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RESEARCH ARTICLE

Non-Energy Resources, Waste Disposal, Recycling and Industrial Ecology for Sustainable Development in India

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Abstract

Technology and human values need to develop in order to resolve the conflict between conventional economic and ecological principles and between the human and the natural system. Because only they can generate the right policies for sustainable development. The EU wants to reduce emission of dioxins and acid gases such as nitrogen oxides, etc. which can be harmful to human health. Economic growth has resulted in higher production and consumption, and is driving force behind the growing quantities of waste.

Introduction

India has the world's second largest urban population. Providing basic amenities such as safe water and sanitation to all urban citizens will be one of the biggest challenges facing India this century. People consume huge amounts of energy and food resources and produce equality huge amounts of wastes that are disposed of in the peripheries of the urban areas. Planning for the provision of basic amenities to all urban citizens will need to encompasses both these two dimension; first, the quantitative. Second, the qualitative. For the long-run sustainability of urban systems, there are 2 basic issues of vital concern:

1) The use of proper disposal methods
2) The reduction of the quantity of waste generated so as to reduce the quantities that have to be disposed.

Non-Energy Materials

These materials constitute the physical basis of the produced items of goods and services of the economy. These are categorized as non-renewable resources. In industrial society, those resources belong to metals, plastic and non-mineral resources of producing single product. Repair and renovation are a variant of recycling without throwing off the basic materials as waste. These measures increase the life of the products. Although the virgin raw material and recyclable waste are not perfect substitute of each other, the extant of substitution will be determined by their mutual marginal rate of substitution and the relative prices of reflecting the relative scarcity and efficiency of virgin material vis-à-vis recyclable waste.

The emerging concept of design for environment requires that the products be designed for good performance, low manufacturing cost, long life, efficient disassembly and recycling. The flow of non-renewable materials from nature to economy makes unavailable the tackling of the problem of sustainability of growth and development process. Any important in material yield would require lower amount of raw materials to be processed per unit of output and lower amount of energy as well. The conservation of matter is a co-benefit of energy conservation and lower volume of waste flow to the silk.

Apart from the quantum of waste handling and disposal the a biotic non-energy material resource use gives rise to problem of qualitative degradation of environment. also the nature of degradability of waste generated is important in deciding the qualitative impacts. Hence, maximization of recycling of non-biodegradable material is best way to reduce stress on nature and avoid negative externalities.

Any disruption of natural function would affect human beings. Also new technology may reduce the cost of extraction and lower the cut of grade. Environmental hazardous is the fast rise in the generation of wastes at the raw

material stage. The sustainability of technology depends on the availability of virgin material resources in future as well as the life cycle of material in economic system. A sustained growth of GDP will require rise in material productivity. one important strategy for that is dematerialization production, which means less use of material for a given function. Recyclability or re-engineering used products or waste is important ways of raising life cycle efficiency of materials and waste mining too. The dematerialization of production, innovation of new materials re-engineering of old products, waste recovery and its recycling, would contribute to rising of reserve life of the non-renewable materials. Hence the R&D activities in material sciences and technology would be required to strive for change in the technology regime.

Wastes Disposal

1. The wastes is one of pollution and defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that is deemed to be harmful for human being for productivity of natural resources in delivering services for human well being.
2. current regulatory language makes little distinction between solid and hazardous wastes and secondary materials that are usable for other applications determining the regulatory implications of redefining waste materials as useful secondary materials requires industry to work in cooperation with regulatory bodies.
3. Wastes are classified in three categories:

(a) bio-degradable wastes
(b) non-bio-degradable wastes
(c) poisonous or radioactive wastes

The bio gradable wastes can be decomposed and absorbed by nature by its own process. if input of wastes of rate flows faster than time rate of natures recycling capacity, it is difficult for ecosystem to maintain environment quality.

There are three stages of degradable wastes:

(a) Primary treatment- mechanical screening and sedimentation procedure.
(b) Secondary treatment - a biological reduction of organic matter
(c) Tertiary treatment - chemical removal of harmful solvents, nitrates, etc.

The major sources of biodegradable wastes in India have been fruit processing, paper mills, sugar mills and textile factories.

The non bio-degradable wastes mostly emerge from industries like a aluminium products, steel plant waste, etc. recycling is the best way of waste management. Table 1 gives methods of waste disposal in India.

Non bio-degradable hazardous waste are including items like heavy metals, radioactive substances nuclear waste, pesticides, etc.

Nuclear waste is hazardous to all forms of life by the criterion of toxicity as well as mutagen city. The effect of heavy metals on the ecosystem depends on the dosage condition of released metal wastes into nature. Every day 90 per cent of generation of hazardous wastes belong to industrial world. As the soil & grounds water are affected by the hazardous wastes, the governmental regulations on the use of these chemicals in industrialized countries is inducing the latter to put increasing pressure on the developing countries to accept the concerned polluting technologies. Table 2 gives the rate of various hazardous waste origins in India.

WASTE WATER GENERATION AND DISPOSAL:

Sources of waste water categorized into **1 point** sources **and 2 non point** sources

1. point sources of pollution from urban municipal use and industries
2. non-point sources include pollutants from agriculture insecticides and pesticides, organic pollution, pollutants from rural populations and dairies . The total waste generated in the basin is about 1500 tonnes a day.

Identity 'Stressed Districts'

The following parameters were studies from each of the districts and the stretches:

- pollution density
- industrial activity
- fluctuations in water table
- depth of water and groundwater exploitation
- quality of surface water
- quality of ground water
- flows of surface _water

ASSESSMENT OF THE CASUAL FACTORS

The casual factors are distributed:

- households (population)
- industries (large-medium-(small-scale) industry)
- agriculture (irrigation)
- groundwater
- surface water

Pollution load on water resources is increasing due to the increase in population, industrial activities and extensive use of pesticides and other chemicals for cultivations.

LIQUID WASTES AND MANAGEMENT

Historically, cities have used rivers, lakes and coastal waters to dispose of liquid wastes. The natural flow of the water helped to disperse and break down the wastes and render them harmless. In the case of India, total sewage generation from urban centers grew from about 5 billion liters a day in 1947 to around 30 billion litters day in 1997.

At a national level, the Ganga basin is clearly a "hot-spot" for water pollution caused by urban sewage. In addition to sewage produced by households, waste water generated by industrial activities located in and around cities is another case of water pollution. The waste water contains both organic and inorganic pollutants and industries vary considerably in terms of their share to total water pollution.

The pollution which caused by large @ medium sized industries is that caused by small-scale industrial units. The mass of liquid wastes have affected by the surface water, percolation , the ground water quality. There has been a huge increase in the quantity of liquid waster generated in the urban areas with the larger river basins emerging as the hot-sopts. Also government and private sector are major polluters, the government through the actions of municipal bodies and the state owned industrial enterprise, and both of them must be made to treat liquid wastes before disposal. it is needed to minimizing the production of liquid waste.

SOLID WASTES AND MANAGEMENT

The collection, transport and safe disposal of solid wastes is of critical importance to the health of the urban community and the environment.

Solid waste generated can be categorized into two types:

Municipal solid waste (MSW) and industrial solid wastes (ISW). MSW are generated by households, commercial establishment, markets and comprise a heterogeneous mixture of discarded durable and non-durable goods.

ISW are generated by industries such as metals, drug and leather, etc. In last fifty years, the total waste generated has increased form 6 million tonnes in 1947 to 48 million in 1997 (TERI, 1998). of this, 1.43 million tonnes is hazardous medical wastes that should be disposed off separately and no enter the general MSW streams.

Per capita waste generation varies by income group, changing life styles and increasing consumption. Also shortage of workers and trucks to transport MSW are some reasons for the poor services. therefore government must do "strengthen to capability of the local authorities". Municipal government must have freedom to enter into long term agreement with private firms and have competent staff and authority to be able to monitor and enforce contract agreements with private parties.

In Iran, more than 45,000 tones of waste is produced daily, 30 per cent of which is solid waste. By 2020, our waste generation would be double. Disposal is still the most common of managing waste.

The drivers of change of waster into dynamic, fast change, international economic sector are:

- Growing concern about hazardous of waste disposal
- Broader environmental concerns, especially global warming and resource depletion.
- Economic opportunities created by new waste regulations and technological innovation.

Intensive recycling requires householders to separate their waste into three main streams: organics recyclable and residual waste, supplemented by periodic collections of goods and hazardous items. Recycling needs skilled front line collectors, transformed management information systems and multiple bins. Also the lack of the markets for secondary materials is seen major weakness of the recycling alternative.

Table 1:*Methods of waste disposal in India (23 cities)*

Methods	**1991**
Land dumping	89.8%
Composing	8.6%
Others (pelletizing, vermicomposting)	1.6%
Recycling	Plastic, metal, glass and paper

Sources: Pachauri et al. (1998), p. 252

Table 2: *Hazardous wastes in India (tonnes per tonne of product)*

Industry	Solid waste
Caustic soda	0.03
Drugs and pharmaceuticals	0.04
Dye and dye intermediates	1.36
Fertilizer	0.085
Inorganic chemicals	0.4
Organic chemical	0.15
Pesticides	0.07
Petrochemical	1.38
Refinery	0.015
Textile processing	0.02/1000 m (or 2 gms/metre)

Source: Pachauri et al. (1998), p. 254

Table 3: *Import of waste/scrap into India during April 1993 and 1994*

Items	Value (Rs. Crore)	Tonnes (000s)
Plastic	31.9	87.1
Paper	158.5	365.6
Zinc	1.06	.051
Rubber	.41	.0096
Iron and steel	688	2.4
Copper	338.9	114.4
Aluminium	39.2	21.5

Source: Directorate general of commercial intelligence and Statistics cited from Kalra (1994, 29)

MODERN APPROACH

The approach of advanced countries to waste management is based on:

1. waste prevention: It is linked with improving manufacturing methods and influencing consumers to demand greener and less packaging.
2. Recycling and reuse: This includes packaging waste, end-of-life batteries and electric and electronic waste. Several countries are already managing to recycle over 5% of packaging waste.
3. Improving final disposal and monitoring.

Inherited Waste:

Another recent directive lays down though limits and emission levels from incinerators. The EU wants to reduce emission of dioxins and acid gases such as nitrogen oxides, etc. which can be harmful to human health. Economic growth has resulted in higher production and consumption, and is driving force behind the growing quantities of waste.

RECYCLING AND INDUSTRIAL ECOLOGY FOR SUSTAINABLE DEVELOPMENT

Definition of Recycle

Recycling is the common denominator of all environmental activity . It is a determining factor whether you are an environmentalist or not. Recycling is a core principle of sustainability because it performs so much of the agenda of sustainability. It allows for production and consumption without depleting natural resources and energy, alleviates pressures on global warning and the devastating impacts of rapid climate change and reduce flow of toxic substance into all of our natural systems, air, water, etc. as well as our food and bodies. It decentralizes the economy. It helps cities, countries and regions escape the grip of waste monopolies.

Finally, recycling parallels the entrepreneurial optimism of the sustainable development movement. Recyclers and sustainability activists are for new approaches to business and industry. These credentials are the basis for recycling movement to reach out to sustainable development movement.

A much broader investment is needed in transportation agriculture ,energy and manufacturing sectors in order for recycling to reach its good - shared with sustainable development -of zero waste. Garry Liss believes that a summit should be held with recycling and sustainable development to clarify the roles that private progressive firms, local government and mission driven organization should play in achieving zero waste and sustainable economy.

RECYCLING OF MSW AND DISPOSAL:

The most common practice has been they use of land fills that are normally not sanitary landfills but are just low-lying areas on the outskirts of acity. Composting of wastes and pelletizations fo waste also being practiced.

In India the disposal costs for even the most hazardous of waste, does not take into consideration the long term impact of such waste disposal on the environment. The long time impact must be internalise in cost of waste disposal to provide incentives for polluters to reduce the volume of waste either through the use of clean production techniques, reuse of industrial materials and households good and recycling.

In India recycling has been practiced through the separating of old newspaper, magazines, book, plastic and metal, which can be sale to the Kabariwallah to turn to a small crop dealer. Thus, recycling of inorganic urban waste has been done informal sector collecting, sorting and selling to middle scrap dealers who in turn sell to affluent businessmen.

The recycling industry is also the dumping ground for considerable quantities of imported scrap. As it shown in Table 3, recycling of some of these, like, zinc and aluminium, leades to the creating of toxic effluents. The importing of iron and steel scrap seems like a fairly innocuous undertaking until a detailed inventory is taken of the form in which the scrap enters the Indian market.

Without public monitoring, the recycling industry will continue to function in a semi-legal manner, bringing enormous profits to a handful of businessmen but with high social and environmental costs. Waste segregation at the household's level with facilitate the use of the organic contents. Some practices such as a vermiculture has good effect at community level.

SUSTAINABLE DEVELOPMENT

The terms of sustainable development entered the environment movement in the mid 1980s. it marked the third phase of US environment movement . In the early 1990s the fourth phase of the environmental movement, environmental justice was appended to the concept of sustainability. Their activists fight against the location of waste disposal sites and pollution-laden production, for worker rights, living condition, higher wages in countries.

Definition for Sustainable Development

A capital framework of optimal growth is used, taking an inter disciplinary integrative approach while defining the structure of the problem. It requires a boundary condition to satisfied so as to take care of intergenerational equity in resource use. In modelling sustainable development, capital theory approach focuses on the present equivalent of the utility stream as the maximand and it can take account of the role of generations of resources and life support in the formulations of the problem.

If the index of development is a combination of the level of well being of a typical individual of society and the distribution of well -being ,the same level of social product can provide a higher level of social well-being if:

(a) Population size is lower
(b) More equitable inter temporal re-distribution and warrant composition of social product.
(c) Technical change
(d) Human values

POLICY APPROACH OF SUSTAINABILITY DEVELOPMENT

Role of Technology And Human Values

Technological developments need to relax the constraints imposed by the ecological principle to the functioning of the human common through appropriate interventions. Technological concerns should aim at he following:

(a) dematerialization
(b) decarbonisation of energy
(c) increasing substitution of non- renewable resources of by renewables.
(d) Non-recyclable waste treatment before disposal
(e) Recycling of waste by converting to it into a manmade resource.
(f) Enhancement of primary productivity of biosphere space
(g) Facilitation of the redistribution process of income.

Recycling of material waste can reduce the material flow from nature into economy. No recycling is 100 percent efficient, not all wastes are usable in the production system in cost effective manner. The sustainable strategy of material management is minimization of flow of material resources in economy and the reverse flow of difficult waste; at the same time, the maximization of the flow of use and circulation of material resources within their economic system as a sustained process. Recycling of energy is not possible due to the entropy Law. Process of science and technology is a major source of optimist for the sustainable developments. Human values as reflected in enlightened preferences of process to find some space for it self in the human time-scale. Technology and human values need to develop in order to resolve the conflict between conventional economic and ecological principles and between the human and the natural system. Because only they can generate the right policies for sustainable development.

Incentive:

The Indian government has established the following incentives to encourage environmentally activities by Industry:

- The government will subsidise pollution control treatment facilities in industrial parks.
- Industrial facilities make take a 100% depreciations allowance on devices and systems installed for minimizing pollution or for conservation of natural resources
- In order to encourage industries to shift away form congested urban areas, the government is providing a tax exemption and capital gains arising from the transfer of used lands and buildings. This could be used to encourage participants to join EIPS.
- A modified value added tax credit has been extended to manufacturers of pollution control equipment, reducing the cost of production by 6 to 7 %.
- The government has listed machinery on which it will allow an investment allowance of 35% on the actual costs of purchase expected to assist in pollution control or conservation of the environment.

- There are a number of excise and duty exemptions:

(a) excise duty is exempted on the production of building materials using fly ash in 25% as raw materials.
(b) Custom duty is exempted on the import of equipment.
(c) Excise duty is exempted on the production of low costs building materials and components. (Bowonder 1994).

- India's ministry of non –conventional Energy Source and the state governments offer incentives, concessions, and fast-track approvals for projects.

Conclusion:

The volume of production of liquid waste by households has increased five fold and by industries has increased 41 times in last fifty years. The quantity of municipal solid wastes produced has increased seven fold between 1947 and 1997. increased capacities to deal with their collections, transportation and safe disposal. Rate of growth of industrial waste has been higher domestic wastes. More stringer government regulation of their production, transport and disposal be undertaken.

For long run sustainable of the urban system, waste minimization practices have to be adopted both by industry, institutions and households. The pricing of waste management services of disposal of waste could provide an incentives to households to reduce wastes. For industries internalising the long – term costs of disposal would encourage experimentations with waste minimizations process and the substitutions of hazardous with substances with alternatives and for this, government has an important role to play using their pricing mechanism. India has a large recycling industry in unorganised sector. There is need for greater government regulations of its wages and working conditions as well as the kinds of material recycled and waste products generated. In India, which faces sever resources constraints, a community based approach appears to be the only viable option for improving water quality and better environmental management.

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