Hair Extensions and Its Impact on Planetary Health

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Hair is more than just protein filaments that grow out of our scalps—It is deeply personal and defines one's individuality. Hair extensions, wigs, toupees, and other false hair products provide a flexible way for individuals to hone their personal aesthetic, similar to choosing types of clothing for a fashion aesthetic. Some false hair consumers are looking to change up their style, some find it to be an easier way to manage their natural hair, some use wigs for religious reasons, and some are using false hair to overcome a medical condition.

A large percentage of the consumer base of false hair is black women, as it is not only a cultural practice, but wearing certain hairstyles helps protect one's natural hair from breakage and brittleness. **Regardless of why one may choose to use false hair, the market for these products is significant. It was valued at $2.4 billion in 2020**[1] and continues to grow rapidly, partially due to it's unregulated nature and its primarily underground existence. The false hair industry is nearly invisible to the consumer as well as to the stylists who heavily influence many wearers' choices. Greater transparency around the source of these products can help consumers make informed, and ultimately, improved choices.

Human hair has historically been the premium choice for false hair, but in the mid 20th century, synthetic hair composed of plastic fibers quickly became an affordable, easily manufacturable product offering that made false hair more accessible across economic classes. The market price of high quality human hair can reach up to $400 per pound, whereas one pound of synthetic plastic hair can be as low as $10 per pound. The laws of supply and demand are well at play in the hair industry.

Beauty store's vast inventory of false hair in Hattiesburg, MS

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Despite rapid increases in prices over the years, the rate of consumption of hair extensions has risen just as quickly, thus proving to be a very price-inelastic market. Human hair is a renewable resource, but it takes years to grow. Moreover, the sourcing methods for human hair are questionable at best and highly unethical at worst. Conversely, synthetic hair, which is produced using a solution-spinning engineering method, can spin thousands of meters per minute.

False hair products made with synthetic materials are often designed to be single-use, and the typical method of disposal leads to the landfill. Synthetic hair can be spun from vinyl chloride, vinylidene chloride, polyester, nylon, and/or modacrylic, which are derived from petroleum. The solution spinning process also creates environmental hazards for factory workers. A copolymer of acrylonitrile and vinylidene chloride forms the most commonly used synthetic hair material: modacrylic fibers.

Modacrylics are listed as one of the top ten highest ranking hazards for environmental toxicity[2]. One study has shown that a number of dangerous volatile organic compounds (VOCs) are released when synthetic hair is burned, creating a health hazard in salons and homes when burning

the ends of braids[3]. **Synthetic hair waste that is sent to landfills may be incinerated, releasing large amounts of VOCs into the atmosphere.** Additionally, the manufacturing process of acrylonitrile is "a high-energy consumption industry with the highest impact to be found on fossil fuel depletion and human health."[4]

The environmental impact of false hair products is not well-documented, though Wilson et. al[5] offers a life cycle analysis of the current industry and researched opportunities to improve the existing market and its supply chain. One suggestion is to create a circular economy for false hair, considering that the average life cycle of synthetic hair wigs and human hair wigs is short. Those who are not addressing hair loss **dispose of synthetic wigs in 2 to 6 months.** The combination of synthetic hair's short life cycle, chemical composition, and landfill disposal method indicates that synthetic hair is a significant contributor of environmental plight for the planet.

Source: Reuters "Hair scavenged from Nairobi dump ends up in salon amid COVID-19 pandemic" 2020

Who is most affected by these negative impacts on the environment? Studies have shown that people of color, primarily the black community, are the most impacted by climate change. Racial disparities in climate change are well documented in academic literature[6] [7] but marginalized communities are often left out of the conversation when it comes to creating sustainable alternatives to products they consume, such as hair extensions. With black women spending thousands of dollars on hair care products, including false hair, and the mounting research that the chemicals used in synthetic hair have negative health impacts[8] [9] [10], there should be a greater impetus to address the pitfalls of the synthetic hair industry.

While the evidence on the direct impact of synthetic hair on the environment is limited, there is an abundance of research and demonstrated success on this topic in an adjacent industry: textiles. The synthetic hair industry leverages many of the same manufacturing technologies as the textile industry, specifically when it comes to filament extrusion. Synthetic textiles such as nylon, rayon, and polyester are spun from synthetic polymer resins and then further processed to make the textile fabrics used in applications, such as clothing. Synthetic hair uses the same spinning methods to create hair-like filaments, but the product is designed to mimic the mechanical properties and aesthetic of human hair.

Clothing can be temporarily diverted from landfills by donating to charities that sell used clothing in thrift stores, but ultimately, clothing ends up in landfills. The biodeterioration of textiles has been studied extensively, demonstrating overwhelming evidence that the composition of fashion textiles contain many non-biodegradable, sometimes toxic chemicals. Additionally, harmful chemicals used in

the manufacturing processes creates a hazardous environment for factory workers[11 12 13]. Many disruptive innovations have sought to change this.

Advances in textile engineering and greater awareness around the impact of textiles in landfills have prompted the industry to look for greener methods to manage the supply chain. From upcycling raw material sources, to greener manufacturing methods, to reclaiming waste material to produce regenerated fibers, the textile industry has been leading the way in creating a circular economy.

A number of popular fashion brands have begun to include sustainability claims in their products. Adidas, North Face, and H&M recently partnered with a novel fiber company that is producing textiles by upcycling agricultural waste using a method free of harsh chemicals. Sustainable textiles are gaining traction in the mainstream market as climate change has become a hot topic in recent years. The advances in the textile industry can benefit the existing synthetic hair industry.

Aja Labs is committed to raising awareness to environmental justice and implementing sustainable practices to the hair industry.

Research and development efforts are currently underway to create a plant-based, biodegradable fiber upcycled from crop waste using scalable engineering methods. Hair extensions are not just hair accessories that craft a personal style. It is a product that offers a multi-sensory experience: the way it shines, the tactile feel between our fingers, the way it falls into layers, the depth of color, and even the way

Aja Labs prototype plant based hair

it smells. Creating a sustainable alternative to substitute something that intimately impacts the user is a monumental challenge, even for the most highly skilled innovator.

Aja Labs is taking a multidisciplinary approach and leverages green chemistry, polymer science, and materials engineering to deliver a novel fiber that can match the aesthetic and performance of hair. By utilizing agricultural waste as feedstock and designing the product to be biodegradable or reclaimable, Aja Labs is striving to apply the concepts of a circular economy to the false hair industry. The communities most impacted by this industry and by the effects of climate change deserve better.

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