Research Journal of Environmental and Earth Sciences 4(8): 776-781, 2012
ISSN: 2041-0492

Submitted: March 31, 2012 Accepted: April 30, 2012 Published: August 20, 2012

Mitigating the Impact of Climate Change through Waste Recycling

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Abstract: This study reviews the impact of disposal of liquid and solid waste on earth's environment and their emittance of Greenhouse Gases (GHG) into the atmosphere. They trap re-radiated solar heat energy in the atmosphere and subsequently overheat the earth. It advocates that instead of production of materials from earth's virgin resources and disposal of wastes by burning or degradation, minimal production from virgin materials and total recycling of wastes drastically reduce the emission of such gases and vapours that would otherwise have had damaging effects on the environment. This was based on the European Commission Study on Environment's Report, (Smith *et al*., 2001), which showed that reduced dependence on fresh production of goods and overall source segregation of Municipal Solid Waste (MSW), followed by recycling, gives the lowest net flux of greenhouse gases, compared with other options for industrial production processes and treatment of bulk MSW. The text recommends global action on treatment of wastes and concludes that GHG emission is not a regional phenomena and should therefore receive local, state and national attention.

Keywords: Change, climate, mitigating, recycling, waste

INTRODUCTION

Climate change: The Earth has gone through many natural cycles of warming and cooling during droughts, flooding and extreme weather patterns. Scientists have confirmed that the Earth's atmosphere and oceans are warming gradually as a result of human activity (Intergovernmental Panel on Climate Change-IPCC, 2007). This warming will exacerbate climate variability and ultimately, adversely impact food and water security around the planet. Central to global warming and climate change is the "greenhouse effect". Carbon dioxide (CO_2), Nitrogen Oxides (NO_X), Sulphur dioxide (SO_2), dioxins, fine particles and other greenhouse gases entering the Earth's atmosphere by activities of everyday energy use and the way of management of the environment still contribute to the build-up of Green House Gases (GHG), which are directly released into the atmosphere. Climate change impacts are only one of a number of environmental impacts that derive from solid waste management options. Other impacts include health effects attributable to emissions of ozone-depleting substances like Chloro-Flouro-Carbons (CFC), contamination of water bodies, depletion of non-renewable resources, noise, accidents and so on. These environmental impacts are in addition to the socio-economic aspects of alternative ways of managing waste (Smith *et al*., 001). Waste minimization, recycling and re-use represent an important and increasing potential for indirect reduction of GHG emissions through the conservation of raw materials, improved energy, resource efficiency and fossil fuel avoidance (Bogner *et al*., 2007). Half the world's population lives in urban areas and a significant portion of human activities that lead to global climate change are concentrated in cities (Betsill, 2001). Controlling local emissions will do little to protect a particular community from the potentially adverse effects of climate change, since emissions of GHGs have global and no direct local effects. Local regions will be impacted on only through the impact of GHGs on global climatic scale. It is therefore questionable whether local initiatives can make meaningful contributions to mitigating global climate change in the absence of policy changes at the state and national levels. When decisions taken at such fora as the Kyoto Protocol on climate change are applied nationally and locally, great strides will be made to save the inhabitants of this planet from further disasters.

The subject-matter of this study therefore comes at a time when the issue of climate change is being discussed on global scales. The objective of this text is therefore to encourage and advocate zero-waste recycling in production of goods and services as an alternative to production from new or 'virgin' sources because less energy, less carbon emissions and better social services are provided by the former. Shortfalls can however be made up from new sources of production.

Effects of climate change: The best that can be done globally is to cut down on emissions of GHG because it

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appears that the rate of rebuilding the gaps in the ozone layer seems to be slow. It is human beings that need the environment more than it needs the humans. Environmental sustainability should be the keyword for every action taken in respect of humans' relationships with the environments-natural and built. The effects of climate change are already in existence and are felt in every part of the planet earth. Flooding is most devastating in low-lying areas of the world, due to glacial meltdown at the polar regions of the world, resulting in upsurge of ocean levels and currents. Tornadoes and resultant extreme rainfalls add to dislodge human settlements. Higher than normal temperatures experienced around the world have caused uncontrollable bushfires because the protection which the earth receives from the ozone layer against the penetration of hot infrared rays of the sun has significantly diminished.

Peer-reviewed research published by the Journal of Geography and Regional Planning, concludes that Nigeria's average temperature has risen by 1.7°C in the period 1901-2005. The increase has been higher in the semi-arid regions and lower in the coastal zone. The study also demonstrates that the rate of change has increased since the 1970s. By contrast, rising sea levels threaten Nigeria's coastal regions (One World Guides, 2011). The low-lying terrain of the Niger Delta, criss-crossed with creeks and waterways, open to the Atlantic Ocean, make it extremely vulnerable to flooding. The protective mangroves of this coastline have been largely lost to human intervention.

Half of the 15 million population of the city of Lagos live less than 2 m above the sea level. The wealthiest areas of Victoria Island and Ikoyi are in Nigeria's coastal front line, alongside the slum settlement of Maroko. The consequences for the Nigerian people is a geographical threat from desertification in the north, gully erosions and landslides in the central states and flooding in the south. Each effect results in dislodgement and dislocation of inhabitants from their households and ancestral domains.

HOW PRODUCTION AND WASTES CONTRIBUTE TO CLIMATE CHANGE

Much of the waste that is disposed of in landfills decompose, resulting in the release of both methane and carbon dioxide. In 2008, 20 million tonnes of CO_2 equivalent (eq.CO_2) were released from the disposal of solid waste on land (Gregory, 2010). Waste policies can impact decisions made all the way up the supply chain, where GHG emissions are generally more significant. Using recycled content in products instead of new materials usually results in less GHG emissions over a product's life cycle.

High levels of energy and materials consumption in industrialized countries are the driving force behind the decline in virtually all major life support systems on Planet Earth. Over the last decade, Sheehan (2000), an increasing number of scientists and other concerned individuals concluded that modern levels of materials and energy consumption have a destabilizing influence on the world's atmosphere. Energy consumption contributes directly to climate change by adding carbon-based molecules to the atmosphere in excess of naturally occurring amounts. Carbon molecules, primarily carbon dioxide from burning petroleum products, trap radiant heat and keep it from escaping from the Earth's atmosphere. The resulting warming of the air has continued to change in global climate. Materials consumption contributes indirectly to climate change because it requires energy to mine, extract, harvest, process and transport raw materials; more energy to manufacture, transport and dispose of waste products.

THE RECYCLING OPTION

Recycling is important to the environment because it controls GHG emissions in two ways:

Increasing recycling rates: Recycling more materials means less virgin resources are being used in manufacturing processes. All of the GHGs that would have been released from extracting and refining new resources are avoided. Although some GHGs are released by transporting and processing recycled materials, there is almost always a net benefit over the use of virgin resources. More recycling means that less waste ends up in landfills, decreasing landfill emissions. It should be noted that recycling paper products both saves GHG emissions that would have been generated from cutting and processing trees as well as allows trees to continue to act as carbon sinks.

Extended producer responsibility: Extended Producer Responsibility (EPR) is a waste management framework that seeks to shift the responsibility for managing the end-of-life of a product from the government and taxpayer to those in charge of designing and producing the product. The theory is that if a producer is burdened with the cost of disposing a product at the end of its life, it has an incentive to design the product for recyclability or reusability as well as to reflect on the environmental cost of the product.

CONTROLLING GHG EMISSIONS THROUGH RECYCLING OF WASTES

Beyond everyday recycling option is a zero-waste situation; an absolute reuse and recycling of waste. This calls for a radical zero waste resource efficiency and strategies for elimination, by recycling, rather than managing waste; a consequence that will result in many benefits for slowing down climate change. Zero Waste is a goal for responsibly managing materials and the energy required to make them (Sheehan, 2000). It is a system approach to resource management that maximizes recycling, minimizes waste, reduces consumption and ensures that products are made to be reused, repaired or recycled back into earth's environment without dire consequences. It will mitigate climate change by drastically minimizing the amount of GHG released into the atmosphere by human activities.

Zero waste recycling as noted by Sheehan (2000), Morris (2008) and Seidel (2009), will cut down on virgin materials extraction (including drilling, digging, cutting, refining, smelting and pulping) in addition to energy wastes which hitherto:

- Release chemical substances, carbon dioxide, waste heat and processing refuse into air water and land.
- Impair the health of people exposed to polluting chemical releases.
- Dislocate and destroy habitat for a wide variety of non-human creatures and organisms.
- Impair ecological functions and biological diversity in ecosystems.
- Alter the senses and feelings humans enjoyed in many previously natural environments.

Such consequences create important differences between recycled material-and virgin material-based system.

Reasons for zero-waste recycling:

It saves energy: By reducing energy consumption associated with extracting, processing and transporting 'virgin' raw materials, manufacturing with recycled materials uses less energy compared with manufacturing using virgin materials. Conserving energy remains an important issue worldwide especially with increased demand in domestic and industrial concerns. Energy savings through recycling are of important environmental benefit. It always takes less energy to make a new product from recycled materials than it does to make it from new materials. Manufacturing using recycled rather than virgin material saves substantial energy in virtually every case. Net carbon emissions are four to five times lower

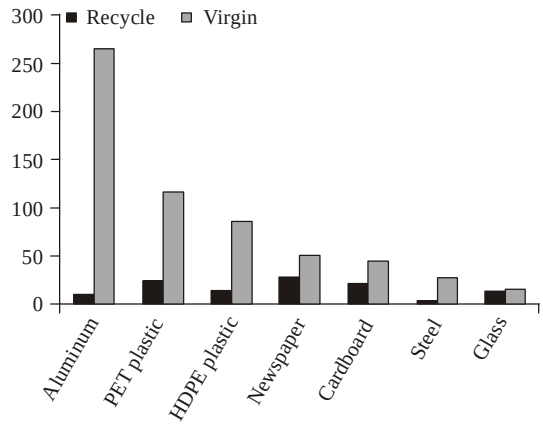

Fig. 1: Energy use: recycled & virgin content products (MJ/kg) (Morris, 2008)

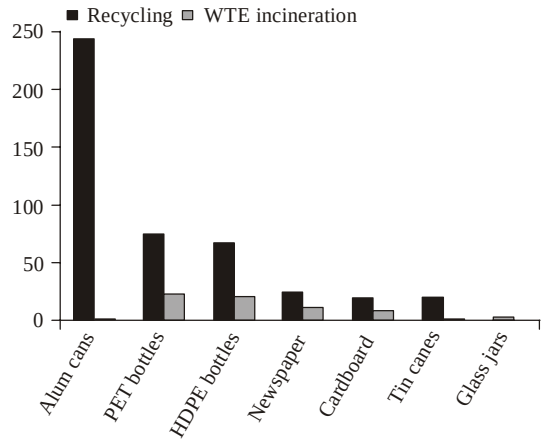

Fig. 2: Energy savings: recycling versus Waste to Energy (WTE) incineration (MJ/kg) (Morris, 2008)

when materials are produced from recycled steel, copper, glass and paper Morris (2008). They are 40 times lower for aluminum. Making a tonne of aluminum cans from its virgin source, bauxite, uses 229 British thermal units (Btus). In contrast, producing cans from recycled aluminum uses only 8 Btus/tonne, an energy savings of 96%.

Figure 1 and 2 show relative energy uses and savings when recycling of wastes are applied. Despite this, 45 billion aluminum beer and soft drink cans were wasted in the U.S. in 1998. Likewise, extracting and processing petroleum into common plastic containers (Polyethlene Terephthalate 'PET' and High Density Polyethylene 'HDPE') takes four to eight times more energy than making plastics from recycled plastics. The recycling rate for these plastic containers was only 20.2% in 1998. Energy conservation is just one of the environmental benefits attained by eliminating waste, increasing material efficiency and manufacturing products from recycled rather than virgin materials.

Soft drink containers, Sheehan (2000), may be only 2% of the waste stream and aluminum cans may only comprise 1.4% of the entire waste stream by weight, but they contribute ten times as much (14%) of the emissions embodied in a tonne of divertible waste sent to landfill. Plastic containers take large amounts of energy to manufacture.

It preserves the natural environment and its resources: Paper and wood account for almost half of all waste that goes to landfills and incinerators. Forest products (paper and wood) constitute 38.3% by weight of 'municipal solid waste' and 51.9% by weight of all products (excluding food scraps and other domestic wastes) sent to municipal waste facilities. Wasted paper alone constitutes 48% of the greenhouse gases emitted during the production of products that wind up in a tonne of municipal waste sent to landfill and 64% of commonly diverted waste (Morris, 2008).

Reducing paper and wood scraps save forests that absorb carbon from the atmosphere thereby reducing the global greenhouse effect. Trees take carbon from the atmosphere and store it in their tissues for long periods. Waste prevention and recycling reduce greenhouse gases by saving trees that take up carbon dioxide. This is so because by recycling paper, more trees are left standing so they can take in carbon dioxide and release oxygen into the atmosphere (I Love a Clean San Diego-ILACSD, 2004-2011). Paper and paperboard dumped at landfills are burnt or decomposed. Tonne for tonne, recycling reduces pollution, saves more energy and reduces GHG emissions more than any other solid waste management option. Increasing recycling should be a priority strategy for reducing global warming effects associated with solid waste management. By using materials more than once, natural resources are conserved, ensuring reserves for future generations.

Reduces air and water pollution: Recycling reduces air and water pollution because the recycling process reduces the amount of air pollution produced by power plants and the amount of water pollution produced by chemicals used in the manufacturing process. In the United States of America, Sheehan (2000), estimates that by cutting the amount of waste generated back to 1990 levels, greenhouse gas emissions can be reduced by 11.6 million Metric Tonnes of Carbon Equivalent (MTCE), the basic unit of measure for greenhouse gases. The largest source of emissions is landfill methane (CH_4), followed by that of wastewater and Nitrous Oxide (N_2O).

In addition, minor emissions of carbon dioxide (CO_2) result from incineration of waste containing fossil Carbon (C) -plastics and synthetic textiles (Bogner *et al*., 2007). Waste minimization, recycling and re-use

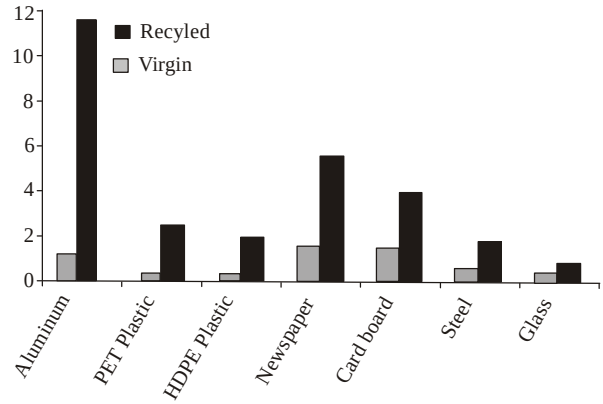

Fig. 3: Carbon dioxide emissions: recycled & virgin content products (kg eCO_2/kg) (Morris, 2008)

represent an important and increasing potential for indirect reduction of GHG emissions through the conservation of raw materials, improved energy, resource efficiency and fossil fuel avoidance. Increasing recycling rate from between 28 to 35% would reduce greenhouse gas emissions by 9.8 million MTCE, compared to landfilling the same material.

These levels of waste prevention and recycling would slash emissions by more than 21.4 million MTCE-an amount equal to the average annual emissions from generating electricity for consumption of roughly 11 million households. Figure 3 compares CO2 emissions between recycling of wastes and production from virgin materials.

Eliminates need for landfill sites: Recycling reduces and eventually eliminates the need for landfills (which release methane) and incinerators (which waste energy relative to recycling and reuse). Recycling saves space in existing landfills. When landfills fill up, new spaces have to be allocated for additional landfills. There are no such spaces in many urban areas unless in the back yard. Recycling reduces the amount of solid waste going into landfills, making each landfill last longer. Reducing land filling and incineration cuts down methane gas emission and saves energy. Landfills and incinerators contribute to global climate change by destroying resources and causing more new resources to be extracted (I Love A Clean San Diego-ILACSD, 2004-2011). When a million tones of used products and packaging are buried or burned, then billions of tones of virgin materials will be extracted from the environment to make new products and packaging to replace those wasted. Methane from landfills is the top human-caused source of methane. Thirty six percent of human-caused methane releases come from municipal solid waste landfills, according to the U.S. Environmental

Protection Agency (Seidel, 2009). Organic materials derived from living organisms, produce methane in landfills when they decompose without oxygen, under tonnes of garbage. Methane gas is a potent greenhouse gas, 21 times more effective at trapping heat in the earth's atmosphere than carbon dioxide. A tonne of municipal solid waste, land filled, produces 110 kg of methane. Some landfill operators try to recover methane. According to Reay (2006), 50% is about the best recovery of methane from landfill sites. Most landfill methane is flared on site while few recovered methane is used to produce energy. Many landfills eventually leak and pollute groundwater.

It creates jobs: A lot of money is made by scavengers on dumpsites who extract reusable waste/byproducts for sales to recycling industries and also for exports. In this way hitherto unemployed individuals source their means of livelihood from waste recycling.

CONCLUSION AND RECOMMENDATIONS

Recommendations: In view of the issues discussed in this study, it is recommended that governments should encourage the following practices at local, state and national levels:

- Implement waste reduction practices: reuse, recycle, use recycled content products.
- Reduce raw material usage.
- Improve and optimize manufacturing processes.
- Improve material specification standards.
- Encourage recovery of byproducts and scraps for reuse.
- Increase energy efficiency.
- Change production lines based on envisaged sound environmental impacts results.
- Decrease transportation of materials or products.
- Use energy substitutes or waste-to-energy processes.
- Remanufacture/refurbish products.
- Improve operation and maintenance programs for efficient waste reduction and GHG impacts.

Conclusion: There is need to develop an international response to global warming in line with negotiations of the United Nations Framework Convention on Climate Change and the Kyoto Protocol. Countries will not be able to meet the commitments contained in these agreements without the assistance of city and local government agencies. Non Governmental Organizations (NGOs) and individuals should invest in zero-waste recycling ventures because of their profitability commercially and to the environment.

There is urgent need for national and global declarations for intensifying zero-waste policies for their environmental and economic values, in order to save planet earth from further degradation. Saving the planet ends up in saving humans all over it. Climate change is not a regional concept, so attacking the problem from regional perspectives will yield little or no effect. Environmental issues should be introduced at all levels of education, to bring the awareness of environmental abuses and their consequences, to the consciousness of everyone in the planet.

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