

# A Review on Mitigating the Environmental and Socioeconomic Impacts of Textile Industry Pollution

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**Abstract**— The textile sector, renowned for its substantial impact on worldwide greenhouse gas emissions, is progressively engaged in researching methods and technologies to enhance its environmental efficiency. The textile and garment business is a major global sector, but it is also a significant contributor to environmental deterioration due to its manufacturing and distribution operations. Environmental contamination is a pervasive worldwide problem in the contemporary world. Rapid global industrialization is now occurring, leading to significant contamination of water and air. The textile industry is recognised as one of the most environmentally damaging industries in the world and is frequently associated with problems related to pollution of the environment. The textile sector accounts for about 14.5% of India's GDP. India has become a world-class hub for the production of synthetic fabrics, particularly those containing mixed fibres, such as cotton and synthetic, in polyester/viscose fabrics. It has been discovered that the industry operates in accordance with the norms and requirements. In this situation, environmental impact assessments could provide a helpful framework to help apparel and textile industries lessen their environmental impact

**Keywords**— Textile industry, Health hazards, Industry Pollution environmentally friendly

## 1. INTRODUCTION

The recent significant growth in the world economy has also led to a noticeable increase in spending. While a fraction of this rise in consumption is essential for people to maintain their livelihoods, the other fraction is superfluous. Just as with wealth, the distribution of consumption is likewise exhibiting inequalities. Although per capita consumption has risen in most places worldwide, the extent of these increases varies greatly across people, resulting in considerable differences in the size of the benefits. The most affluent unions globally represent 86% of personal consumption expenditures, but the destitute only spend a mere 1.3%. An person living in North America typically earns an income that is around 65 times higher than that of someone in Bangladesh, and about 20 times more than that of someone in China or India. Presently, the expenditures of 100 million persons

dwelling in economically developed countries are equal to the consumption of more than one billion individuals living in impoverished places globally, only to meet their fundamental need (Sangeetha, B et. al 2013). This instance presents a predicament due to its dual conflicting manifestations, which both significantly tax the world's ecology. Individuals experiencing resource insufficiency are compelled to make immediate choices that often result in detrimental long-term environmental impacts in order to meet their fundamental requirements. Low consumption and poverty lead to a number of environmental issues, such as cyanide fishing, which puts Southeast Asian impoverished fishermen's reef ecosystem in jeopardy, and African farmers who burn trees to make rice bread, which destroys forests and exacerbates poverty and deprivation by speeding up erosion and desertification. The use of advanced production technologies to fulfill growing consumer needs has significantly elevated the significance of production activities in the global environment. The advent of advancing technology has resulted in several issues such as environmental contamination, including contamination of the air and water, ozone layer thinning, and shrinkage of green areas. Conversely, a prevailing public sentiment has arisen, particularly in wealthy nations that are attuned to these issues. Measures are being taken to balance industrialization with environmental preservation. Evidence indicates that the expenses associated with post-pollution cleanup surpass those of pre-pollution cleanup, and it is not practical to completely restore the damaged ecological balance following pollution. This prompted a conversation on the topic of "how can we achieve industrialization while simultaneously safeguarding environmental values" rather than debating the relative importance of development vs the environment. The expansion of environmental concerns has been significantly influenced by the advancements in the textile industry and other industries, which have occurred alongside technical breakthroughs in recent years. The primary environmental consequence in the textile sector is seen via the release of substantial quantities of chemical pollutants into the surrounding ecosystem (Singh, R et. al 2020). Additional significant challenges include increased air pollution, air pollution from solid waste generation, formation, and increased usage of chemicals and water. The earliest connections between the textile and apparel

sectors and environmental issues are chemicals used in the cultivation of natural fibres and pollutants emitted during the manufacture of synthetic fibres. The fibres are then processed through a series of procedures that require a lot of energy, water, and different chemicals to create the finished textile product. This literature study delves into the textile industry's environmental problems and suggests that cleaner and more sustainable production methods might be the solution. A lot of thought has gone into the concept of cleaner production, with an eye toward how it relates to sustainability.

### TEXTILE INDUSTRY'S ENVIRONMENTAL EFFECTS

The textile industry is a major contributor to environmental problems, impacting several areas of the ecosystem throughout its entire lifespan, including raw material production, manufacture, distribution, usage, and disposal (Kant, R. 2011). The textile sector is related with many significant environmental effects:

**Water Consumption and Pollution:** The textile industry is highly reliant on water, particularly in the cultivation of cotton, which necessitates substantial water use. Furthermore, the dyeing and finishing procedures of textiles need significant amounts of freshwater and generate wastewater including a combination of chemicals, dyes, and other contaminants that have the potential to pollute rivers, lakes, and oceans if not adequately cleaned (Migo et. al 2018).

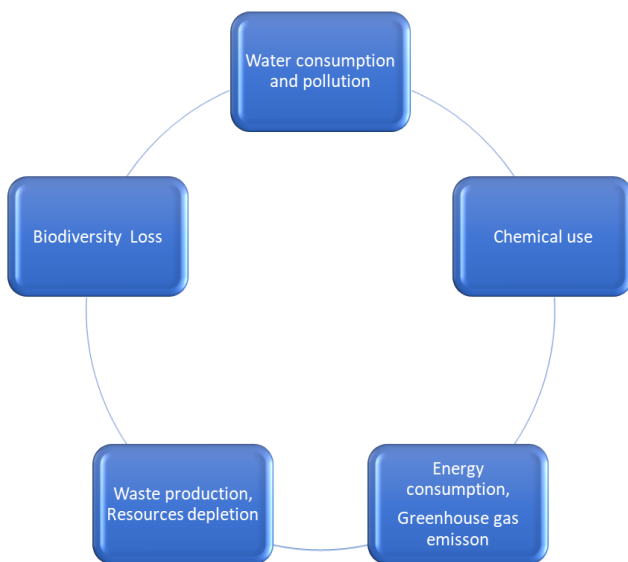


Fig 1. EFFECTS OF THE TEXTILE INDUSTRY

**Chemical Use:** A variety of chemicals, such as dyes, bleaches, and finishes, are used in the textile industry. Numerous of these substances are hazardous and can contaminate water and soil. Workers handling these substances are also at risk of exposure, which can lead to health issues (Kolekar, et al 2008).

**Energy Consumption:** The textile sector is characterized by high energy use, especially throughout the production and manufacturing stages. When fossil fuels are used as a source of energy, greenhouse gases are released into the atmosphere. These gases play a major part in the phenomenon of global warming and climate change.

**Waste Production:** Textile production generates significant amounts of waste, including off-cuts, fiber waste, and chemical waste. Furthermore, because clothing has a short lifespan, the fast fashion model has increased the amount of textile waste. A large portion of this garbage is burned or dumped in landfills, both of which have an adverse effect on the environment.

**Greenhouse Gas Emissions:** At many points in the textile lifecycle, the sector contributes to the global warming problem. A large portion of the textile industry's contribution to climate change comes from the emissions produced during production, the transportation of products, and the use of raw materials, particularly synthetic fibers derived from petrochemicals.

**Resource Depletion:** Raw materials used in textile manufacture are often obtained in an unsustainable manner. The manufacture of synthetic fibers requires fossil fuels, while the cultivation of cotton may degrade land and reduce local water supplies.

**Biodiversity Loss:** The loss of habitat and biodiversity may result from the growth of agricultural area for fiber production, such cotton growing. In addition, aquatic life and other species may be negatively impacted by the contamination of ecosystems with chemicals and dyes used in textile production.

Efforts are being made within the industry to mitigate these impacts through sustainable practices, such as the use of organic materials, water-efficient technologies, eco-friendly dyes, and recycling and up cycling of textile materials (Hossain, L., et. al 2020). Consumer awareness and demand for sustainable products also play a crucial role in driving change in the industry.

### 2.1 Sustainable Practices and Innovations in Cleaner Production for Environmental Stewardship:

As environmental concerns rise, companies are embracing greener manufacturing methods to lessen their ecological imprint and promote sustainability. Renewable energy sources, water-saving technology, recycling, and the usage of eco-friendly products are all part of these programs' efforts to lessen our impact on the environment. Improving manufacturing processes to decrease material waste and encourage product recycling and upcycling is one way to waste reduction. The use of less harmful chemicals in production helps clean up the environment by lowering pollution levels in both soil and water. To conserve natural

resources and biodiversity, enterprises are using sustainable sourcing strategies to procure raw materials (Hubler, et al 2013). In addition to satisfying legislative demands, by focusing on the environment, these initiatives want to boost their company's reputation, save expenses, and meet customers' increasing demand for eco-friendly products. In the long run, they want to make money, too. Tackling the urgent global environmental concerns of our day requires a shift towards greener industrial practices and environmental sustainability if we are to construct a strong and sustainable future. It stresses the need of preserving natural resources, lowering the environmental impact of industrial activity, and making sure the environment is healthy and sustainable. If we want to move toward an economy that can support both economic development and environmental protection, this strategy is essential.

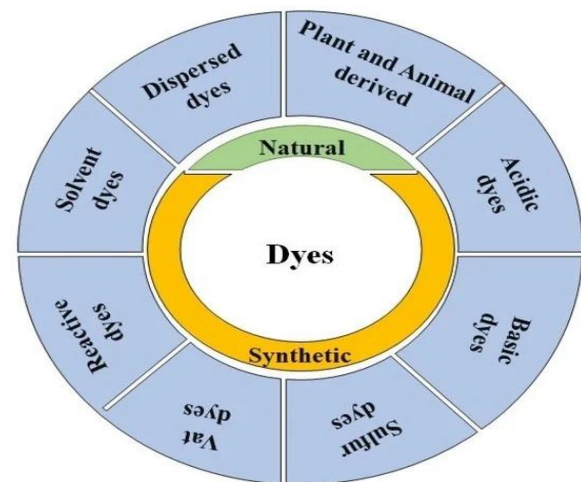


FIG 2. TYPES OF DYES

### 2.2 Environmental impact of Dyes

The environmental impact of dyes, particularly synthetic dyes used in the textile industry, is significant and multifaceted, affecting both ecosystems and human health. Dyes are released into water bodies through the discharge of untreated or poorly treated industrial effluents. Water quality is harmed by this pollution, which also raises COD and BOD levels and hinders aquatic plants' ability to photosynthesize. Dyes can leach into the soil from water, affecting soil quality, plant growth, and the health of terrestrial ecosystems. Workers in dye manufacturing and processing facilities may be exposed to harmful chemicals, leading to health issues such as allergies, skin conditions, and even increased cancer risk. The broader population may also be affected through exposure to contaminated water and food (Imtiazuddin, S. M et. al 2018). The production of dyes, especially synthetic ones, is resource-intensive, requiring significant amounts of water and energy, which contributes to the depletion of these vital resources and increases the carbon footprint of the industry. Efforts to mitigate the environmental impact of dyes include developing and implementing cleaner production technologies, such as water recycling and treatment systems, using natural dyes, and adopting less toxic synthetic dyes.

### 2. OCCUPATIONAL HEALTH HAZARDS OF TEXTILE INDUSTRY

Praveen Kumar Mettal (2014), said that occupational lung disease is first. Occupational cancer leads work-related illnesses, followed by cardio-vision diseases, reproductive disorders, neurotoxicity, noise-induced hearing loss, dermatological conditions, and psychiatric disorders. Cotton processing and spinning workers are exposed to so much dust that they get byssinosis, or brown lung. Breathlessness, coughing, wheezing, and pressure in the chest are symptoms of this illness. dermatitis (atopic eczema), consequences of endotoxins, Dusts from raw cotton and flax fibre processing have long been associated with a number of chronic health effects, including obstructive lung disease (asthma, bronchitis), interstitial lung diseases (follicular bronchiolitis), lung fibrosis (asbestosis), lung cancer and mesothelioma, and pulmonary disorders (byssinosis). Over time, high noise levels from spinning wheels, weaving looms, and other sources can harm the eardrum and result in hearing loss. Continuous exposure to noise may also cause tiredness, absenteeism, aggravation, anxiety, efficiency loss, pulse rate and blood pressure abnormalities, and sleep disturbances. Osteoarthritis in the knee, carpal tunnel syndrome, and forearm tendonitis are musculoskeletal problems that can result from significant weight lifting and moving big textile rolls and warp beams. The textile business exposes its workers to a variety of occupational health risks, such as the use of chemicals in the operations of dyeing, printing, and finishing; dust and fibre exposure; and ergonomic obstacles. Workers are at risk of respiratory issues, chemical-related illnesses, skin diseases, and musculoskeletal disorders due to repetitive tasks and poor workplace ergonomics. Noise from heavy machinery can lead to hearing loss, and lack of proper safety measures can result in accidents and injuries. Addressing these health hazards requires stringent safety protocols, protective equipment, adequate ventilation, and

regular health monitoring to ensure a safer working environment for textile industry employees.

Sr no.	Mitigation Strategy	Description
1.	Wastewater Treatment	Implementation of advanced treatment technologies to remove pollutants before discharge.
2.	Cleaner Production	Adoption of eco-friendly production processes, such as waterless dyeing and organic fiber sourcing.
3.	Sustainable Materials	Substitution of conventional materials with sustainable alternatives, such as recycled fibers.
4.	Regulation Compliance	Enforcement of strict environmental regulations and standards to ensure industry accountability.

### 3. ENVIRONMENTAL FOOTPRINT OF THE TEXTILE SECTOR: CHALLENGES AND IMPACTS

The textile and garment industries have a substantial impact on the economies of emerging nations. The industrial sector is the first phase of the process of industrialization and is a prominent component of Turkey's economy, making about 22% of its export revenue. Turkey's largest employer is the textile sector, which provides jobs to about 2 million people. The necessity of addressing the industrialization's acceleration, the growing global population, the decreasing availability of clean water resources, the rising energy costs, and the environmental challenges has necessitated the development and utilization of environmental processes and chemicals in various sectors, including the textile industry (Hossain, L et.al 2020). This industry, which significantly contributes to water consumption, energy usage, and wastewater generation, is particularly affected by stringent environmental regulations. Several chemical compounds included in textiles volatilize into the atmosphere, while others dissolve in the wastewater released into the environment, and others adhere to the cloth and are absorbed by human skin. According to the National Institute of Health (NIH) chemical list, several substances used in fabric manufacture are directly linked to health issues. According to a publication in Business Week on June 5, 2005, it is projected that the percentage of individuals with chemical allergies would increase to 60% by the year 2020. The compounds that elicit worry while persisting in the environment might exhibit the following

attributes: persistence (resistant to degradation), bioaccumulation (accumulating in living organisms), and toxicity (Al-Ghouti et. al 2010). The substances included in this attribute may also be referred to as Persistent, Bio accumulative, and Toxic compounds (PBTs) and/or Persistent Organic Pollutants (POPs). Assessing the environmental friendliness of the whole chemicals used in textiles is a challenging task. One of the causes for these issues is the abundance of different dyestuffs used in coloring operations. The Color Index International catalogues a total of 27,000 goods categorized under 13,000 Color Index Generic Names. During the period from 1985 to 1995, a comprehensive evaluation of varied toxicity reduction was carried out in North Carolina. This assessment revealed that several compounds associated with wet treatment and known to be harmful were found to be reoccurring.

### MITIGATION STRATEGIES FOR TEXTILE INDUSTRY POLLUTION :-

#### 4.1 Effects of pollution from the textile industry on others

During textile processing, extraneous elements and residues from the textile industry are released into the environment. While some residues are produced during the production or processing of products, others are unprocessed raw materials. Pollution in industrial development is associated with process inefficiencies. Water, soil, and air pollution brought on by the textile industry's inefficiencies can have an impact on humans, aquatic life, and plantations (Mia, R., et al., 2019). This has a cascading effect that puts humans and other living things in danger as the ecosystem is impacted. Impact on People Chemical contamination in the textile sector has an effect on people's health. Both air and water pollution can harm people's respiratory systems. A type of illness called respiratory disease is one that can result in conditions that threaten the lungs or respiratory system, such as asthma, lung cancer, and chronic obstructive pulmonary disease (COPD). Lung cancer is one of the many harmful effects of air pollution on human health. The chemical activation of methane and chlorine in air leads to lung cancer. Nitrogen oxide pollutants (NOx) originally came in some non-toxic types in smaller amounts but oxidized and formed pollutant gases by reacting with hydrocarbons in the presence of sunlight which cause asthma and respiratory problems (Jaganathan et.al., 2014). According to a survey that was conducted in cluster control areas with 639 villagers, it is reported from the survey data that 67% of the villagers have flu, cough, bronchitis, COPD, and asthma, 56% have respiratory problems and 77% have fever (Parvin, F et.al., 2020). Studies have shown a correlation between elevated levels of particle air pollution and reduced lung function or alterations in respiratory symptoms, including cough, runny nose, shortness of breath, wheezing, and asthma (Yaseen & Scholz, 2018).

Furthermore, substantial respiratory morbidity might arise due to severe air pollution. Prior studies have revealed exacerbated respiratory symptoms that may lead to higher short-term mortality and cancer rates. The presence of excessive amounts of chromium and copper in soil due to pollution from the textile industry may result in a high concentration that poses a threat to human health. This can lead to conditions such as anaemia, renal failure, and cerebral edema (Manzoor, 2006). In addition, water pollution in this business may also lead to allergies, dermatitis, skin irritation, cancers, and human mutations (Sakamoto et.al., 2019). The pollution emanating from the textile industry has extensive ramifications that beyond mere environmental deterioration, affecting human health, economy, and society on a broad scale. Below is a comprehensive analysis of the impact of pollution caused by the textile industry on several facets of life and the environment:

**Human Health:** The release of toxic chemicals and dyes into water bodies from textile processing not only harms aquatic life but also poses significant health risks to humans. Contaminated water sources can lead to various health issues, including skin rashes, respiratory problems, and even more severe diseases when people consume contaminated water or food. Workers in the textile industry are particularly at risk, facing exposure to hazardous substances that can lead to chronic health conditions.

**Aquatic Life and Biodiversity:** The release of chemical effluents and dyes into rivers and seas has a significant detrimental effect on aquatic ecosystems. These contaminants have the potential to reduce oxygen concentrations in water, resulting in the formation of areas devoid of life where aquatic organisms are unable to thrive. Moreover, harmful substances may build up in the food chain, impacting many species and resulting in a decline in biodiversity.

**Soil Degradation and Agriculture:** Chemical and heavy metal leaking into soil may reduce its fertility and quality, which in turn reduces agricultural yields. Soil pollution has further negative effects on plant life, including crop failure and diminished farmland.

**Air Quality:** When textiles are made, they release a lot of pollutants into the air, including particulate matter, volatile organic compounds (VOCs), and others. Because of this, air quality may decline, which is bad for people's lungs and adds to global warming.

**Economic Impacts:** The environmental degradation caused by textile industry pollution can have significant economic consequences. Cleanup of polluted water sources, treatment of pollution-related illnesses, and restoration of damaged ecosystems may all add up to a hefty price tag. Pollution also threatens the way of life for

those who work in industries that rely on natural resources, such as farming and fishing.

**Social Impacts:** Environmental pollution from the textile industry can exacerbate social issues, including inequality and displacement. Communities that rely on natural resources for their livelihoods may face economic hardships, and there may be increased health disparities due to unequal access to clean water and healthcare.

The pollution from the textile industry underscores the need for sustainable practices, stricter environmental regulations, and greater corporate responsibility to mitigate these adverse effects. Initiatives like adopting cleaner production technologies, wastewater treatment, and recycling, along with international cooperation and community engagement, are crucial steps towards minimizing the environmental and social impacts of textile industry pollution.

#### 4. CONCLUSION

The textile industry's pollution has significant and wide-ranging effects on human health, economic stability, and societal welfare in addition to the environment. Toxic chemicals and dyes released into water bodies threaten aquatic life, seriously jeopardise human health, and reduce biodiversity. Soil degradation from these pollutants compromises agricultural productivity and affects plant life. Air quality is also impacted by emissions of volatile organic compounds and particulates, contributing to respiratory problems and climate change. Economically, the costs associated with cleaning up pollution, treating health conditions, and restoring ecosystems can be substantial, while socially, communities dependent on natural resources face hardships and displacement. The pervasive effects of textile pollution highlight the urgent need for sustainable industry practices, improved environmental policies, and global cooperation to safeguard health, preserve natural resources, and ensure economic and social stability.

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