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Global Warming – Combating It through Cyclic Solid Waste Management Processes

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Abstract: ***By 2025 about 60% of the global population will be living within urban areas and on an average an urban resident will generate about 1.42 kg of waste per capita per day. The manufacturing, distribution, and use of products-as well as management of the resulting waste-all are source of greenhouse gas emissions. The cyclic processes for solid waste management are required for reducing the green house gas emissions. A waste management index is required so as to form a new equation between GDP and a 'gross waste product' (GWP).***

Keywords: greenhouse gas, solid waste, managmnmet, cyclic process, GWP, waste management index.

1. Introduction

Atmospheric concentrations of carbon dioxide have increased by nearly 30 percent and methane concentrations have more than doubled since the pre-industrial era. There rising levels of greenhouse gases in the Earth's atmosphere are causing changes in our climate through "Global warming". Among several causes solid waste is one of the causes of the source of green house gases especially methane.

Solid waste management deals with the way resources are used as well as with end-of-life deposition of materials in the waste stream. (Franklin Associates, Ltd, 1997.) Waste generation is growing faster than the rate of urbanization, rate of population growth and even faster than Gross Domestic Product (GDP).

The manufacture, distribution, and use of products-as well as management of the resulting waste-all result in greenhouse gas emissions. Solid waste has emerged as one of the biggest anthropogenic causes of green house emission. Different categories of waste need to be disposed off differently but majority of the nations lacks the basic and appropriate waste management practices. Developing and underdeveloped nations who do not produce much waste are often the receipt of the waste from developed nations in the form of the dismantling industries, e-waste disposal and so on.

The amount of waste produced depends on the culture, consuming habit and monetary conditions. Our choices as consumers have a significant impact on climate change. The culture of 'use and throw' and the growing urge to buy things, all results in waste generation. We need to understand that there is a process behind every product that we buy, use and ultimately reuse, recycle or throw out.

2. Problem

The process of waste management is a linear one instead of cyclic which is leading to continuous increase in green house emissions through solid waste.

3. Analysis

On an average an urban resident generated about 0.64 kg of Municipal Solid Waste (MSW) per capita per day more than a decade ago but the amount is about 1.2 kg per capita per day today. By 2025 when 60% of the global population will be living within urban areas this is likely increase to about 1.42 kg per capita per day(World Bank, 2010). Looking at the state of solid waste and amount of Green House Gas (GHG) emission in two of the world's most influential nations- India and USA we find that , according to the latest U.S. Environmental Protection Agency (EPA) inventory of GHG emissions, the waste management sector represents ~4% of total U.S. anthropogenic GHG emissions (i.e., 260 out of 6750 teragrams (Tg) of CO2 equivalents). Landfills are the largest anthropogenic source of CH4 in the United States and represented ~90% of GHGs from the waste sector in 1999. (US EPA, 2001).

Similarly solid waste generated in Indian cities increased from 6 Tg in 1947 to 48 Tg in 1997 (Pachauri and Sridharan, 1998) with per capita increase of 1– 1.33% per year (Rao and Shantaram, 2003). About 0.5–0.7 kg capita1 day1 MSW is generated in urban India (Kameswari et al., 2003) with volatile matter content of about 10–30% (Rao and Shantaram, 2003). About three-fourth of the MSW generated from urban India is collected and disposed off in non-scientifically managed dumping grounds. Almost 70–90% of landfills in India are open dumpsites (Joseph et al., 2003). In fact nation-wide data on MSW is still not available in India (Kumar et al., 2004b).Similar situation exists in other parts of the world.

The energy is required during each step along a product's life – from raw material extraction, manufacturing, transportation, purchase, use and finally to disposal. At virtually every step along this "life cycle," the potential exists for GHG impacts. Waste management affects GHGs by affecting one or more of the following: (1) Energy consumption (specifically, combustion of fossil fuels) associated with making, transporting, using, and disposing the product or material that becomes a waste. (2) Non-energy-related manufacturing emissions, such as the carbon dioxide released when limestone is converted to lime (which is needed for aluminum and steel manufacturing). (3) Methane emissions from landfills where the waste is disposed. (4) Carbon sequestration, which refers to natural or man-made processes that remove carbon from the atmosphere and store it for long time periods or permanently. A store of sequestered carbon (e.g., a forest or coal deposit) is known as a carbon sink. Except step (4) all three add GHGs in the atmosphere. Different wastes and waste management options have different implications for energy consumption, methane emissions, and carbon sequestration. Growing urbanization and population will increase the amount of waste per person. Thus the emission per head will also increase.

The process of disposal has transformed from cyclic-meaning a products going back to the same source from which it was extracted. Or simply things getting biodegraded and going back to nature as everything we produce has its raw material coming from nature. But slowly with industrialization, urbanization and increased consumerism has changed the definition of the nature of waste and disposal methods. The non-cyclic process of waste and disposal waste involves extraction, production, consumption and dumping or landfilling, resulting in green house gas emissions, ground water pollution and an ever-increasing strain on natural resource. In a linear system everything ends up as waste resulting in depletion of raw-materials and accumulation of waste. Anaerobic decomposition of MSW in landfills generates about 60% methane (CH_4) and 40% carbon dioxide (CO_2) together with other trace gases (Hegde et al., 2003). Globally, in 2002 there were 2.9 billion urban residents who generated about 0.64 kg of MSW per person per day (0.68 billion tonnes per year) when today generation levels are approximately 1.3 billion tonnes per year, and are expected to increase to approximately 2.2 billion tonnes per year by 2025 representing a significant increase in per capita waste generation rates, from 1.2 to 1.42 kg per day 5 over the next eleven years. Waste management is still a non-cyclic system of collection and disposal, either in dumping grounds or incineration chambers, consequently creating considerable health and environmental hazards.

Therefore, waste Management is rightly referred to as 'the defining challenge of 21st century. The reduced emissions of these Short Lived Climate Pollutants (SLCPs) particularly methane, black carbon and hydrofluorocarbons (HFCs) will provide much needed early relief from the adverse impact of climate change. Compelling scientific evidence indicates the importance of fast global action to reduce Emission of SLCPs can help slow global warming by up to 0.5°C between 2010 and 2050(Shende et.al,2014) .The increased temperature will have severe consequences on sustainability and existence of life.

4. Impacts

International scientific circles consensually believe that the buildup of carbon dioxide and other GHGs in the atmosphere will lead to major environmental changes .Some impacts can be listed as: a) Glacier recession and reduced snow cover which will impact the fresh water resources, b) sea level rise which will flood coastal regions and inundate small islands; c) health impacts through the spread of infectious diseases, d) loss of biodiversity and ecosystem degradation, and e) agricultural shifts such as impacts on crop yields and productivity ; f)change in climatic parameters like precipitation and temperature. Poor SWM policies and practices heavily impact the environment, well--being and quality of life. Despite municipalities in India are spending up to 50% of their budgets on SWM(World Bank, 2006),they are often not prepared or lacked sound vision on how to address mounting quantities of wastes.

Although it is difficult to reliably detect trends in climate due to natural variability, the best current predictions suggest that the rate of climate change attributable to GHGs will far exceed any natural climate changes that have occurred during the last 10,000 years. The solid waste management thus needs to be addressed seriously.

4.1 Waste Management Practice: GHG Emission and Sinks (Figure 1)

Waste management practices will affect the emission factor.

- **Reduction at source:** This reduces GHG emissions in a significant way. This reduces the energy-related CO_2 emissions from the raw material during the whole process.

- **Recycling-** It reduces energy-related CO_2 emissions in the manufacturing process and avoids emissions from waste management. Paper recycling directly increases the sequestration of forest carbon.

- **Composting**-This is for the bio degradable waste. The net GHG emissions from composting are lower than land filling for food discards (composting avoids CH_4 emissions), and higher than land filling for yard trimmings (land filling is credited with the carbon storage that results from incomplete decomposition of yard trimmings). Overall, given the uncertainty in the analysis, the emission factors for composting or combusting these materials are similar. (EPA ,2001)

- **Technological inputs** in combustors and landfills.

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4.2 Figures

Figure 1: Greenhouse Gas Sources and Sinks

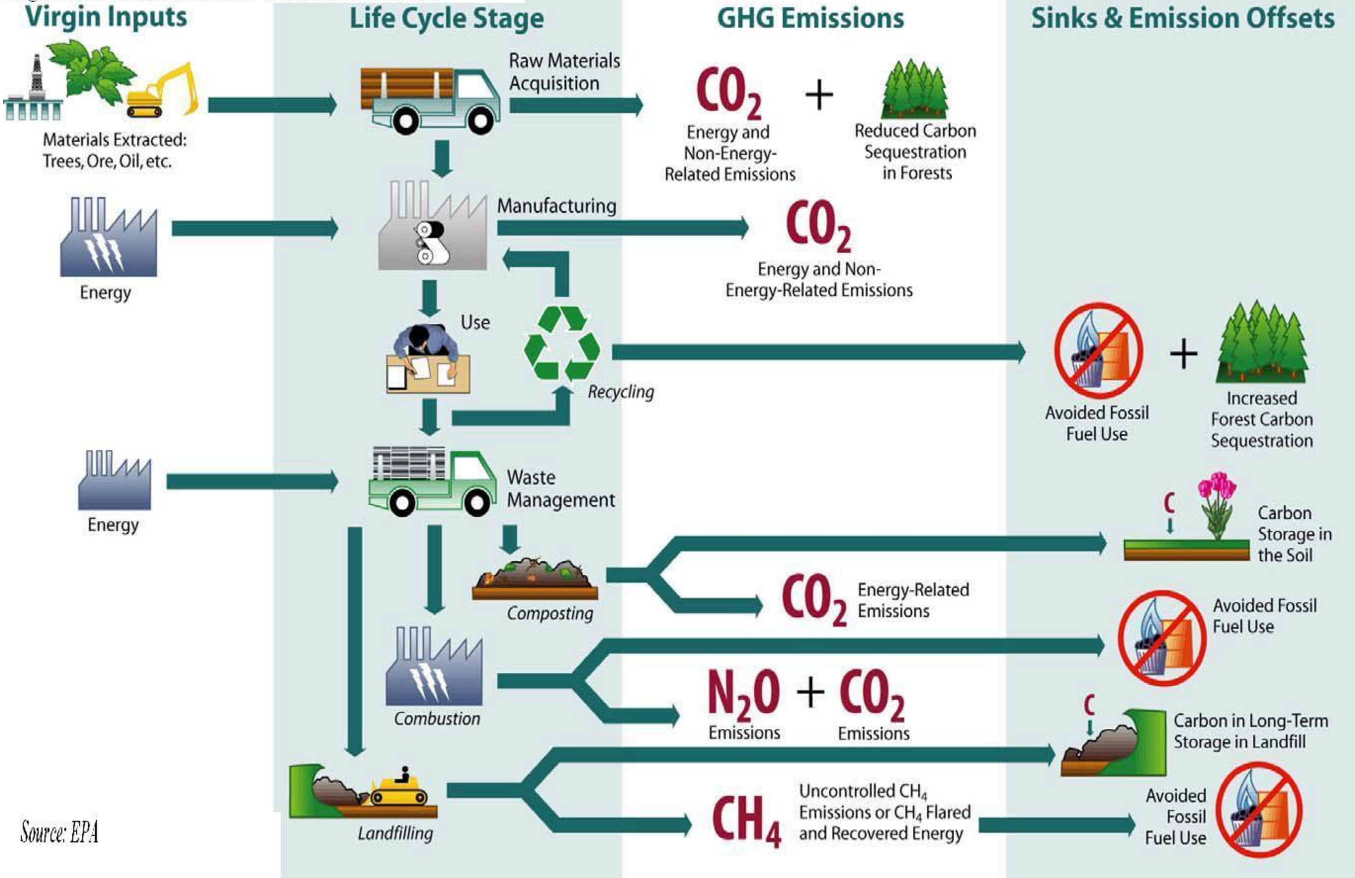

Figure1: Green house gases sources and sinks (Source EPA)

5. Result and Conclusion

A cyclic management of management of solid waste presents many opportunities for GHG emission reductions. Reduction at source and recycling are potential methods of reduction of GHG emissions at the manufacturing stage. There is need to increase forest carbon sequestration, and avoid landfill CH4 emissions as much as possible. Combustion of the waste also reduces the methane emission. Landfill CH4 emissions can be reduced by using gas recovery systems and by diverting organic materials from landfills. When used for its energy potential, landfill CH4 displaces fossil fuels, as with MSW combustion. In order to support a broad portfolio of climate change mitigation activities covering a range of GHGs, various methodologies for estimating emissions are needed.

Appropriate waste management contributes to reducing not only the emission of water/atmospheric pollutants and odours, but also the emission of greenhouse gases (GHGs). Waste prevention and recycling are real ways to help mitigate climate change. The world needs to create a new equation between GDP and a ‘gross waste product’ (GWP) . Protection of natural ecosystems and the effective management of anthropogenic waste are the two most critical issues that need our focus.

The cyclic process of waste management is sustainable but has its own limitations too. The concept of cyclic waste management is the solution but still not many countries are in a position to go for it. The problem starts with the fact that the chemistry of raw materials (degradable at that time) gets altered during manufacturing. For an effective cyclic management, technology to revert wastes back to resources is required. Secondly sufficient capital to research and develop such technologies is required. That is why mostly loping nations lack such effective waste management initiatives and action. Nations with strong and stable economy have been able to introduce effective waste management systems. Efficient recycling ways include biological digestion, waste-to-energy, and composting whereas landfills are space-demanding and slow with toxic byproducts like methane. To conclude, a good waste management system has to be cyclic in order to regenerate resources, decrease the green house emissions and other related impacts and ultimately improve the quality of life.

6. Recommendation

- Integrate waste management in the manufacturing process and making it ‘inclusive green accounting’.
- Stop uncontrolled dumping
- Provide good landfill
- Deploy the concepts of ‘cyclic waste management’.
- Reduce the waste in manufacturing, distribution, marketing and consumer supply chain.
- Enhance Awareness on the 3 R - Reduce, Reuse and Recycle and promotion of community Driven Initiatives

like on Zero Waste and Decentralized zero-waste Model for bigger projects and industries.

- Develop a Waste Management Index to measure how the waste can be managed gainfully by large industries.

References

[1] Climate Change, Environment and Natural Resources Management: World Bank Initiative (2006-2008) Solid Waste Management Program, India

[2] Jha, A.K. et al., Greenhouse gas emissions from municipal solid waste management ..., Chemosphere (2007), doi:10.1016/j.chemosphere.2007.10.024

[3] Joseph, K., Viswanathan, C., Trakler, J., Basnayake, B.F.A., Zhou, G.M., 2003. Regional networking for sustainable landfill management in Asia. In: Proceedings of the Sustainable Landfill Management Workshop, 3–5 December 2003 Anna University, Chennai, 2003, pp. 39

[4] Hegde, Ullas, Chang, Tsan-Chang, Yang, Shang-shyng, 2003. Methane and carbon dioxide emissions from Shan-ch-ku landfill site in northern Taiwan. Chemosphere 52, 1275–1285

[5] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–1999; EPA- 236-R-01-001; Office of Atmospheric Programs, U.S. Environmental Protection Agency:Washington, DC, April 2001

[6] Kameswari, K.S.B., Ravindranath, E., Ramanujam, R.A., Rajamani, S., Ramasami, T., 2003. Bioreactor landfills for solid waste management. In: Proceedings of the Sustainable Landfill Management Workshop, 3–5 December 2003 Anna University, Chennai, 2003, pp. 39.

[7] Kumar, S., Gaikwad, S.A., Shekdar, A.V., Kshirsagar, P.S., Singh, R.N., 2004b. Estimation method for national methane emission from solid waste landfills. Atmospheric Environment 38, 3481–3487.

[8] Pachauri, R.K., Sridharan, P.V., 1998. In: Pachauri, R.K., Batra, R.K. (Eds.), Directions, Innovations and Strategies for Harnessing Action for Sustainable Development. TERI, New Delhi.

[9] Rao, J.K., Shantaram, M.V., 2003. Soil and water pollution due to open landfills. In: Proceedings of the Sustainable Landfill Management Workshop, 3–5 December 2003 Anna University, Chennai, 2003, pp. 27–38.

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Bhavna Karki received the B.S. degree in Environmental sciences from University of Delhi in 2004 and M.S. degree from the forest Research Institute University, Dehradun, Uttarakhand in year 2007. She has an experience of seven years working in the field of environment management, disaster risk reduction, climate change and law and policy with agencies like United Nations Development Programme(UNDP) India, Department of Disaster Management (Government of Uttarakhand) and NGOs, in various capacities.