SUSTAINABILITY SCIENCE PROJECT: ANALYSZING FRITO LAY CHIPS:

Kristen Peach, Laura Rose Dailey, Trevor Michalak, Nate Clark

Class assignment for Sustainability Science, ENVS 195 University of Vermont, taught by Dr. Saleem H. Ali

> "At Frito-Lay's factory here, more than 500,000 pounds of potatoes arrive every day from New Mexico to be washed, sliced, fried, seasoned and portioned into bags of Lay's and Ruffles *chips.* The process devours enormous amounts of energy, and creates vast amounts of wastewater, starch and *potato* peelings. Now, Frito-Lay is embarking on an ambitious plan to change the way this factory operates, and in the process, create a new type of snack: the environmentally benign chip" (Martin, 2007).

Recently, Frito Lay Corporation, mega producer of potato chips and other quintessential American snacks premiered their new "environmentally friendly" bag for their Sun Chip products. While met with mixed reviews from consumers, products such as these eco-friendly bags represent a recent phenomenon in the corporate world. Corporations are responding to consumer's desires to buy in an environmentally responsible manner, without compromising their current product preferences. American's want to buy potato chips and want to feel good about it when they do.

The recent prevalence of corporate attempts to "green" their products has resulted in a confusing multitude of supposedly eco-friendly products or materials, in reality these products range from semi-green or pseudo eco-friendly, to even more detrimental to the environment than their predecessors.

It is imperative to consider a host of factors when assessing the sustainability of these new 'green washed' products; including but not limited to, the chemical and physical

makeup of the product or material itself, the environmental and social impacts of every step of production and distribution, and an assessment of corporate practices. A holistic view of sustainability will provide a more equitable and thorough assessment of the value of these "environmental friendly" products and aid consumers in making truly responsible purchases.

In the pursuit of such a holistic assessment it is important to acknowledge the inherently unsustainable nature of the business in question. The American snack business, including the packaging component, is one of luxury. Sun Chips are an unnecessary luxury item, not even remotely necessary to the pursuance of a healthy and productive lifestyle. A sustainability purist would undoubtedly highlight the many more valuable activities that would benefit from the energy and resources currently used in Sun Chip production and packaging. The resources inputted into the production and packaging of Sun Chips or luxury goods in general are significant, and could undoubtedly be put to more sustainable use in other sectors. In a true exploration of sustainability one would have to conclude that potato chips, however environmentally packaged, are inherently unsustainable products. These same sustainability purists may argue that the sustainability of the packaging is irrelevant to true sustainability because in a broader sense potato chips and snack foods in aggregate, as luxury items are counterintuitive to projects of sustainability.

Because this product is tied to an agricultural product (namely potatoes) issues of socioeconomic equity abound, and it is important to be particularly attuned to this variety of sustainability assessment when analyzing potato chip bags. While our analysis deals only with the bag itself, in the interest of truly valuable and holistic research it is

imperative we take special consideration of not only our product but the industries it is intrinsically related to and dependent on, due to the excessive amount of socially, environmentally and economically unsustainable practices that pervade said industry. Due to limited time and resources our research cannot reach the depth a true assessment would require, for example an analysis of the chemicals in the pesticides used to grow the potatoes that will someday fill these bags. Because sale of the bags is dependent upon the contents therein we must note that our study is incomplete (Pannell). However, analysis of the bag on its own is not unimportant or useless to consumers, particularly considering the speed and enthusiasm with which American's consume potato chips.

Every year, every three weeks, 89% of American households purchase potato chips (Marcia). They are a cultural staple for sacred American traditions such as barbeques, Fourth of July celebrations, birthday parties, holiday gatherings, and snack time. Since the cultural and lifestyle decisions of the American people are unlikely to significantly change anytime soon, an albeit incomplete assessment of the sustainability of the Sun Chips eco-friendly bag is a valuable tool to the would-be savvy consumer.

Environmental and Social Impacts in terms of Sustainability

As concern over the environmental impact of consumer products continues to rise, corporations are frantically attempting to develop effective strategies aimed at creating products that satisfy the consumer without putting stress on the Earth's ecosystems. Compostable packaging is one method that is being utilized by businesses in order to reduce the amount of waste associated with certain products. A recent report by the Hartman Group, a market researcher firm, stated that when 1,600 consumers were surveyed on their opinions regarding environmentally-friendly packaging, fifty-one percent stated that they believed "it was at least somewhat important that it [packaging] be compostable," (Jones, 2009, p. 3b). The idea behind compostable packaging is that at the end of the product's life cycle, the materials used to make the packaging can be returned to the environment in the form of decomposed organic matter.

Compostable packaging can differ in its effectiveness based on whether the product was designed to be compostable in a large-scale, industrial compost pile, or a smaller-scale compost pile, for example one that a person may tend to in their back yard. A survey conducted in spring 2010 by the Sustainable Packaging Commission (SPC) of forty U.S. composting facilities, all with larger-scale composting systems, found that ninety percent of responding facilities accepted compostable packaging, and seventy-five percent would consider, or already do, promote compostable packaging in their local regions (Yepsen, 2010). This is encouraging information to companies attempting to promote compostable packaging to consumers that have access to large composting facilities. But, a problem lies

in the fact that not all consumers have direct access to these types of large-scale composting facilities, such as the facility currently located at the Intervale in Burlington, Vermont. The Frito-Lay corporation attempted to combat this problem for consumers by producing a 100% compostable chip bag that would "be compostable in a backyard compost pile," (Sullivan, 2010, p. 21). The result was the compostable SunChips bag that Frito-Lay revealed to the world on Earth Day 2010.

The Sun Chips Company has always strived to be an environmentally-conscious business. In 2003, the company installed a five-acre solar field in Modesto, California, in order to power an existing factory they ran there (Sullivan, 2010). The compostable chip bag served as an opportunity for the company to, "begin thinking about alternatives to that [packaging] in terms of the front end of life and the back end of life for consumers," (Sullivan, 2010, p. 21). Reducing the amount of packaging would in turn reduce the company's overall impact on the environment. The overarching goal of the bag was to be both compostable, and serve as an adequate shield in order to maintain the products' freshness; also, by promoting composting on the packaging itself, SunChips hoped to educate consumers on the benefits associated with composting wastes (Sullivan, 2010). SunChips worked together with NatureWorks, a company specializing in creating compostable polymers for packaging, in order to create the bag, composed of about ninety-four percent plant-derived polylactic acid (PLA), which along with the remaining four percent of materials, are said to completely break down when the bag composts (Sullivan, 2010).

The Sun Chips Company went through great lengths in order to ensure that the compostable bag truly did decompose in backyard compost piles. The American Society

of Testing and Materials (ASTM) D6400 sets standards for compostable packaging and its ability to biodegrade (Sullivan, 2010). Biodegradable Products Institute (BPI) is an organization that uses ASTM standards to test certain products biodegradability, and then uses that information to determine whether the product should be BPI certified, a certification that has become the prime standard for compostable packaging today (Sullivan, 2010). SunChips set out to not only comply with the standards set up by both of these organizations, but also generate their own research independently in order to back up their claim of creating a 100% compostable bag. The company turned to Will Brinton, a researcher at Woods Ends Laboratories in Mt. Vernon, Maine, in hopes that he could provide accurate data on the effectiveness of the SunChips compostable bag. Testing the bag with five different feedstocks in six different sized compost piles, Brinton found that compost piles with a minimum size of 21 cubic feet, preferably built all at one time, were most successful at reaching the 125^{o}F-135^{o}F temperatures necessary for the bag to decompose, and provided the most effective environment for the decomposition of the SunChips bags (Sullivan, 2010). The overall outcome of Brinton's results provided the Sun Chips Company with enough confidence to release their product, as well as display the research findings on their website.

A recent study of the combustion kinetics and emission factors of 16 U.S. Environmental Protection Agency priority polycyclic aromatic hydrocarbons (PAHs) in polylactic acid (PLA) (a primary component of the Sun Chip eco-friendly bag) combustion revealed that the emission factors for PAHs are in the range of not detectable to 98.04 μg/g. This is significant in terms of sustainability because these emission factors are much lower than those of polyethylene terephalate (PET) and other combustion of plastics. Combustion

is a common manner of waste disposal and this data indicates that PLA is well suited to this method of disposable, or at least better suited that its plastic counterparts. The details of the experiment are enclosed in Appendices 1-4 and indicate that Sun Chip bags, due to their eco-friendly composition (use of compostable polylactic acid) are better suited to a common method of waste disposal than are plastics. This is certainly a credit to the relative sustainability of the product. (Yi-Chi)

American grown corn is another primary component of the Sun Chip eco-bag. The (somewhat) local suppliers of corn may be a plus in terms of sustainability as they may lessen transportation costs such as emissions; however the American corn industry has several problematic components that may skew any assessment of sustainability. From 1995-2009 federal corn subsidies amounted to 73.8 billion dollars in the United States. Such an enormous amount of money spent on one sector could be difficult to support in the long term, such a subsidized crop may have problems in the long term due to skewed market pressures and conditions. (Farm Subsidy Database)

Corn is the most heavily subsidized crop in the United States. The federal crop subsidy program is highly polarized, with the top 10% of "farmers" receiving 74% of all subsidies, and 62% of American farmers receiving no federal subsidies at all. Many scientists and policy analysts at the Environmental Working Group feel that the current structure and allotment program of the US subsidy program is extremely inequitable and unjust both in regard to concerns with environmental and socioeconomic justice. (Farm Subsidy Database) Sun Chip bags rely heavily on corn bi-products. Even if Sun Chips used only US grown corn in an attempt to buy local and lessen transportation costs, corn

agribusinesses in the United States are certainly not shining stars of sustainability. However Frito Lay (Sun Chips) has recently ordered its suppliers to stop growing genetically modified corn for its products. Sun Chip bags are certified to be free of any genetic material by GeneScan Inc., recognized by both government and NGOs as the leading authority for testing food, feed and raw materials. Because the relative "sustainability" of genetically modified organisms is a hotly contended debate among sustainability advocates this factor could help or hurt Sun Chip's attempts at eco consciousness.

Despite the data indicating Sun Chip bags should be somewhat easily composted, many home composters still found that the SunChips compostable bag refused to decompose in their home composting piles. Unfortunately, many home composters still found that the SunChips compostable bag refused to decompose in their home composting piles. Even experienced composters, such as the head composter at Warren Wilson College in North Carolina, had trouble actually getting the chip bag to decompose in their compost piles (Sullivan, 2010). According to employees at the Biodegradable Products Institute, the reason for this may be that there is no actual definition for what constitutes a healthy, at-home compost pile, and therefore the temperatures necessary for the chip bag to decompose are not actually being reached, and the bag remains in tact in the pile (Sullivan, 2010). The research conducted by William Brinton was done by professionals in a laboratory setting, and therefore there results may have differed from an average composter in their own backyard (Sullivan, 2010). The questions on this matter remain unanswered, because only eighteen months after the compostable chips bag was released, SunChips decided to take it off the shelf.

According to the reports conducted by SymphonyIRI Group, a research market specialist, the sale of SunChips declined eleven percent over the fifty-two weeks following the release of their compostable bags, mostly due to consumer complaints over the loud noise the bag creates when it is crinkled or touched (Horovitz, 2010). Consumers also looked to the Internet to express their discontent with the SunChips packaging. A Facebook group entitled, "Sorry But I Can't Hear You Over This Sun Chip Bag" had 50,000 members in October 2010, and posts on the page compared the bag to anything from jet engines to lawn mowers (Goldstein, 2010). Consumer response to the bag has stirred uneasiness among environmentalists who are constantly striving to "green" up any aspect of our current environmentally degrading society. According to Kate Sheppard, energy and environmental politics write for *Mother Jones* magazine, "If the sound of a crinkly eco-chip bag is too much to handle, then the human species really is screwed," (Goldstein, 2010).

Despite the controversy over the SunChips compostable chip bag, there is still strong support for developing compostable packaging products as an alternative to conventional packaging. According to Steven Mojo from the Biodegradable Products Institute, "From an end of life perspective, compostable thin film bags are superior to non-compostable ones because they can become part of the carbon cycle as humus or compost," (Mojo, 2010, p. 1). Norma McDonald, sales manager for Organic Waste Systems, shares the same opinions as Mojo on compostable packaging. Organic Waste Systems is a company that tests products biodegradability (McDonald, 2010). According to McDonald, "Compostable packaging made from renewable materials that provide comparable performance do contribute to a more sustainable future," (McDonald, 2010, p. 1). In a society striving for sustainability, a product designed to eliminate an entire waste stream is

extremely important, and therefore it would be certainly beneficial to continue research on compostable packaging.

A discussion of corporate practices and any other relevant information related to the social and political aspects of the product and its prevalence.

As a company, Frito-Lay was very interested in legitimizing the biodegradable claim. They looked at different breakdown times set by other organizations; BPI, a non-for-profit organization that promotes biodegradable plastics and created a certification and seal for compostable packaging, and the American Society of Testing and Materials (ASTM) D6400. These two organizations have created the highest standard for compostable packaging times (Sullivan, 2010). Frito-Lay decided to try and surpass these times. BPI certified that the Sun Chip bag was industrial compostable, therefore labeling it: "Industrial Compostable" (Sun chips, 2007). Industrial compost systems are now being used as an alternative to landfills. The system mixes waste streams and anaerobic digestion which helps reduce the amount of methane entering the landfill therefore reducing global warming (Hotrot, 2010). Since Frito-Lay brought in a third party certification, this adds a higher level of guarantee and corporate social responsibility. The third party certification also dismisses any suspected green washing that could arise from the many critics of sustainability initiative.

Frito-Lay believes that a product is not compostable until it is actually composted. They understand half of the battle with compostable products is the knowledge of the consumer. On the SunChips webpage there is extensive information about their bag

including PDF files discussing why they made the compostable bag, how it is composted, how they tested the bag's ability to decompose, and how to take steps towards starting a compost pile in your own back yard. They emphasize the importance of composting the bag in an active compost pile instead of merely disposing of it in the garbage where it will most likely end up in a conventional landfill and degrade no faster than a conventional plastic or aluminum bag. This displays how the company is not solely interested in marketing sustainability but truly seeing and promoting product sustainability throughout its lifetime.

SunChips are also committed to energy and climate sustainability. They recently built a plant in Modesto California which runs on solar power instead of fossil fuel. The plant is made up of a football field-sized farm of mirrors that move according to the position of the sun and direct the heat into tubes of glass filled with water (Solerno, 2008). The water is then converted to steam at the plants boiler system in order to heat the oil used to cook the chips (Solerno, 2008). The solar panels produce 14,700 MMBTU a year, which is just above what it takes to run the manufacturing line each year (Solerno, 2008). Their website provides information about the technology of the plant and its solar capacity in order to promote insight into their corporate practices. Plans are under investigation to use solar technology at a plant in Casa Grande Arizona as well (Solerno, 2008).

Sustainability initiatives continue at Sun chips; they are teaming up with the National Geographic Society on the Green Effect project, which invites consumers to suggest how they would use one of five $20,000 grants to make their homes, offices, schools or communities more eco-friendly. SunChips also donated $1 million toward the

reconstruction of Greensburg Kansas which was leveled by a tornado in May of 2007. The town is being rebuilt as the "greenest town in North America" and will include a solar-powered SunChips Business Incubator (Borden, 2009).

As encouraging as all of these sustainability practices are, they are still driven by profit and consumer demand which cannot always work in the favor of sustainability. Three years ago Frito-Lay began several marketing studies including in home ethnographies of its customers to better understand its brand strategy (Borden, 2009). "We discovered an intersection between consumers concerned about their own health and also concerned about their planet" (Borden, 2009). This is a huge competitive advantage, but it can easily fall apart when customers lose interest in environmental salvation due to trivial concerns. Roughly eighteen months after the biodegradable bag was launched it was removed from the shelves due to complaints of noisy packaging (Horovits, 2010). This demonstrates consumers expressed interest in sustainability verses their actual interest in sustainability. This also shows that corporations, no matter how "sustainable" only exist because they generate a certain amount of monetary income.

Conclusion

As an environmentally conscious consumer, there are many factors that contribute to a product's overall sustainability. Unless one does extensive research (not unlike this project), it is difficult to know which products are sustainable, which are not and which are merely products of green-washing. While looking specifically at our potato chip product, the process required to create a Sun Chip is inherently unsustainable. The potatoes need to be washed, sliced, fried, seasoned and portioned, all of which is unnatural to begin with and uses an incredible amount of energy along with the amount of waste it generates. This

process would score extremely low by sustainability standards. Realistically Americans love potato chips so no matter how much they care about their environmental impact, unfortunately their snack food of choice will most likely not change because of it.

Since we cannot change our crispy fried potato addiction, companies have decided to move towards the next step in the process; packaging. SunChips are one of the first to market this sustainable initiative in the hopes that the contents of the bag are not the only ones to decompose. They claim their bag can be returned to the environment as organic matter in the consumer's own backyard compost pile or local industrial compost system. The company performed a successful experiment in which the necessary conditions for composting were met, and the bag did decompose. Although the company's experiment was successful, consumers at home were having a hard time yielding the same results, probably due to the fact that most do not have the ideal conditions or settings for this complex natural process. There could have been potential for more experimenting and tweaking in order to make it easier for the consumer, but the because of the noise complaints the bag was taken off the shelf.

Corporations are still in the beginning stages of trial and error in trying to "green up" their consumer products. Although environment activists are creating new initiatives and implementing new policies, the real challenge is to educate and encourage consumers to get on board the green train. This is proving to be an incredibly tough endeavor, especially with the discouraging news of Sun Chip's compostable bag being removed from grocery shelves due to its racket. The Sun Chip Company's efforts are in the right place, but

unfortunately without consumer demand there is no incentive for the company to make the noisy, jet-engine lawnmower bags.

In the hopes of advancing the environmentally responsible initiatives, policy makers should be obligated to become more involved. Our suggestions to policy-makers such as the Food and Drug Administration perhaps, would be to start a "Sustainability Facts" label. Similar to the Nutritional Facts one would find on the side or back of a product, the "Sustainability Facts" would provide information about the product's impact on the environment as well as our bodies. Examples of this information would include the carbon, water or total ecological footprint of the product. This would ease consumer's confusion and give certifiable answers about the actual sustainability of their product of choice. There is a large part of the population who does care about the fate of the Earth but do not know how to help it. The only way to improve this conundrum is to educate them, make the decision easier, and the products more accessible. Knowledge is power; the more people know about something, the more they care. Topophilia is the acquired tendency to bond with what is familiar to you. If consumers are familiar with the Earth, they are more likely to care for it and make decisions that will positively impact it.

Unfortunately the Sun Chip bag is off the market so consumers have no choice but to continue buying chip products packaged in plastic or aluminum material that will most definitely end up in a landfill. Hopefully in the very near future there will be other alternatives for packaging, or a new and improved way to measure and score products for their sustainability. In the meantime consumers need to work on reevaluating their priorities; a planet packed with garbage, or a little extra crackle while eating their chips.

APPENDIX:

Pros	Efficiency -Cost -Performance	-100% Compostable -The use of PLA (polylactic acid or polylactide) in place of petroleum
Cons	-Petroleum is a nonrenewable resource (which takes millions of years to form) -Rising prices of oil -Pollution of soil and water -Product is non-biodegradable. It pollutes landscapes and/or ends up in a landfill. These plastics are extremely slow to decompose. -Plastic production (conversion of oil) process emits greenhouse gases	-Frito Lay has received a "high volume" of customer complaints about how much noise the new bag makes. -The crunch of the bag has been measured at volumes between 70 and 95 dbs.

Raw Materials	-Multiple layers of polyolefin (or polyalkene) materials, which are derived from petroleum by-products. (Traditionally recognized as nearly impossible to compost. However according to a study conducted in 2003 there was clear evidence of biodegradation and assimilation of a synthetic polyolefin at a substantial level, even though reached at fairly long incubation time. (Chiellini) -Thin sheet of aluminum (Although metals are finite resources they have the infinite capacity for recycle and reuse. (Gordon) However since 1900 nearly 40% of the cumulative discarded aluminum has not been recycled for domestic use in the U.S. or for export to foreign consumers (McMillan))	-Polylactic acid (or polylactide) a versatile polymer made from plants - A comparative in-depth investigation of the biodegradation of untreated and treated thermoformed polymer polylactic acid (PLA) under anaerobic conditions yielded the results that untreated PLA degraded only at thermophilic conditions. Treated PLA degraded at both conditions and was more sensitive to biodegradation. Treated PLA showed greater weight loss and methane yield. A comparison of differently "treated" PLA revealed that steam exposure was the most effective treatment with gamma irradiation, and e-beam irradiation in second place. Under thermophilic conditions, gamma-irradiated PLA lost 45% of its .weight in 180 days, and steam-treated PLA produced methane at 225 cc CH4 per gram in 56 days. Perhaps most significantly the authors of this experiment discovered that PLA

		degrades under anaerobic thermophilic conditions. This is pertinent to our analysis because it suggests that post-consumer PLA material may be used in anaerobic digestion for energy recovery, instead of being treated as waste disposal. See following sections for relevance. (Vargas) -Sugars harvested from plants (currently from corn) -Future plans include using cellulosic raw materials, agricultural wastes and non-food plants
Where are materials from?	-Various oil reserves around the world	-The corn materials are from field corn that is already grown across the US for industrial and functional end-uses -Corn is the most heavily subsidized crop in the United States. The US subsidy program has come under heavy criticism by those concerned with sustainability. (See socioeconomic and environmental impacts section)