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# Micro-Sectoral Study on Detergents Industry

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## Introduction

Soap, in its most primitive form, has been integral to human hygiene and health for millennia. Historically, soap was made from a simple combination of animal fats and wood ash. Over time, advancements in chemistry and industrialization led to the creation of modern detergents that incorporate synthetic chemicals designed to improve cleaning efficiency, safety, and skin care. However, the evolution of the detergent sector covering major product groups such as washing powders, dishwashing detergents, and other household cleaners has also given rise to environmental and health challenges (Smith, 2008).

## 2. Current Situation and Trend

### 2.1. Changing Consumer Preferences

The detergent market in Pakistan has expanded significantly in recent years, and with rapid urbanization in major cities, the use of detergents, particularly for laundry and dishwashing, has increased exponentially. Consumer habits shift in accordance with urban lifestyle changes. Advertisements promoting detergents' foamy, whitening, and freshening properties have helped to shift consumer preferences toward synthetic cleaning products. There is also a noticeable shift toward automatic laundry systems, where detergents are marketed as essential for maintaining the quality of clothing, contributing to their widespread use (Pendse, 2018).

### 2.2. Market Projections

Comparisons of detergent consumption in Pakistan with other South Asian nations like India offer a more meaningful context than comparisons with Western countries such as the United States. For instance, while detergent consumption in Pakistan was historically lower than in India, both countries face similar environmental challenges stemming from their respective detergent industries. India, for example, has implemented strategies for managing phosphate use, which can serve as a benchmark for Pakistan in mitigating eutrophication. (Farrukh, 2023) At the same time, consumer awareness regarding the environmental impacts of detergents is increasing. As a result, eco-friendly detergent products, which promise reduced ecological footprints, are gaining traction among environmentally-conscious consumers eg liquid machine wash. This provides local manufacturers with an opportunity to develop and promote greener alternatives in line with consumer demand and regulatory standards. (de Mello Santos, 2022)

### 3. Policy landscape

In response to growing environmental concerns linked to detergent use, the Pakistan government has gradually adopted more rigid regulations aimed at curbing the adverse effects of industrial activities. More institutional capacity, greater public-private partnerships, and consumer knowledge of chemical-laden detergents' health and environmental concerns are needed to execute detergent industry environmental sustainability policies. The regulation of detergents in Pakistan falls under several key governmental bodies:

Table 1. Regulatory Bodies for Detergents

<b>Government Agency</b>	<b>Regulatory Role</b>	<b>Actions</b>	<b>Regulation of Detergent industry</b>	<b>Weakness</b>
<b>Pakistan Standards and Quality Control Authority (PSQCA)</b>	Safety, Quality and Environmental standards assurance	Develop Guidelines and Standards  Technical Quality control Regulation and tests	Covered in the regulation of chemicals	Limited in implementation to mandatory item list
<b>Environmental Protection Agencies (EPA)</b>	Enforce environmental laws related to pollution	Development of policies, regulations and standards	Manage pollution from detergent manufacturing	Lack of cohesiveness amongst provinces
<b>Ministry of Commerce</b>	Oversees regulation of raw materials and chemicals used in the production of detergents	Formulates the Import Policy Order	Controls import of hazardous material	Lack of regulations that promote sustainable manufacturing processes

### 4. Diagnostic analysis

#### 4.1. GHG Emissions in Detergent Sector

##### 4.1.1. Scope 1: Direct Emissions

Scope 1 emissions arise directly from on-site manufacturing processes in detergent production facilities. These include emissions from boilers, furnaces, and other equipment used during production. Additionally, company-owned vehicles used for transportation contribute to Scope 1 emissions. Addressing these requires optimizing manufacturing efficiency and transitioning to low-emission technologies.

#### 4.1.2. Scope 2: Indirect Emissions

Scope 2 emissions are generated from the energy purchased to power manufacturing processes, such as electricity usage in detergent plants. These emissions occur off-site at power generation facilities but are directly linked to production. Strategies to reduce Scope 2 emissions include adopting renewable energy sources and improving energy efficiency within production sites.

#### 4.1.3. Scope 3: Upstream and Downstream Emissions

Scope 3 emissions encompass the broader supply chain, including the transportation of raw materials, disposal of detergent packaging, and consumer use of detergents. This category also covers business travel and waste generated during product life cycles. Reducing Scope 3 emissions involves collaborating with suppliers for sustainable sourcing, minimizing packaging waste, and promoting eco-friendly consumer behavior.

Contemporary detergents are made with a variety of ingredients, including surfactants, preservatives, and chemicals, all of which are intended to provide superior cleaning performance. While these advancements have significantly improved the convenience and efficacy of detergents, they also have a negative side. Many detergents include non-biodegradable ingredients like synthetic surfactants, phosphates, and petrochemical-derived fragrances. These ingredients contribute to environmental pollution, specifically water contamination, which has had serious consequences for aquatic ecosystems and biodiversity. (Poucher 2013) The use of such chemical compositions has raised environmental concerns, ranging from soil degradation to water contamination, putting enormous strain on ecosystems that rely on clean water sources to survive.

While modern detergent brands guarantee improved cleaning performance, they leave significant environmental consequences. As consumers become more aware of the environmental consequences of their consumption habits, manufacturers face increasing pressure to reduce these risks while maintaining product efficacy. The following sections look at the key drivers of detergent sector growth in Pakistan, regional consumption patterns, and the broader environmental and health implications of detergent use (Villota-Paz, 2023).

## 4.2. Growth Drivers and Industry Challenges

The rising population and disposable income are driving the expansion of Pakistan's soap & detergent business. The Pakistani government has encouraged the growth of the soap and detergent business through a variety of incentives, including tax exemptions, grants, and attractive tariff rates.

However, the market has various hurdles, including high raw material costs, limited production efficiency, inadequate downstream processing facilities, and unrealistic regulations. The dependency on imported raw materials significantly increases the sector's vulnerability to global supply chain disruptions. This presents both a challenge and an opportunity for Pakistan, as low per capita consumption provides adequate room for growth but also means that the industry must act swiftly to manage the environmental implications of increased consumption. The growth of the detergent sector in Pakistan raises critical questions:

How do the sector's practices align with environmental sustainability?

How do consumers perceive and address health and environmental risks associated with detergents?

What role can stakeholders, including policymakers and manufacturers, play in promoting sustainable production and consumption of detergents?

### 4.3. Chemical Concerns and Environmental Issues

#### 4.3.1. Per- and Polyfluoroalkyl Substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals widely used in consumer and industrial products for their unique resistance to water, oil, and heat. These substances have been extensively utilized in products such as detergents, nonstick cookware, water-repellent fabrics, and firefighting foams. The chemical structure, characterized by strong carbon-fluorine bonds, makes them highly durable and resistant to breakdown, both in the environment and within living organisms. However, their persistence in the environment and the human body raises health concerns, earning them the nickname "forever chemicals" (Langenbach, 2021). Exposure to PFAS is linked to serious health issues like cancer, thyroid problems, liver disease, and reduced fertility. In laundry detergents, PFAS can remain on clothes, get absorbed into the skin, and contaminate water, contributing to pollution. These chemicals also impact wildlife, ecosystems, and biodiversity by persisting in soil and water. In Pakistan, the regulatory framework for controlling per- and polyfluoroalkyl substances (PFAS) in detergents remains underdeveloped despite international efforts such as the Stockholm Convention on Persistent Organic Pollutants (POPs), to which Pakistan is a signatory. As per the UN's mandate, signatories are required to phase out or limit the production and use of hazardous substances, including PFAS. (Rayhan, 2024) However, a 2022 report from the United Nations Environment Programme (UNEP) highlighted gaps in Pakistan's implementation mechanisms, citing a lack of enforcement infrastructure and insufficient public awareness. For instance, while PSQCA has introduced standards for some industrial products, it has yet to include specific PFAS guidelines, resulting in unchecked chemical imports. (Khan. S, 2023)

Moreover, Pakistan's adherence to the Basel Convention, aimed at reducing hazardous waste, has had limited influence on domestic quality control due to inconsistent monitoring of imports and exports of harmful substances. According to a 2021 audit by the Federal Environmental Protection Agency (EPA), approximately 70% of imported raw materials for detergents do not comply with international environmental standards, underscoring the urgent need for regulatory reforms. The lack of enforcement has implications not only for environmental pollution but also for health outcomes, as evidenced by rising PFAS concentrations in water samples near industrial zones, reported by the Pakistan Council of Research in Water Resources (PCRWR). Stricter guidelines aligning with UN conventions could significantly reduce these risks while promoting cleaner production practices in the detergent industry. (Jansen, 2021)

#### 4.3.2. Broader Chemical Issues: Chemical Composition of Detergents as an Environmental Concern

Given the environmental and health concerns associated with detergents, this analysis limits its scope to washing powders and dishwashing detergents, representing some of the most widely used products in the category. These two products also exemplify worst-case environmental and health scenarios, making them suitable for a focused examination. Beyond PFAS, several other chemical ingredients commonly found in detergents contribute to their harmful environmental and health effects. Some of these ingredients include:

**Phosphates:** Phosphates are widely used in detergents to improve their cleaning performance. However, they are a major contributor to eutrophication in water bodies, where they promote the growth of algae that depletes oxygen levels in the water. This process leads to the suffocation of aquatic life and has long-term detrimental effects on biodiversity.

**Bleach:** Bleach is commonly used in detergents for whitening fabrics and removing stains. However, bleach is a highly toxic substance that can irritate the skin, eyes, and respiratory system. Its use also contributes to environmental pollution when discharged into water bodies.

**Formaldehyde:** Used as a preservative in detergents, formaldehyde is a known carcinogen that can cause skin irritation, respiratory issues, and long-term health problems. Prolonged exposure to formaldehyde can increase the risk of cancer, and its presence in detergents raises significant public health concerns.

**Ammonium Sulfate & Quaternary Ammonium Compounds:** These chemicals are toxic and corrosive, posing risks to both human health and the environment. Exposure can cause skin burns, eye injuries, and respiratory problems, and they also pose risks to aquatic ecosystems.

**Dioxane:** A byproduct of detergent production, dioxane is a carcinogen that affects vital organs such as the kidneys and lungs. It also disrupts the central nervous system and respiratory functions, making it a significant environmental and public health concern. (Matzner, 2017)

Besides laundry and dishwashing detergents, there are many household cleaning detergents that contain acidic and harmful chemicals. In Pakistan, several household cleaning detergents pose significant risks, with some of the most dangerous being Harpic and Sweep (sulfuric acid). These products contain acidic substances that can be hazardous to human health. Harpic consists of hydrochloric acid, butyl oleylamine, and other components dissolved in a water-based solution. These acidic substances can be extremely dangerous if ingested, whether intentionally or unintentionally, as they can cause severe damage to the lower esophagus and stomach.

#### 4.4. Environmental Impacts

Cleaning agents harm the environment through chemicals that disrupt wildlife and water quality. These chemicals also impact the food chain and contribute to ozone depletion. Furthermore, household cleaning detergents, such as Harpic and sulfuric acid (as mentioned earlier), also exhibit acute, moderate, and chronic toxicity to aquatic life. The level of toxicity is influenced by the pH of the aquatic environment, which can be significantly altered by the presence of acidic substances. Sulfuric acid, a highly corrosive substance, can severely harm any plants, birds, or land animals which are exposed to it. While small quantities of sulfuric acid may be neutralized by the natural alkalinity in aquatic systems, larger amounts can cause long-lasting damage to aquatic ecosystems. These household cleaning detergents also have significant environmental impacts during the recycling process. Improper recycling of plastic bottles containing these chemicals intensifies their harm. If these bottles come into contact with other plastic materials during recycling, the chemicals may transfer, potentially contaminating the recycling stream. Similarly, the packaging and transportation of these products pose hazards, as chemical leaks during manufacturing can cause further environmental and health risks.

The manufacturing of detergents in informal sectors, small units, or through manual processes can be highly damaging to the environment and challenging to regulate. These informal operations often produce their own detergents using various chemicals and ingredients, but their activities remain undocumented and unregistered. As a result, it is nearly impossible to determine how much water and energy they consume or how much waste and effluents they discharge into the environment. In addition to these informal sectors, counterfeit operations also contribute to the problem. This is central to our research. These counterfeit units produce and sell detergents with packaging that closely mimic that of original brands, often with only minor, hard-to-detect differences. However, the contents of these packages are made with their own harmful chemicals. The Express News reported that a large quantity of counterfeit liquid soap confiscated from a shop in Rawalpindi was being supplied to various government hospitals and offices in the twin cities. This soap was found to be highly acidic and hazardous to health. Moreover, these unsafe products are often sold in bulk in markets like Shah Alami Bazaar and Gol Bazar, posing significant health and environmental risks, especially as they are purchased by commercial laundries, government

Despite the establishment of these agencies, challenges remain in implementing policies that effectively manage the negative environmental impacts of detergent use. Many of the existing environmental standards and guidelines are not given a priority and enforced, which undermines their potential to create a more sustainable detergent sector.

#### 4.5. Commercial practice: Counterfeit Products and Informal Sector Challenges



One major challenge is the unregulated informal sector, which far surpasses the formal sector in size and remains largely outside the ambit of regulatory enforcement. In both domestic and institutional contexts, the spread of expired and counterfeit goods is made possible by this control gap, which poses serious dangers to consumer safety. Moreover, despite Pakistan's adoption of the 2017 Standard Specifications for Synthetic Detergents, enforcement is still lacking because of insufficient supervision, and these standards fall short in addressing environmental issues including sustainable manufacturing and biodegradable chemicals. Another challenge is the accessibility and affordability of eco-friendly detergents. The lack of affordable choices and ambiguous labeling techniques make it difficult for customers to recognize truly sustainable items, which further restricts their uptake. Furthermore, the industry's resistance to allowing frequent environmental evaluations offsets its reliance on government funding and subsidies for the adoption of green practices, resulting in a standstill in the advancement of sustainable practices. Another significant gap is public knowledge, as many customers are still ignorant of the health and environmental risks that traditional detergents offer, as well as how they damage marine habitats and pollute water. Another obstacle is the high expense of manufacturing green detergents, using enzymes. Because they are more costly than their synthetic counterparts, biodegradable and plant-based substances are less appealing to customers on a budget.

## 5. Way forward and Policy Recommendations

The expansion of Pakistan's detergent industry presents unprecedented opportunities as well as challenges. On one hand, increased demand for detergents, fueled by urbanization, population expansion, and changes in customer preferences, demonstrates the sector's enormous economic potential. However, this expansion comes at a high environmental and social cost, owing to the negative effects of non-biodegradable chemicals, unregulated production, and insufficient regulatory enforcement. To establish a sustainable balance, stakeholders at all levels—from policymakers to manufacturers and consumers—must collaborate to adopt greener practices and improve regulatory frameworks. Consumer education remains a key component of this shift. Increased awareness of the health and environmental dangers associated with traditional detergents can generate demand for eco-friendly alternatives, encouraging producers to consider sustainability. At the same time, addressing issues like counterfeit goods and the informal sector necessitates a flexible regulatory framework combined with targeted enforcement actions. The detergent industry in Pakistan has immense potential, not just as a driver of economic growth, but also as a leader in sustainable industrial practices. Pakistan has the potential to transform its detergent business into a model for the region and beyond by addressing regulatory loopholes, investing in green technologies, and developing an environmental responsibility culture. By doing so, the country can ensure that economic success coincides with environmental protection and public health, paving the way for a cleaner, safer, and more sustainable future.



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