[An Education Lab for Socially Responsible Fashion Design]

Fibre Analysis:
Possible Social and Environmental Impacts

By Mary Hanlon

SOCIAL ALTERATION: SUSTAINABLE DESIGN SOLUTIONS THROUGH SOCIALLY RESPONSIBLE FASHION DESIGN EDUCATION, Appendix 1, "Fibre Analysis," by MARY HANLON, Integrated Studies Project, submitted to Dr. Patricia Hughes-Fuller in partial fulfillment of the requirements for the degree of Master of Arts – Integrated Studies, May 2009, has been reformatted for Social Alterations: An Education Lab for Socially Responsible Fashion Design, Oct. 2009, by Mary Hanlon.
Contact: Mary Hanlon, Founder, Editor and Lead Contributor, Social Alterations: An Education Lab for Socially Responsible Fashion Design
e. maryhanlon@socialalterations.com
w. www.socialalterations.com

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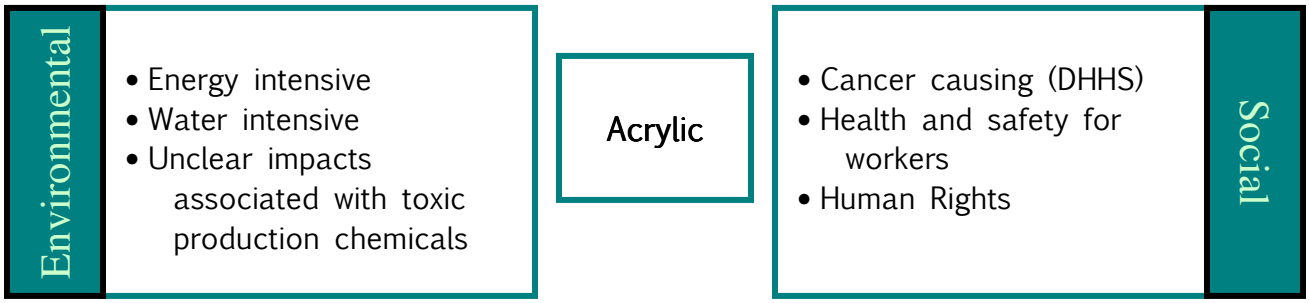
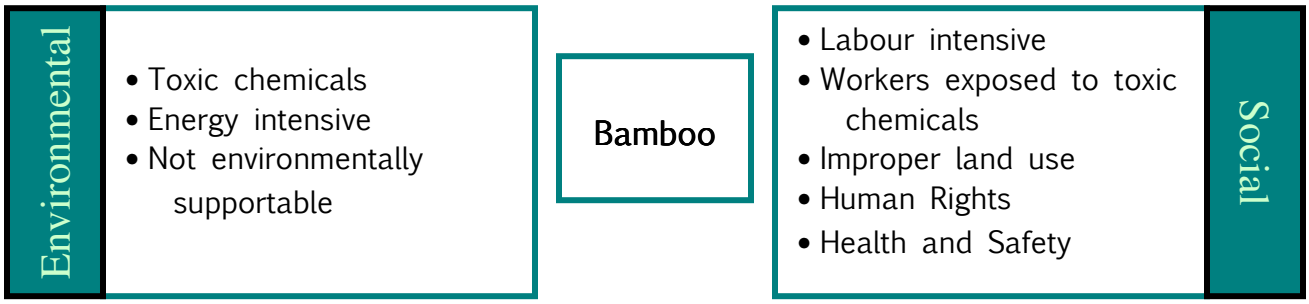


Acrylic fibre production is energy intensive and calls for a heavy consumption of water (Fletcher, 13). Environmental issues surrounding the fibre are unclear, although "it is thought that a significant number of production chemicals (including the base ingredient acrylonitrile) have a high potential for creating environmental problems if discharged untreated" (Fletcher, 13). Acrylonitrile, the base ingredient in acrylic fibre, may compromise the health and safety of workers without proper safety measures, as "[e]xposure [...] occurs mostly from breathing it in the air. Acrylonitrile primarily affects the nervous system and lungs." (ATSDR) According to the Agency for Toxic Substances and Disease Registry (ATSDR), "[t]he Department of Health and Human Services (DHHS) has determined that acrylonitrile may reasonably be anticipated to cause cancer in people." (ATSDR)



Bamboo is converted into a fibre through either chemical (bamboo rayon) or material (bamboo linen) processing. Chemicals used in the manufacturing of bamboo rayon are hazardous to the environment if not properly treated (Organic Clothing Blogs: "Bamboo: Facts behind the Fiber"). Chemically manufactured bamboo rayon uses carbon disulfide and sodium hydroxide (Organic Clothing Blogs: "Bamboo: Facts behind the Fiber"). Bamboo rayon should ***not*** be "considered sustainable or environmentally supportable" (Organic Clothing Blogs: "Bamboo: Facts behind the Fiber").

Chemicals used to breakdown bamboo into a fibre are extremely hazardous for workers (Organic Clothing Blogs: "Bamboo: Facts behind the Fiber"). Mechanical processing is highly labour intensive, and workplace standards may cause concern (Organic Clothing Blogs: "Bamboo: Facts behind the Fiber"). It is unclear whether proper systems of land use are in place. According to CSR Asia, for bamboo to be considered a socially responsible fibre, manufacturers must "certify the agricultural and workplace practices involved" (CSR Asia).

Environmental	Cotton	Social
• Water contamination • Deforestation • Defoliation • Unfertile soil • Resistance • Change in water balance		• Severe health problems • 20,000 deaths/ year • 200,000 suicides/ year • 1,000,000 suffer effects from exposure/year • Human Rights

Conventional cotton cultivation uses "very large quantities of fertilizers and pesticides, which in turn have caused a range of well-documented environmental impacts including: reduced soil fertility; loss of biodiversity; water pollution; pesticide-related problems including resistance" (Fletcher, 9). Pesticide use in conventional cotton cultivation is also said to cause deforestation and defoliation (Kooistra and Termorshuizen, 15-16).

Conventional cotton cultivation is extremely water intensive; it "is sometimes highly irrigated and [...] has been associated with adverse changes in water balance" (Fletcher, 9). It is estimated that water consumption for cotton cultivation ranges "from 29000 litres in Sudan to 7000 litres in Israel per kg of cotton fibre (approx 2 pair of trousers)." (Fletcher, Eco Textiles) The use of fertilizers and pesticides in conventional cotton cultivation causes "severe health problems relating to exposure to acutely toxic pesticides." (Fletcher, 9)

An estimated 40,000 annual deaths due to pesticide use (10% in agriculture sector) (Kooistra and Termorshuizen, 15) According to organic cotton activist and fashion designer Katherine Hamnett (citing the World Health Organization and Pesticide Action Network), "20,000 people die every year from accidental pesticide poisoning in conventional cotton agriculture [...] and 200,000 cotton farmers commit suicide annually due to spiralling debts incurred from buying pesticides. A further 1,000,000 people a year suffer from long-term pesticide poisoning" (Hamnett, Campaigns: Organic Cotton).

Environmental	Fairtrade Cotton	Social
• Water contamination • Deforestation • Defoliation • Unfertile soil • Resistance • Change in water balance		• Health and Safety re: complications associated with chemical usage • Human Rights

Although the Fairtrade Foundation ensures that Fairtrade certified cotton farmers "implement a system of integrated crop management which enables them to establish a balance between environmental protection and business results through the permanent monitoring of economic and environmental indicators" (Fairtrade, 4-5), cotton that has been certified by the Fairtrade Foundation is not necessarily organic. Therefore, environmental issues surrounding conventional cotton, including pesticides, fertilizers and intense water use, may still be a factor, albeit to a much lesser extent.

The Fairtrade Foundation itself claims Fairtrade certification is only one way to support cotton farmers; for this reason, the Fairtrade Foundation also supports "the Trade Justice Movement (TJM) that campaigns to put poverty reduction and sustainable development at the heart of international trade negotiations." (Fairtrade, 4). Continued use of pesticides and fertilizers in Fairtrade certified cotton may means that the health and safety of the farmer may still be at risk; however, the Fairtrade foundation requires that certified farmers "demonstrate increased diligence in choosing appropriate non-harmful chemicals or a biological or home-made alternative wherever possible." (Fairtrade, 5).

Environmental	Low-chemical Cotton	Social
• Unknown side effects of Genetic modification • Farm organism pollutants • Pollution of gene-pool of crops, micro-organisms, and animals etc.		• Denial of free choice Violation of human rights Economic dependence • Labour intensive • Health and safety

Cultivation of low-chemical cotton included such methods as systems of integrated pest management (IPM) and genetic modification (GM). In California, The Sustainable Cotton Project (SCP) has shown that IPM systems can create an overall chemical reduction greater than in organic systems, without the use of genetic modification. The SCP aims to reduce the farms chemical dependency by introducing "[c]omposted manures and cover crops replace synthetic fertilizers; innovative weeding strategies are used instead of herbicides; beneficial insects and trap crops control insect pests; and alternatives to toxic defoliants prepare plants for harvest" (SCP).

Other low chemical systems may involve GM. Arguments against GM within agricultural systems include: "negative and irreversible environmental impacts; release of organisms which have never before existed in nature and which cannot be recalled; pollution of the gene-pool of cultivated crops, micro-organisms and animals; pollution of farm organisms; [...] practices which are incompatible with the principles of sustainable agriculture" (Kooistra and Termorshuizen, 17).

Genetic modification of cotton raises serious social, cultural and political concerns. Social issues include: "denial of free choice, both for farmers and consumers; violation of farmers' fundamental property rights and endangerment of their economic independence; [...] unacceptable threats to human health." (Kooistra and Termorshuizen, 17). In that low-chemical cotton initiatives are primarily focused on environmental factors, it is important that social goals not be abandoned. IPM systems can be labour intensive, and where toxic chemicals are used, health and safety, as well as working conditions, remains a factor (Fletcher, 21).

Environmental	Low-water Cotton	Social
• Toxic chemicals		• Human Rights

Non-conventional irrigation methods such as rain-fed cotton and drip irrigation can save "up to 30 per cent water consumption compared to conventional irrigation" (Fletcher 23). However, the use of toxic chemicals remains an environmental issue.

Low water cotton production requires intense labour (Fletcher, 23). As a result, cotton farmers and workers may still be at risk for labour abuses and exposure to chemicals.

Environmental	Organic Cotton	Social
• Water intensive (where conventional water irrigation is used)		• May cause short-term/long-term financial complication for farmers • Labour standards/organic does not = Fairtrade

When compared to conventional cotton, organic cotton "production results in a dramatic change in the profile - the toxicity of the materials cultivation phase of the lifecycle drops to zero and overall product toxicity is reduced by 93 per cent" (Fletcher 19). Water consumption remains an environmental issue within organic cotton production where conventional methods of water irrigation are used (23).

In 2007/08, global organic cotton production increased by 95%. (Ecotextile News). Although demand for organic cotton is on the rise (63%), 2007/08 also saw an 8% global oversupply of the fibre (Ecotextile News). The process of converting conventional cotton to be certified as organic can be slow and expensive; it may be considered "a risky venture for many farmers who are already struggling to stay on the land." (Fletcher, 21)

Environmental	Hemp	Social
• Water pollution		• Political issues • Human Rights re: labour intensive harvesting/ processing

Potential environmental impacts associated with the hemp cultivation and fibre production are on par with those in Linen (see 'Linen'). Although hemp is considered to be a low impact fibre, due to its rapid growth and soil enriching properties (Fletcher, 25), production of the fibre is banned in many countries, such as the U.S. (Inside Bay Area, L.A. Times). Where the fibre is imported, its carbon footprint has increased in the shipping stage of its lifecycle.

In the context of any possible social impact the hemp fibre may be associated with, there are political issues surrounding the crop due to its narcotic properties (marijuana). For this reason, hemp "cultivation is banned in many countries" (Fletcher, 25). Further social implications surrounding the fibre involve intense labour usage: "[o]ptimum quality fibre is achieved by using traditional hand methods of harvesting and processing (still done in parts of China); however, high labour costs make this uneconomic in many countries" (25).

Environmental	Linen	Social
• Water pollution		• Human Rights re: labour standards

The production of linen can cause high levels of water pollution through 'water retting.' Retting is the necessary "practice of de-gumming flax fibres from the stalk (retting)" (Fletcher, 22). 'Dew retting' is an alternate technique with less association to pollution (22). Linen production can be highly labour intensive, as "[t]he selection of optimum quality flax fibre has traditionally been done by hand in many countries" (11). As a result, labour standards remain an issue.

Environmental	Lyocell	Social
• Energy intensive • Air pollution • Waste		• Human Rights re: health and safety of workers due to chemical use

Although lyocell fibre production boasts an environmentally friendly process, fibre production "is energy intensive" (Fletcher, 32). Furthermore, recently the fibre has been treated with enzymes during production to aid in lasting quality (resulting in less pilling). According to Fletcher, "as with all similar processes, these consume a combination of energy and chemical inputs and produce waste and emissions" (32).

Potential social impacts of lyocell production involve issues surrounding chemical use, and workers safety.

Environmental	Naturally Coloured Fibre	Social
• Improper usage can deplete genetic diversity		• Health and Safety

Using the example of Indigo, McDonough and Braungart explain how natural dye can be dangerous; "Indigo contains mutagens and [...] depletes genetic diversity" (McDonough and Braungart, 42).

According to McDonough and Braungart, "'natural' products are not necessarily healthy for humans." (McDonough and Braungart, 42) Careful attention must be paid in this regard.

Nylon

Environmental

- Petrochemical dependent
- Unclear environmental impact at this time (not public available)

Social

- Toxic metal antimony may cause cancer
- Incineration of antimony creates bioavailability of toxins

Nylon is a petrochemical dependant fibre (Fletcher, 13). As a result, potential environmental impacts associated with the fibre involve "the political, ecological and pollution effects associated with carbon chemistry" (13). According to Fletcher, "information or analysis of its environmental impacts is not in the public domain." (13) Nylon production is also energy intensive

Potential social issues surrounding the production of Nylon may be similar to that of Polyester as, according to Fletcher, the fibres are similarly "based on a petrochemical feedstock and are effected by the same issues" (Fletcher, 13).

PLA

Environmental

- Unknown side effects of genetic modification
- Aggressive agriculture
- Methane gas

Social

- Unknown side effects of genetic modification
- Political issues re: food safety

Possible environmental impacts of PLA fibres "include the negative effects associated with large-scale, intensive agriculture and the problems associated with landfilled biopolymers with the generation of methane, a powerful greenhouse gas." (Fletcher, 28)

PLA fibre is made primarily through corn. Possible social impacts surrounding the fibre relate to the use of food crops converted into non-food products. Furthermore, in the U.S., when corn is used as a raw material for PLA production, companies are "unable to guarantee a GM-free status of the fibre, because of the US policy of not segregating its GM and non-GM corn crops" (Fletcher, 29).

Environmental	Polyester	Social
• Petrochemical dependent • Energy intensive • Air pollution • Water pollution • Slow to biodegrade		• Toxic metal antimony may cause cancer • Incineration of antimony creates bioavailability of toxins

According to Fletcher, there are four main environmental impacts of polyester production: use of petrochemicals (non-renewable resource); high level of energy consumption (contributing to global warming); potential toxic air and water emissions such as "heavy metal cobalt; manganese salts; sodium bromide and titanium dioxide" (Fletcher, Eco Textiles); and the environmental cost associated in slow biodegradability (Fletcher, Eco Textiles). According to Braungart and McDonough, polyester often contains the toxic metal antimony which is "known to cause cancer under certain circumstances." (Braungart and McDonough, 37) In the recycling process, polyester may be incinerated. "Incineration makes the antimony bioavailable–that is, available for breathing" (38).

Environmental	Recycled Fibre	Social
• Energy intensive • Unknown environmental side effects of process		• Toxic metal antimony may cause cancer • Incineration of antimony creates bioavailability of toxins

Chemically recycled fibre is energy intensive (Fletcher, 35). According to McDonough and Braungart, if the product, or fibre, was not designed with the intent to be recycled, the processes may have a negative environmental impact (McDonough and Braungart, 39)

Possible social implications of recycled fibre involve its association with chemicals. According to Fletcher, "[t]he most commonly available recycled synthetic fibre is polyester" (Fletcher, 35). As a result, social implications seen with the polyester fibre may be carried forward in the recycling process.

Environmental	Silk	Social
• Water pollution		• Animal rights

Commercially processed silk uses low levels of pesticides and fertilizers; however, low level pollutants are discharged into ground water during processing (Fletcher, 11). To insure fibre quality, commercially processed silk requires that "fibres are extracted by steaming to kill the silk moth chrysalis" (11) PETA has campaigned against conventional silk, as they believe it is an inhumane process (PETA, Asia-Pacific).

Environmental	Wild Silk	Social
• Limited impact		• Human Rights re: labour standards

The potential environmental impacts of wild silk (or peace silk) cultivation are limited, as no hazardous chemicals are used in its production (Fletcher, 27).

According to Fletcher, the cultivation of peace silk facilitates "a major year-round income for millions of tribal people in India" (Fletcher, 27). Potential social impacts of the fibre may involve securing international standards for working conditions.

Soya

Environmental

- Water intensive
- Energy intensive
- Unknown effects of Genetic modification

Social

- Denial of free choice Violation of human rights Economic dependence
- Labour intensive
- Health and safety

According to Fletcher, "[c]ommercial, large-scale soya bean farming is water, fertilizer and pesticide intensive, and is commonly reliant on GM technology and widespread herbicide use supported by biotechnology companies" (Fletcher, 34).

Potential social issues surrounding soya fibre are those associated with chemical use, as well as the social, cultural and political concerns surrounding genetic modification (see 'Low-chemical cotton').

Viscose

Environmental

- Toxic chemicals emissions
- Water pollution
- Air pollution

Social

- Human Rights
- Health and safety, labour standards re: toxic chemicals

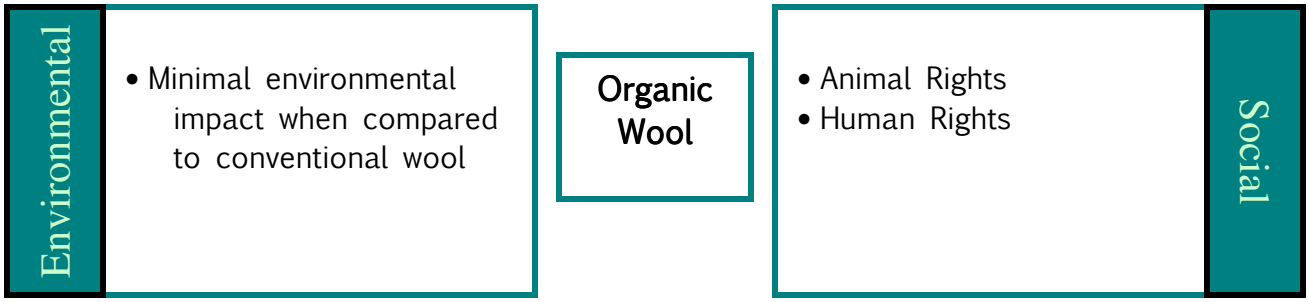
Although the raw material (beech wood, and other soft woods, or bamboo, etc.) used to create the viscose fibre may be considered 'carbon-neutral' (in that they release the same amount of carbon dioxide as they absorb during growth), fibre production uses toxic chemicals, creates damaging emissions and creates water and air pollution (Fletcher, 14). The use of such toxic chemicals raises serious concerns regarding the health and safety of workers. Earlier processing "created worker safety hazards from chemical fumes escaping during the processing." (Organic Clothing Blogs, Regenerated Cellulose Fabrics) Health and safety remain an issue, although, "[s]trengthened environmental protection standards and worker health regulations have lead to improved manufacturing processes" (Organic Clothing Blogs, Regenerated Cellulose Fabrics).

Environmental	Wool	Social
• Water pollution (in farm and downstream) • Danger to aquatic life • Toxic runoff/effluent (through scouring)		• Pesticides linked to severe nerve damage in humans • Animal Rights re: museling and flystrike

Pesticides are used on sheep for wool production to control infection from parasites (Fletcher, 10). Pesticides are either poured on the sheep or the sheep is injected with the insecticide or dipped in a chemical bath (10). Badly managed pesticides can adversely effect "watercourses both on the farm and in subsequent downstream processing" (10) In cases where the organophosphates (Ops) has been replaced by cypermethrim, due to risk of health problems in humans, aquatic life becomes in danger of water pollution through high toxicity levels (10).

Wool production also carries an environmental impact within its pre-production and production stages (Fletcher, 10). The wool must be scoured to remove grease and dirt prior to being transformed into yarn: "[s]couring produces an effluent (wool grease sludge) with high suspended solids content and a high pollution index" (10). Further consequences of poorly managed pesticides in wool production can impact health in humans: "[o]rganophosphates (Ops) for example [...] are linked to severe nerve damage in humans" (10). As a result, Ops may be replaced by cypermethrim (10).

Although cypermethrim increases safety to for farmers, these dips have "been linked to a significant growth in incidences of water pollution, as they are 1000 times more toxic to aquatic life than organophosphates" (Fletcher, 10). In terns of animal welfare, activist groups, such as PETA (People for the Ethical Treatment of Animals) have rallied against conventional Merino-wool production due the practice of 'museling' (where the sheep is striped of pieces of skin around its buttocks) (Wikipedia, Museling). Once the wounds have healed, scar tissue would act as a barrier against flystrike (PETA). Myiasis, also known as flystrike, a disease which can occur in both animals and humans, takes place when fly larva feed off of the skin or tissue of the host (Wikipedia, Myiasis). The Australia government has pledged to phase out the practice of museling by 2010 (News).



Organic wool production is less environmentally damaging compared to conventional wool production, as it "comes from sheep reared on organically grown feed, that graze on land not treated with pesticides and that are not dipped in synthetic pyrethoids or OPs" (Fletcher, 25). Organic Wool is less popular than conventional wool, and thus produced on a much smaller scale.

According to Fletcher, organic wool production deals with 'sheep scab' in organic wool production "can be controlled only with certain injectable or pour-on preparations that minimize use of chemicals, impacts on fresh water ecology and downstream processing" (Fletcher, 25). According to PETA however, wool fibre remains inhumane as shearing is considered cruel (PETA, Inside the Wool Industry).

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