

RESOURCE RECYCLING AND REUSE – CONTRASTING DEVELOPED AND DEVELOPING COUNTRIES

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Keywords: Municipal solid waste, municipal solid waste management, recycling, resource(s) recycling, reuse, composting, solid waste, waste collection, waste disposal, United States, Czech Republic, Nigeria, Guyana, case study, developed countries, developing countries, contrasting, future

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Summary

Municipal solid waste management is becoming a major problem in both developed and developing nations. The wealthy citizens of developed countries have much disposable income which leads to the generation of large quantities of municipal solid waste. As the citizens of developing countries become more affluent, they, too, have begun to generate increasing amounts of waste. While the global population continues its exponential growth, the resources that form the basis of all consumer products remain in fixed quantities, yet in spite of this, more than half of the municipal solid waste in developed countries is still either landfilled or incinerated, and not enough emphasis is being placed upon resource recycling and reuse. In developing countries, resource recycling and reuse used to be a normal part of life, based on necessity and not on mandate like in many developed countries, but with the emergence of globalisation, the

citizens of developing countries have followed in the footsteps of their counterparts in developed countries and recycling and reuse of materials have been replaced by increased landfilling. This paradigm must shift and resource recycling and reuse must become the primary method of dealing with waste. Because developing countries take their cues from developed countries, changes in the waste management approach should begin in the developed countries as a shift in the means of production of goods from using virgin materials to recycling and reusing goods that have already been produced. This will not only decrease resource use and environmental degradation, but will also ensure a sustainable future for coming generations. Developing countries, however, also need to take responsibility for their waste and should begin to incorporate recycling and reuse into their solid waste management plans. It is imperative that both developed and developing countries realise that increasing environmental education and awareness are key in changing the current paradigm.

1. Introduction

All waste can be divided into two main categories – solid waste and hazardous waste. Solid waste is further subdivided into municipal solid waste (MSW) and industrial waste (Miller and Spoolman, 2012). The primary focus of this chapter is MSW, which is sometimes also referred to as urban waste.

According to the United States Environmental Protection Agency (USEPA) (USEPA 1, 2011), MSW, commonly known as trash or garbage, consists of everyday items that are used and discarded, such as, product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint and batteries. This waste stream is generated in households, schools, hospitals and businesses. In effect, it is a waste stream that includes predominantly household waste (also known as domestic waste) as well as commercial waste, collected by a municipality within a given area.

MSW management refers to the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste generated in urban areas. The goals of MSW management are to promote the quality of the urban environment, generate employment and income, protect environmental health and support the efficiency and productivity of the economy (Ogwueleka, 2003). The two most commonly employed methods of MSW management are landfilling/dumping and incineration. Landfilling and dumping are basically the same method of subsurface disposal of waste, where the main difference is that in landfilling the waste is put into a controlled environment where the landfill is lined with a synthetic liner and also, especially with state-of-the-art landfills, is outfitted with leachate and methane collection equipment. Dumps, on the other hand, have neither liners nor leachate or methane controls. Incineration refers to the burning of waste. Recycling is another method of MSW management and is environmentally more desirable. Recycling reduces the amount of waste that needs to be collected, transported and disposed of, and extends the life of disposal facilities such as landfills/dumps (Ruzi, 2001). More importantly, recycling can help economies by recovering and reusing valuable materials.

Resource recycling and material reuse have been occurring in some manner from the beginning of human history, as our earliest ancestors were very much aware of the

benefits of such practice. Today, millennia after our ancestors survived in a harsh world without the technology that has become virtually indispensable to us, recycling and reuse form part of an elaborate hierarchy of waste management that is not very “environmentally friendly” because it does not place them as a priority in how to deal with the waste that we generate. For our ancestors, resource recycling and reuse were the only waste management options, but for us, landfilling and incineration are the predominant methods of dealing with our waste.

Many developing nations still practice resource recycling and reuse that very much resemble what our forefathers practiced, as opposed to the kind of recycling and reuse that take place in many developed nations today. In developing countries, where incomes are low and resources are limited, recycling and reuse are done out of necessity. In developed countries, where incomes are much higher and resources are not as limited, recycling and reuse are mainly done because of government mandates and are often not very efficient. However, as developing nations become richer and have more disposable income, they adopt the habits of the citizens of developed nations which include, for many, the newly acquired and insatiable appetite for “stuff” where “stuff” refers to everything from ever-newer and improved electronics to the latest fashions. In fact, this condition of acquiring more and more material possessions has become so chronic, that it has been given a name: “affluenza.” The combination of the words “affluent” and “influenza,” “affluenza,” describes the addiction to overconsumption (de Graaf, 2005), a condition that has led to grave problems with waste management in many developed countries, and is now also, very quickly, becoming a serious issue in developing countries where local municipalities are simply overwhelmed with the amount of waste being produced.

Originating in developed countries, the disposable lifestyle and the constant desire to acquire “more,” are already causing problems in a world where natural resources are limited. This problem is only exacerbated by the exponentially-growing world population. What most people in this technological epoch of human history do not realise, is that the vast majority of the things that allow us to function in our daily lives, things that are taken for granted, come from limited non-renewable resources, where at the top of the list is petroleum. It is this precious fossil fuel that truly makes the “world go round,” for if all of the goods and services based upon it that make the daily lives of those in developed countries possible were removed, their lives would grind to a complete halt. Petroleum-based products and petrochemicals are all around us, from the alarm clock that awakens us in the morning to begin another hyper-speed day in today’s globalised world to the television remote control that we use to turn off the plasma television (also made of petroleum-based plastic) at night, not to mention the food we eat and the beverages we drink, most of which are produced by large-scale petroleum-based agriculture.

Westing *et al.* (2001) state that humans are utilising all of the world’s major renewable natural resources at rates ever more greatly, exceeding their natural renewal abilities, while introducing pollutants into the environment at levels increasingly beyond the point at which they can dissipate or decompose into insignificance. Non-renewable resources are being consumed just as quickly, but the difference is, that unlike renewable resources which if used wisely can be naturally replenished within our

lifetimes, non-renewable resources cannot. The time scales required for their replenishment range from millennia to hundreds of thousands of years. In addition, humans are encroaching ever more drastically upon what remains of relatively wild nature (Uhoo, 2007).

Resource recycling and reuse have several major advantages: 1) they reduce energy and mineral use, 2) they reduce air and water pollution, 3) they reduce greenhouse gas emissions, 4) they reduce solid waste, and 5) they save landfill space (Miller and Spoolman, 2012).

With a global population of almost 7 billion (U.S. Census Bureau, 2011), it is imperative that lifestyle changes be made if a sustainable future is to be found for the world's citizens. The "throw away" mentality that is so prevalent in developed nations must be changed. Resources must be conserved, recycled and reused, not discarded without a second thought. As developing countries go through their own industrial revolutions, it is of utmost importance that developed nations set the correct example in terms of resource recycling and reuse, because it is a lead that developing nations will undoubtedly follow, and in the global picture, this will benefit all of humanity. The first step in achieving this will require a dedicated effort to increased environmental education and awareness, as knowledge and an understanding of our lifestyle's impacts upon the environment will allow for change to begin. It will have to occur in both developed and developing countries as it is the collective responsibility of all human beings to secure a healthy environment not only for the present, but also for future generations.

2. Resource Recycling and Reuse – The Past

The Industrial Revolution that began in the 1700's was characterised by large amounts of waste created from nascent manufacturing processes. Until then, from the earliest days of nomadic hunters and gatherers, and throughout the Agricultural Revolution that spanned approximately the previous 10 to 12 millennia of now sedentary human existence, waste management, for all practical purposes, entailed the recycling and reuse of all waste produced.

The hunters and gatherers, who were highly mobile following game and moving with seasons, had very little in terms of material possessions and what little they had, was made of natural material such as stone, wood and leather. Because of their mobility, they could not carry much and when they created waste, most of it was organic – food preparation and hunting remains. This waste would either be thrown aside if the groups were on the move, or would be buried in holes in the ground if the groups remained in one particular spot for an extended period of time. Whether simply tossed aside or buried, the waste would decompose and its constituents would return into nature's great nutrient cycles. Populations were small, so the amount of waste produced was low. Most of the waste was biodegradable and did not contain any dangerous materials (such as the many chemicals used in our lives today that invariably end up in our waste streams), so the environmental impact of the hunters and gatherers was minimal (Pitchel, 2005).

During the Agricultural Revolution, as the population started to increase, the composition of the waste changed to include larger quantities of food preparation and hunting remains, such as ash, wood, bones, vegetable waste and animal carcasses; once again, mainly the remains of daily life. Because the population had become sedentary, rather than leaving waste simply thrown about, it was put into excavated pits in the ground where it would decompose and act as fertiliser that improved soil quality (Wilson, 1977). This was a long time before today's disposable society took root. The biodegradable organic waste was returned to nature and when things broke, they would be fixed by people who had the skills to do the repair. Tools and utensils were reused time and time again and they were still made from natural material such as stone, wood and leather.

As the population continued to grow, the increasing amounts of waste generated started to become a problem, so the first dumps were established, usually being situated away from human settlements. Some early civilisations would even periodically cover the waste with layers of soil as a precaution for human health so that the rotting waste would not encourage disease vectors to breed (Wilson, 1977). Since most of this waste was organic in nature, it would biodegrade and would again return its precious components into nature's cycles while fertilising the soil.

Evidence suggests that older civilisations reused and recycled wastes that had "value." There was composting in China and there were recovery and reuse systems for bronze scrap in Europe more than 4,000 years ago. Traditionally, materials that were reused included leather, feathers and down, and textiles. Examples of recycling and reuse included feeding vegetable wastes to livestock such as pigs, who are not known to be fussy eaters, and using organic waste as fertiliser. Construction and ship-building ventures salvaged and reused timber. Metals, both ferrous and non-ferrous, have always been recovered, melted and recast (Kelly, 1973).

With the advent of the Industrial Revolution in the 18th century, the biggest impact on waste management occurred. This was a result of the general increase in population and its use of the numerous newly-manufactured products that made many of life's chores easier. The large-scale migration of people from rural to newly industrialised towns and cities began to stress the primitive waste management methods that had been employed and that had met the needs of the citizens, thus far. The quantities of domestic waste increased and industrial waste was born, both posing a threat to human health as well as to the environment. By the middle of the 19th century, because all of this waste had to be dealt with, recycling and reuse had taken hold, primarily out of necessity, as it was cheaper to recycle and reuse materials rather than to buy new ones and the term "recycling" became a regular part of our vernacular (Pitchel, 2005). At this point in human history, when materials were more available than labour, reuse and recycling became a normal part of life and for some, a livelihood; e.g., In the late 1800's, five categories of workers within the then largely informal waste management and recycling collection occupations in London were defined by Henry Mayhew (2008), an English social researcher and reformer:

- a) *Street buyers*, who bought any repairable items including old clothes, furniture, waste paper, bottles and glass, metals, hare and rabbit skins, grease, bones and tea leaves, were referred to as "rag and bone men" long after the Second World War.

- b) *Street finders*, who were bone grubbers and rag gatherers at the bottom of the heap, eked out a miserable income from the dregs overlooked by others. The more prosperous among them focused on “pure” (dog-dung in demand for leather tanning), cigar-ends and old wood.
- c) *Paid labourers* were dust-men employed by dust contractors, and scavengers (street sweepers) who were employed by their sub-contractors (as street cleaning was included in the dust contracts).
- d) *Night-men* removed “night-soil” (human sewage) that had a ready market as a fertiliser.
- e) Those who worked in *recycling shops* which were a particular type of shop that bought and sold reusable goods and recyclable materials. The most comprehensive ones, which bought directly from the public, street buyers and various “finders,” were called “rag-and-bottle” and “marine store” shops.

In the 19th and 20th centuries, as a result of emerging technologies such as controlled landfilling/dumping and incineration, waste management changed significantly. As time went by, more and more waste was being landfilled/dumped and the practices of recycling and reuse became less and less prevalent because of the increasing availability of cheap disposable goods and open land (Newman, 2005). In 1885, the first incinerator was installed in Allegheny, Pennsylvania, and after 1910, incineration as a method of waste management in the United States became widespread (Pitchel, 2005). The same started in Europe, where one of the main driving forces for the adoption of incineration was energy recovery.

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Biographical Sketches

Anita Zavodska is a dedicated environmentalist who is a strong advocate for environmental education and awareness. Her underlying passion is woven into the classes that she teaches as well as her community activities. She began her involvement in environmental education as a graduate student at the University of Illinois, where she earned a Master's degree in Environmental Studies. Following research in her area of specialty of municipal solid waste and conducting waste characterisations with garbologist, Dr. Bill Rathje, she earned a Ph.D. in Environmental Sciences at the University of Arizona in Tucson in 2000. She then joined a private, non-profit environmental organisation where she headed an NIH-funded environmental health project along the Arizona/Mexico border. She was also involved in various research projects aimed at reusing recyclable materials. In 2002, she joined the School of Adult and Continuing Education at Barry University in Miami, Florida where she currently holds the position of Associate Professor of Environmental Sciences. During her time at Barry University, she also served as Academic Coordinator for Mathematics and Science, as well as Assistant Dean for Academic Affairs. At present, she is involved in several collaborative projects with colleagues in the Czech Republic and Nigeria.

Jerry E. Uhuo has been involved in environmental issues since 2002, when he formed a Non-Governmental Organisation to champion the campaign for Clean Environment in Abuja, the Federal Capital of Nigeria. Since then, he has been promoting waste management awareness programmes especially at the state levels in the south-eastern part of Nigeria. At the National Assembly in Abuja where he works, he has over the years worked very closely with the Senate Committee on Environment and Ecology in initiating and implementing environmental programmes through which legislation on environmental issues is proposed to the Legislature. He holds two Master's degrees in Social Sciences and has recently concluded work on his Ph.D. in Political Science at the University of Stuttgart in Germany.

Libuse Benesova is very familiar with waste water treatment not only in the Czech Republic, but also in Europe. She studied Water Technology and Environmental Protection at the Institute of Chemical Technology, completed an Environmental Protection course at the Czech Technical University and earned a Ph.D. in Water Technology and Environmental Protection from the Institute of Chemical Technology in 1986, all in Prague. Prior to earning her Ph.D., she worked at the Water Research Institute for 10 years and then, in a chemical laboratory at the Hydroprojekt in Prague for 15 years. Since 1986, she has been a member of the science faculty at the Institute for Environmental Studies at Charles University in Prague where she has been involved in numerous projects supported by the Czech Ministry of Environment. These projects include municipal solid waste characterisation, recycling of paper, plastic and glass, and chemical analyses of municipal solid waste. For the past three years, she has participated in the TEMPUS project, which is supported by the European Union's programme that supports the modernisation of higher education in Partner Countries of Eastern Europe. She teaches environmental courses focused on water technology and waste treatment, and works as a supervisor for diploma and doctoral students who specialise in environmental studies.