

PLASTIC GROCERY BAGS: THE ECOLOGICAL FOOTPRINT

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1. INTRODUCTION

One of the most common items in our modern world is the ubiquitous plastic grocery bag. Highly convenient, strong and inexpensive, plastic grocery bags are appealing to both customers and businesses as a reliable way to deliver goods from the store to home. However, there are several issues associated with the production, use, and disposal of plastic grocery bags which may not be initially apparent to most users, but which are nonetheless extremely important. By assessing the lifecycle of plastic grocery bags, we can better understand the full ecological footprint of the plastic bag, and find more effective means of dealing with the associated negative impacts. This report will outline the ecological footprint of plastic grocery bags by looking at the immediate impacts associated with their manufacturing, followed by impacts created by their use and disposal, with a final discussion concerning waste management and recycling.

2. MANUFACTURING

2.1 THE MAKING OF A PLASTIC GROCERY BAG

2.1A Energy

The lifecycle of a plastic grocery bag begins with the extraction and processing of raw materials (for a visual aid illustrating the lifecycle of a plastic grocery bag, see Figure 1). The process of manufacturing plastic grocery bags requires significant quantities of both energy and raw materials. Two plastic bags require 990 kJ (kilojoules) of natural gas, 240 kJ of petroleum, and 160 kJ of coal (Institute for Lifecycle Environmental Assessment, 1990). Additionally, there are large amounts of energy used to acquire oil, such as the large, fuel-burning heavy machinery, and most of the electricity used in the

process of manufacturing the actual bags comes from coal-fired power plants (Greenfeet, 2004).

2.1B Ingredients

The key ingredients in plastic bags are petroleum and natural gas (Lajeunesse, 2004), and the manufacturing of plastic bags accounts for 4 per cent of the world's total oil production (Greenfeet, 2004). Components of oil or natural gas are heated in a cracking process, which creates hydrocarbon monomers (Environmental Literacy Council, 2005). In the manufacturing process, hydrocarbon monomers are biogeochemically manipulated, resulting in the creation of hydrocarbon polymers, which are essentially large molecules made up of repeated units of hydrocarbon monomers (see Figure 2 for an illustration of a hydrocarbon polymer and its chemical makeup) (ibid.; Greenfeet, 2004; Lajeunesse, 2004). Different groupings of monomers make polymers with different characteristics (Environmental Literacy Council, 2005).

2.1C Types of Polyethylene

Grocery bags are made from high-density polyethylene, also known as HDPE (Eco-sense, 2002). Polyethylene is a non-renewable resource made from ethylene (Lajeunesse, 2004), which takes hundreds of years to break down (Eco-sense, 2002). Polyethylene is appealing to manufacturers because it can be manipulated into any shape, size, form or color (Greenfeet, 2004). There are two other types of polyethylene, other than HDPE, used to make plastic bags: low-density polyethylene (LDPE) and linear low-density polyethylene (LLDPE) (Lajeunesse, 2004). LLDPE makes up thicker,

glossy bags, such as carrier bags used by businesses in shopping malls, and LDPE is used to make very thin, filmy bags, such as dry-cleaning bags (ibid.).

The main difference between the three types of polyethylene (HDPE, LDPE, and LLDPE) is the branching of the polymer chain of molecules; the more branched out the molecules are, the thinner the plastic (Lajeunesse, 2004). Plastic grocery bags are made of HDPE, which has more branched molecules and consequently lower tensile strength and crystalline form (ibid.).

2.2 ENVIRONMENTAL IMPACTS

2.2A Impacts of Energy Requirements

The energy used to make one high-density polyethylene (HDPE) plastic bag is 0.48 megajoules (MJ). To give this figure perspective, a car driving one kilometre is the equivalent of manufacturing 8.7 plastic bags (Australian Bureau of Statistics, 2004). If a country such as Ireland, with approximately 1.23 million shoppers, switched 50 per cent of plastic bag users to cotton, 15,100 tonnes of CO₂ emissions would be saved per annum. This is equivalent to one person driving around the world 1,800 times (Simmons, 2005). The Ireland study illustrates the immense environmental impacts to be made through a cultural shift to more ecologically responsible choices. The societal acceptance of plastic shopping bags is an integral part of the entire ecological footprint.

2.2B Air and Water Pollution

Air pollution caused by the emission of toxic chemicals and CO₂ during the manufacturing of plastic bags is a significant part of the environmental impact of this

product. According to the Institute for Lifecycle Environmental Assessment (1990), the manufacturing of two plastic bags produces 1.1 kg of atmospheric pollution, which contributes to acid rain and smog. Acid rain is recognized as a serious threat to natural and human-made environments, particularly in regions which have historically relied heavily on coal, such as Eastern Europe. Smog is also a well-documented and significant problem, particularly concerning human health (Environmental Literacy Council, 2005). Additionally, the manufacturing of two plastic grocery bags produces 0.1 g of waterborne waste, which has the capability of disrupting associated ecosystems, such as waterways and the life that they support (Institute for Lifecycle Environmental Assessment, 1990). To exacerbate the problems of air and water pollution, most plastic shopping bags are made in countries with few environmental regulations, such as China, which results in even greater impacts on the environment and human health (Matlack, 2001).

2.2C Shipping and Transportation

Following manufacturing, the plastic grocery bags are subsequently shipped all over the world; Australia alone imports 4 billion bags annually (Australian Bureau of Statistics, 2004). Container ships used to transport these bags to each consumer country use fuels which produce high levels of pollutants, such as sulphur (Long and Wagner, 2000). Annual trips multiply this environmental damage as manufacturers try to accommodate the increasing demand to numerous countries.

To illustrate, of the estimated 4 to 5 trillion plastic bags produced per year, North America and Western Europe account for nearly 80 per cent, with the U. S. eventually

throwing away 100 billion plastic grocery bags annually (Geographical, 2005; Murphy, 2005). Australia uses 7 billion plastic bags annually, of which 53 per cent come from supermarkets (Australian Bureau of Statistics, 2004; Brown, 2003). The United Kingdom consumes between eight and 10 billion bags annually, and in Taiwan this number rises to 20 billion (Geographical, 2005; Reusable Bags, 2005). The ecological footprint of the plastic bag grows with each increasing statistic.

2.2D Health Impacts

Toxic emissions produced during the extraction of materials for the production of plastic grocery bags, their manufacturing, and their transportation contribute to acid rain, smog, and numerous other harmful effects associated with the use of petroleum, coal, and natural gas, such as health conditions of coal miners and environmental impacts associated with natural gas and petroleum retrieval (Environmental Literacy Council, 2005; Institute for Lifecycle Environmental Assessment, 1990; National Plastic Bags Working Group, 2002).

3. USE AND IMMEDIATE DISPOSAL OF PLASTIC GROCERY BAGS

Plastic grocery bags have been a part of daily life in developed countries since their introduction in 1977 (Williamson, 2003), and in more recent years, their use has spread to many developing countries as well (Environmental Literacy Council, 2005). Unfortunately, the most common final resting place for garbage bags is the garbage bin, resulting in countless numbers of bags filling landfills and spilling over onto essentially every other surface of the planet (Chauhan, 2003; Thiel et al., 2003). It is the very

prevalence of these bags that result in several critical environmental and social impacts associated with their use and immediate disposal.

3.1 ENVIRONMENTAL IMPACTS

3.1A Land Pollution

Due to many factors, not the least of which is their ready availability, 96 per cent of all grocery bags are thrown into landfills (Williamson, 2003). However, plastic bags decompose very slowly, if at all. In fact, a bag can last up to 1000 years, inhibiting the breakdown of biodegradable materials around or in it (Stevens, 2001).

Lightweight plastic grocery bags are additionally harmful due to their propensity to be carried away on a breeze and become attached to tree branches, fill roadside ditches or end up in public waterways, rivers or oceans. In one instance, Cape Town, South Africa, had more than 3000 plastic grocery bags that covered each kilometre of road (Ryan and Rice, 1996). In this century, an estimated 46,000 pieces of plastic are floating in every square kilometre of ocean worldwide (Baker, 2002).

3.1B Impacts on Wildlife

Most distressing, over a billion seabirds and mammals die annually from ingestion of plastics (Baker, 2002). In Newfoundland, 100,000 marine mammals are killed each year by ingesting plastic (Brown, 2003). However, the impact of plastic bags does not end with the death of one animal; when a bird or mammal dies in such a manner and subsequently decomposes, the plastic bag will again be released into the environment to be ingested by another animal.

3.2 SOCIAL IMPACTS

3.2A Impacts on Human Health

Impacts on human health are perhaps the most serious of the effects associated with plastic grocery bags, ranging from health problems associated with emissions, to death. Earlier this year, the city of Mumbai, India experienced massive monsoon flooding, resulting in at least 1,000 deaths, with additional people suffering injuries (The Asian News, 2005). City officials blamed the destructive floods on plastic bags which clogged gutters and drains, preventing the rainwater from leaving the city through underground systems (ibid.). Similar flooding happened in 1988 and 1998 in Bangladesh, which led to the banning of plastic bags in 2002 (Environmental Literacy Council, 2005; World Watch, 2004). By clogging sewer pipes, plastic grocery bags also create stagnant water; stagnant water produces the ideal habitat for mosquitoes and other parasites which have the potential to spread a large number of diseases, such as encephalitis and dengue fever, but most notably malaria (for further reading on mosquito-borne diseases, see National Center for Infectious Diseases, 2004) (EduGreen, 2005; Environmental Literacy Council, 2005; IRIN, 2005a; IRIN, 2005b; U. S. Environmental Protection Agency, 2005).

3.2B Impacts on Livelihood

Loss of livelihood is another major social impact connected to the use of plastic grocery bags; two primary examples are the loss of livestock and impacts on tourism. Concerning livestock, plastic grocery bags are often caught in trees or along fences, where they are mistakenly eaten by animals, leading to suffocation or blockage of

digestive tracts, and eventually death (Edwards, 2000; IRIN, 2005a; IRIN, 2005b; Planet Ark, 2005; Ryan and Rice, 1996). South Africa, Kenya, Somaliland, and India are four nations that report high levels of these problems, with as many as 100 cows dying per day in India (Edwards, 2000; World Watch, 2004). Plastic grocery bags also have the potential to leach their chemical components and toxins into soil and water sources, which can be passed on to humans, resulting in health dangers such as neurological problems and cancers (Butte Environmental Council, 2001; Lane, 2003; The Asian News, 2005; IRIN, 2005a).

In many countries tourism is vital to the livelihoods of local people and national governments; this industry is also impacted by plastic grocery bags, both in terrestrial and marine environments. In the Himalayan mountains, plastic bags became such a problem, particularly because of their disruptiveness to the visual beauty of tourist spots, that the Indian state of Himachal banned them and imposed a fine of up to \$2000 US for the use, production, selling, storing or distribution of polythene bags (Chauhan, 2003). In marine environments, bags can entangle, suffocate, or cause blockage in digestive tracts in marine animals, including marine birds, turtles, seals and whales, impacting the appeal of marine tourism (Australian Government, Department of the Environment and Heritage, 2005; Planet Ark, 2005; Spivey, 2003; Thiel et al., 2003). Plastic grocery bags also significantly contribute to beach litter, which requires expensive cleanup projects at tourist resorts (Ryan and Rice, 1996; Thiel et al., 2003).

3.2C Impacts on Government and Politics

The production and use of plastic grocery bags have several important political impacts. Because Western nations have infrastructures that are able to deal well with waste and

recycling, these nations generally do not feel the same effects of plastic bags in the environment (Spivey, 2003). However, this is far from the case in developing nations where waste management is not well established or is non-existent (Environmental Literacy Council, 2005). The effects of plastic bags are most severely felt in poor and rural areas, where shopping bags are dispensed and used widely but not disposed of properly (IRIN, 2005a; Reynolds, 2002). The footprint of plastic grocery bags also includes high civic costs to governments, most of which are incurred through clean-up efforts. Plastic bags can litter roads, sewers and waterways, making litter collection and disposal difficult and costly (IRIN, 2005a; National Plastic Bags Working Group, 2002; Reynolds, 2002; Ryan and Rice, 1996; World Watch, 2004). High costs are being shouldered by governments and taxpayers, which results in the loss of funds from other services offered by the government. Because of this myriad of problems, many governments have banned plastic grocery bags entirely, or imposed levies on their use (The Asian News, 2005; Environmental Literacy Council, 2005; IRIN, 2005b; World Watch, 2004).

4. WASTE MANAGEMENT AND RECYCLING

4.1 MANAGING WASTE

Although plastic bags can be used over and over again, particularly in comparison to a paper bag, they are most commonly thrown into the garbage once they are no longer useful since recycling services for plastic bags are not yet widely available. The recycling rates for plastic bags are extremely low, only 1-3 per cent, primarily attributed to three reasons (McKinney and Schoch, 2003). First, plastics are made from many different resins, and because they cannot be mixed, they must be sorted and processed

separately. Such labour-intensive processing is expensive in high-wage countries like the United States and Canada. Most plastics also contain stabilizers and other chemicals that must be removed before recycling. Second, recovering individual plastic resins does not yield much material because only small amounts of any given resin are used per product. Third, the price of oil used to produce petrochemicals for making plastic resins is so low that the cost of virgin plastic resins is much lower than that of recycled resins (Miller, 2005). As a result, recycling is not a simple solution to lessen the ecological footprint of the plastic grocery bag.

4.2 RECYCLING AND INCINERATION

In all stages of a plastic bag's life, from manufacturing to disposal, negative social and environmental impacts are evident. The planet's environment, including its soil, water and air, is affected directly in numerous ways, beginning with the extraction and use of fossil fuels during the manufacturing process of plastic bags. Emissions resulting from this process are also very harmful to both humans and the physical environments, and the transportation of plastic bags from their origin to their place of use also contributes significantly to the environmental footprint of this product. Further negative impacts are found during the use and immediate disposal of plastic bags, particularly in non-industrial nations where waste management services are not well-developed. In these regions, plastic bags are found everywhere, from remote tourist destinations to city streets where they can clog drain pipes, contributing to massive flooding which has already cost thousands of lives. Plastic bags are also problematic to concerning the livelihoods of local people and national governments, both in terms of the loss of

agricultural potential and impacts on tourism, in addition to the high cost of cleanup which falls to local and national governments. Reducing the economic footprint through recycling and therefore reducing the use of landfills, incinerators, and raw materials is not as important as the other benefits of recycling, which reveal how the net economic, health, and environmental benefits far outweigh the costs. Correcting our faulty economic system in which the market price of a product does not include the harmful environmental health costs associated during its life cycle could reveal the true costs of plastic bag consumption.

The question of plastic bags ultimately comes down to the issue of use. If people are willing and able to use environmentally-friendly alternatives, such as reusable cloth or plastic bags, the decreasing use of plastic bags will reduce their overall footprint. However, without educating the public concerning the impacts of plastic grocery bags or constructing barriers to their use, business will continue as usual. Many governments have chosen the route of taxes or levies on plastic bags, to great success. Perhaps in a culture where convenience often comes before environmental concern, speaking to consumers' pocketbooks may be the only way to effectively deal with this ever-increasing problem.

4.3 THE ECONOMICS OF DISPOSAL

Whether recycling makes economic sense depends on how you look at the benefits and costs of recycling. According to conventional economics, recycling does economically efficient if it costs more to recycle materials than to send them to landfills or incinerators. Many critics also point out that recycling is often not needed to save landfill space

because many areas are not running out of it (Tierney, 1996). The largest problem is the fact that the recycling plastic grocery bags will not “pay for itself”. Nevertheless, conventional garbage disposal systems are paid for by charges to households and businesses (Porter, 2000). It is hard to understand why recycling is held to a different standard and thus forced to cover its own costs. As well, the lower charges for depositing wastes in landfills in North America and the lower prices paid for recycled plastic shows that recycling is not a priority for most governments, businesses and individuals, causing grave consequences around the globe (Porter, 2000). As a result, a responsible economic system that takes account the true costs of plastic could reveal to society how the choices they make impact the environment and society.

5. CONCLUSION

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6. APPENDIX

6.1 FIGURE 1

[not included in this PDF version]

Source: Michigan Technological University, 2004

6.2 FIGURE 2

[not included in this PDF version]

Molecular chain of a hydrocarbon polymer.

C = carbon atoms

H = hydrogen atoms

Source: *Environmental Literacy Council, 2005.*

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