur recovery and energy generation at pilot scale. The system is now being used for commercial scale application.

(iv) **Minimization of Environmental Impacts of Slaughter House Wastes for use as Value Addition foods.**

The project was sanctioned to the Aligarh Muslim University, Aligarh, UP. The main objective of the project was to use the Slaughter House Waste as a by product i.e., value added pet foods and bio fertilizers to have a better environmental management in this sector and to enhance the income of the meat processors. On an average, the wastes produced by the slaughter houses are 45% to 60% of the total meat product from cattle and buffaloes, sheep's and goats etc. These wastes cause serious environmental problems as well as health impacts. On the other hand if properly collected, conserved and processed they can be utilized for food, feed and fertilizer. The economic value of such end products goes as high as 30 folds when compared to the value of the raw materials. Various slaughterhouse wastes like hides, skins, their trimmings, head, shank and tail hides are ideal for conversion into dog chews. Modern food processing technologies viz., thermoplastic extrusion and restructuring of meat has been utilized to produce animal feeds and pet foods of desired shape and characteristics.These pet food/feed can be safely stored for longer periods. Utilization of slaughterhouse waste products for food/feed of pets, poultry and fish etc., will not only lead to minimize the impact of environmental problems but also produce value added products besides generating employment for thousands in rural areas.

(v) **Development of Fly Ash Based Geopolymer Concrete Precast Elements.**

The project was sanctioned to Annamalai University, Tamil Nadu. The main objective of the project was to use large quantities of fly ash to develop an alternative concrete (geo-polymer concrete) to normal cement. Development of an alternative to cement will reduce the production of cement which is in turn will reduce the pumping of CO_2 to the atmosphere as also to save natural resources and vast areas of land for ash pond to store it. The geo-polymer concrete developed can be used for Pre-cast Concrete elements like Railways sleepers, Electric power poles, Concrete bridges etc. The product has shown better strength than the cement.

3.2 RECYCLING OF WASTES

Government of India has undertaken several initiatives at the State and National level to promote recycling of waste in the country. Some of them are illustrated below:

3.2.1 RECYCLING OF E-WASTE

E-waste is one of the fastest growing waste streams in our country. It ranges from 0.01% to 1% of the total household waste generation. A study to assess e-waste generation based on obsolescence rate and installed base indicates a generation of 146180 tonnes per annum. It is a crisis not only of quantity but also of toxic ingredients such as lead, beryllium, mercury, cadmium etc. that pose both occupational and environmental health threats. The Ministry of Environment & Forests, Government of India has notified E-waste (Management and Handling) Rules 2011 effective from 1st May, 2012. These Rules shall apply to every producer, consumer involved in the manufacture, sale and purchase and processing of electrical and electronic equipment or components as specified in schedule I. In these Rules Extended Producer Responsibility (EPR) has been introduced to bear the responsibility of collection or e-waste has been placed with the producer. The guidelines for implementation of the provisions of the E-waste (Management and Handling) Rules 2011 have also been published to help the stack holders, i.e. the Producers, Consumer, Bulk Consumer, Collection Center, Dismantler, Recycler and Regulatory agencies (State Pollution Control Boards / Pollution Control Commitees) for effective compliance/implementation of these rules. This document also provides guidance on setting up collection mechanism, dismantling and recycling operations.The scope of implementing such EPRs is also discussed in these guidelines. As an outcome of this regulatory intervention, at present there are 77 e-waste recycling facilities in 9 States of the country with a total recycling capacity of about 2.4 lakh MTA.

3.2.2 RECYCLING OF PLASTIC WASTE

It is estimated that post-consumer plastic waste constitutes approximately 4-5% by weight of municipal solid waste generated in India. A novel approach is being implemented for reusing plastic waste in road construction. The plastic waste (bags, cups, thermocole) made out of Polyethylene, Polypropylene, Polystyrene are separated, cleaned and shredded to small pieces (passing through 4.35 mm sieve). The aggregate (granite) is heated to 170^{o}C in the Mini hot Plant and the shredded plastic waste is added. It gets softened and coated over the aggregate. Immediately the hot Bitumen (160^{o}C) is added and mixed well. As the polymer and the bitumen are in the molten state (liquid state) they get mixed and the blend is formed at surface of the aggregate. The mixture is used for laying roads. The technique is extended to Central Mixing Plant too. As per the Indian Counsel for Plastics in the Environment (ICPE), 1.2 million tonnes of plastics are recycled.

3.3.3 RECYCLING OF HAZARDOUS WASTE

It is estimated that there are about 41523 number of hazardous waste generating industries in India and their hazardous waste generation is about 7.90 MTA. These wastes can be categorized into three components, such as, recyclable, land fillable and incinerable. Instead of spending large amounts of money for burying or incinerating the wastes, there is a need to find more productive uses. Utilization of hazardous waste as co-processing in cement kilns or in other applications as a supplementary resource or for energy recovery or after processing have very well been initiated in the country. The Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 encourages such resource conservation concept by laying down such provision under the Rule 11 of the Rules. Use of hazardous waste, such as effluent treatment plant sludge from dyes and dye intermediates, tyre chips, paint sludge, tar residue and refinery sludge has been promoted as supplementary fuel in cement kilns. It may, therefore, be concluded that co-processing of hazardous wastes in cement plants has been well established in the country by virtue of high temperature (upto 1400^{o}C) and residence time (>4-5 seconds) with oxygen rich atmosphere prevalence in cement kilns ensuring safe destruction of organic compounds present in most of the wastes. The guidelines for co-processing of hazardous wastes in cement plants have also been prepared by GOI. By integrating co-processing and treatment of wastes in energy and resource rich industry, the country can forego or significantly reduce investments in costly incinerators, save non-renewal fossil fuels and raw material, reduce green house gases, increase waste treatment capacity, reduce the impacts of such hazardous wastes and also reduction in land fill requirements. Co-processing is a sound and better alternative for waste disposal in particular for incinerable hazardous wastes. The figures have shown increasing trend of co-processing of hazardous wastes in cement plants over the last 3 years and currently about 45,500 tonnes of hazardous wastes is being co-processed in cement plants annually.

4. Developing countries share the recognition that the environmentally sound waste management is a significant issue. In particular, there is a need to raise the priority of environmental policies as a whole, including environmentally sound waste management. In addition, there is a need to develop the institutional capacities of Central and Local Governments. To promote international cooperation to raise the priority of such issues, it is necessary to keep social and economical impacts in mind by incorporating the concepts of the 3Rs and effective utilization of resources in addition to promoting environmentally sound waste management. There is also a growing need for information sharing on international cooperation on the 3Rs for the effective collaboration and operation of the projects. Especially, there are areas in which multilateral collaboration can lead to improved efficiency; such as development of policy measures of promoting 3R activities, development of technological guidelines and indices that can be used to compare 3R progress and development of guidelines for promoting sharing of information.

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