Sewnarayan Rameswar Fatepuria College

Beldanga, Murshidabad-742133

ASSIGNMENT ON ENVIRONMENTAL STUDIES(AECC)

Name: AMMARA YEASMIN

Class: B.SC 1ST SEMESTER HONOURS

DEPARTMENT OF ENVIRONMENTAL SCIENCE

ROLL: 211245 NO: 2269615

REG. NO: 067588 SESSION: 2022-2023

-সূচিপত্র-

(১) বায়ুদূষণ নিয়ন্ত্রণের উপায় লেখো।

(২) চিপকো আন্দোলন সম্পর্কে লেখো।

• বায়ু দূষণ কী ?

⇒ বায়ু দূষণ হল বায়ুমণ্ডলে এমন কোনো পদার্থের উপস্থিতির কারণে হওয়া বায়ুর দূষণ যা মানুষ এবং অন্যান্য জীবের স্বাস্থ্যের জন্য ক্ষতিকর, কিংবা জলবায়ু বা পদার্থের ক্ষতি করে।

• বায়ু দূষণ নিয়ন্ত্রণের উপায়গুলি হল —

(i) বিভিন্ন কারখানা কম সালফারযুক্ত জ্বালানি ব্যবহার করতে হবে। জ্বালানি হিসাবে কয়লার ব্যবহার কমিয়ে প্রাকৃতিক গ্যাসের ব্যবহার বেশি করতে হবে।

(ii) কলকারখানায় উৎপাদন পদ্ধতি পরিবর্তন বা নিয়ন্ত্রণ করতে হবে বা নতুন পদ্ধতি চালু করতে হবে।

(iii) যানবাহনে পুরনো ইঞ্জিন বাতিল বা সংস্কার করতে হবে যাতে বায়ুদূষণ কমে।

(iv) প্লাস্টিক, রাবার দিয়ে ধোঁয়া জাতীয় বায়ুদূষণ থেকে কারখানাগুলিকে বিরত করতে হবে।

(v) চুল্লি থেকে নানা জাতীয় পদার্থ যাতে সরাসরি বাতাসে না আসতে পারে তার জন্য বিভিন্ন রকম ফিল্টার ব্যবহার করতে হবে।

(vi) সিমেন্ট শিল্প, কাগজ শিল্প, তেল শোধনাগারে ইলেকট্রোস্ট্যাটিক প্রেসিপিটেটর যন্ত্র ব্যবহার করতে হবে।

(vii) দূষণ সম্পর্কে মানুষকে সতর্ক করা শুরু করতে হবে।

(viii) কৃষিকাজে কীটনাশকের ব্যবহার কমাতে হবে।

(ix) কারখানাগুলোকে লোকালয় থেকে দূরে সরাতে হবে।

(x) জ্বালানি, ডিজেল এসব পোড়ানো বন্ধ করতে হবে।

- **মূল্যায়ন :-**

বর্তমান সময়ে এগিয়ে যাওয়া পৃথিবীর সঙ্গে বায়ুদূষণ ক্রমশ বেড়ে চলেছে। তবে আমরা যদি নিজেরা সঙ্গে এই দূষণ প্রতিরোধ করি, তাহলে এখনও সময় আছে পৃথিবীকে বাঁচানোর। আমরা আশা রাখবো মানবজাতি খুব শীঘ্রই বায়ুদূষণ সম্পর্কে সচেতন হবে এবং এটি প্রতিরোধ করতে এগিয়ে আসবে।

চিপকো আন্দোলন সম্পর্কে লেখ।

● চিপকো আন্দোলন :-

১৯৭৩ সালে ২৬ মার্চ উত্তর প্রদেশে, বনাধিকারিকদের দ্বারা গাছ ও জঙ্গলের গাছগুলি কেটে ফেলা দেওয়ায়, আন্দোলনের লক্ষ্যে স্বতঃস্ফূর্ত ভাবে শুরু হয়েছিল চিপকো আন্দোলন। হিন্দিতে চিপকো কথাটির অর্থ আলিঙ্গন করা।

● পটভূমি :-

চিপকো আন্দোলনের মূল বা ইতিহাস অনুসন্ধান করলে দেখা যাবে এই আন্দোলনের সূচনার মূলে রয়েছে ১৭৩০ সালে ঘটে যাওয়া রাজস্থানের বিষ্ণোই আন্দোলনের মানুষদের মধ্যে অরণ্য সংরক্ষণ এর জন্য প্রাণের বলিদান। চিপকো আন্দোলনের সঙ্গে এই আন্দোলনের বহু মিল দেখা যায়।

সুন্দরলালের বহুগুণা ও চন্ডীপ্রসাদ ভাটের নেতৃত্বে গাড়োয়াল জেলায় চিপকো আন্দোলনের সূচনা হয়। সরকার এই অঞ্চলে অরণ্য সম্পদ সংরক্ষণ করতে চায়না তাই আঞ্চলিক মানুষেরা এর বিরুদ্ধে প্রতিবাদ শুরু করে। মহিলারা বিশেষ ভূমিকা নিয়েছিল।

● আন্দোলনের কারণ :-

(i) বিভিন্ন অঞ্চলে অরণ্য ছেদনের দ্বারা পরিবেশের ক্ষতি করার চেষ্টা হল এই আন্দোলনের অন্যতম কারণ।

(ii) মাওলি গ্রামের স্থানীয় অধিবাসীদের প্রতি বন দপ্তরের বিরূপ মনোভাব পোষণ এই আন্দোলনের আরও একটি কারণ।

(iii) কৃষকদের প্রয়োজনীয় সাজসরঞ্জাম তৈরির জন্য যে কাঠের প্রয়োজনীয় গাছ কাটতে নিষেধাজ্ঞা জারি হয়েছিল, তার জন্য কৃষকরা ক্ষুব্ধ হয়েছিল।

• নেতৃত্ব :-

সুন্দরলাল বহুগুনা ছিলেন এই আন্দোলনের নেতা।

• বৈশিষ্ট্য :-

(i) অরণ্য রক্ষার উদ্দেশ্যে এই আন্দোলন সংগঠিত হয়েছিল।

(ii) এই আন্দোলন ছিল স্বাধীন ভারতের প্রথম পরিবেশ আন্দোলন।

(iii) মূলত মহিলারা ও কৃষকরা এই আন্দোলনে শামিল ছিলেন।

• মূল্যায়ন :-

চিপকো আন্দোলন এর বিরোধিতা দেখে ও পরিবেশের প্রতি মানুষের ভালোবাসা দেখে আমাদের মনে আমাদের পরিবেশ সম্পর্কে সচেতন হওয়া উচিত। ইন্টারনেট ও সোশ্যাল মিডিয়া ব্যবহার করে আমরা অন্য মানুষকে পরিবেশ সম্পর্কে সচেতনতা দান করা উচিত।

Rimpa Mandal

Student's Signature

SEWNARAYAN RAMESWAR FATEPURIA COLLEGE

DEPARTMENT OF ENVIRONMENTAL SCIENCE

B.Sc. 6th Semester
Environmental Science Honours

ROLL: 2116245 NO: 2075651
REGN. NO: 075286
SESSION: 2020-2021
PAPER: UG-ENVS-H-DSE-L-04

A CASE STUDY ON ENVIRONMENTAL IMPACT OF A HAIR INDUSTRY

DISSERTATION REPORT

2022-2023

SUBMITTED BY ARNAB KHAN
Dept. of ENVS, SR Fatepuria College, Beldanga, Murshidabad, 742133

ACKNOWLEDGEMENT

I would like to use this occasion to offer my sincere gratitude to everyone who helped me to complete my dissertation on the hair industry successfully.

First of all, I want to sincerely thank our Principal sir, **Dr. Suhas Roy**, for his unwavering support and direction during this process. His unwavering commitment to enhancing our college has served as a major source of motivation for me.

I also want to express my gratitude to Head of the Department of Environmental Science **Mr. Pinaki Bose**, for his support, insightful comments, and helpful criticism. His knowledge of the subject has been very useful in guiding my research.

My sincere gratitude is extended to our teachers **Poushali Chattaraj** and **Alemara Khatun** for their valuable contributions and help with this endeavour. They have been a constant source of motivation for me because of their everlasting devotion and dedication to our education.

I would like to thank my classmates who have supported me throughout my academic journey. Their encouragement and motivation have been instrumental in helping me to complete this dissertation.

Last but not least, I want to express my gratitude to my parents for helping me to finish this dissertation report.

I want to thank everyone who was listed above once again since without their help and direction, my dissertation would not have been feasible.

Thanking you,
Yours faithfully
ARNAB KHAN

PREFACE

The hair industry is a huge and dynamic sector that includes everything from customer behaviour to salon management to product development (Chatterjee, S. 2019). The business, which has strong roots in culture, fashion, and individual expression, is always changing and offers fresh opportunities and challenges for those who work in it.

This dissertation presents a comprehensive study of my visit to **R.L. Hair Export**, a hair product manufacturing company in India. The purpose of the visit was to gain an in-depth understanding of the company's operations and management, as well as to explore the challenges and opportunities facing the hair manufacturing industry in India.

The study begins with an overview of the hair manufacturing industry in India, including its history, growth, and current state. The next section provides a detailed description of R.L. Hair Export, including its history, mission, and organizational structure. The study then examines the company's production process, supply chain management, marketing strategies, and financial performance.

In addition to analyzing the company's operations, the study also explores the social, economic, and environmental impact of the hair manufacturing industry in India. The study includes interviews with industry experts, government officials, and community members to provide a comprehensive understanding of the industry's impact.

Finally, the study concludes with recommendations for R.L. Hair Export and the hair manufacturing industry in India as a whole. These recommendations are based on the findings of the study and aim to help the industry address its challenges and capitalize on its opportunities.

CONTENT

List of Table

List of Figures

List of Abbreviations

Acronyms	Meaning
SD	Sustainable Development
GHG	Green House Gas
WB	West Bengal
SWM	Solid Waste Management
PA	Phenolphthalein Alkalinity
TA	Total Alkalinity
EBT	Eriochrome Black T
EDTA	Ethylenediamine tetraacetic acid
FAS	Ferrous Ammonium Sulphate
DPA	Diphenylamine
BIS	Bureau of Indian Standards
WHO	World Health Organization
CPCB	Central Pollution Control Board
APHA	American Public Health Association
AWWA	American Water Works Association
WEF	Water Environment Federation
ICAR	Indian Council of Agricultural Research
NRC	National Research Council
ISO	International Organization for Standardization
EMS	Environmental Management Systems
CSR	Corporate Social Responsibility

INTRODUCTION

The hair industry has become an increasingly significant sector in the global market, with an annual revenue of approximately $4 billion (Darien 2021), with an estimated global value of over $100 billion in 2021 (Statista, 2021). Hair is a symbol of beauty and an essential part of many cultures (Mason, C.,2018), with hair exports being a significant contributor to the economy of many countries, including India. The Indian hair industry accounts for approximately 20% of the global hair market, making it a significant player in the global hair market (Bhardwaj and Pal 2020). R.L. Hair Exports is one such player in the Indian hair industry, which specializes in the export of human hair. This dissertation aims to provide an insight into the functioning and operations of R.L. Hair Exports, as well as the broader Indian hair industry.

Lukman SK is the owner and the founder of the company that manufactures and exports human hair extensions. He takes necessary steps to grow the business.

The human hair industry has witnessed significant growth in recent years, with an increasing demand for hair extensions, wigs, and related products. R.L. Hair Exports, a prominent player in this industry, has established itself as a leading exporter of processed human hair. As the company operates in a dynamic and competitive market, it becomes crucial to evaluate its overall performance and impact, not only from an economic perspective but also from environmental and social angles. This dissertation aims to delve into the various facets of R.L. Hair Exports, examining its economic value, environmental practices, and social contributions.

The economic value of R.L. Hair Exports lies not only in its annual turnover but also in its revenue, export earnings, and employment generation. By assessing these factors, we can gain insights into the company's financial sustainability, market competitiveness, and its contributions to the local and national economy. Additionally, examining its tax contributions will shed light on its compliance with regulatory requirements and its social responsibility.

Considering the environmental aspect, the dissertation will analyze the environmental impact of R.L. Hair Exports' operations, focusing on waste generation, disposal practices, and any measures taken to reduce its ecological footprint. Understanding the company's environmental practices is crucial in assessing its commitment to sustainability and identifying areas for improvement.

Furthermore, the dissertation will explore R.L. Hair Exports' social perspective, examining its engagement with local communities, labor rights, diversity and inclusion initiatives, and ethical business practices. Evaluating these aspects will provide insights into the company's social impact, its contributions to the welfare of its employees and the surrounding community, and its commitment to responsible business conduct.

By comprehensively examining R.L. Hair Exports through the lens of economics, environment, and society, this dissertation aims to provide a holistic understanding of the company's operations, strengths, and areas for improvement. The findings of this study will not only contribute to the existing knowledge in the human hair industry but also provide valuable insights for the company itself to enhance its overall performance and sustainability.

Analysis of the impacts of R.L. Hair Exports' activities on various stakeholders and the investigation of potential solutions are essential in addition to examining the company's economic, environmental, and social aspects. Environmental deterioration, such as waste pollution and resource depletion, as well as social issues pertaining to labour rights and community well-being may be brought on by the company's operations. Alternative remedies, such as employing sustainable practises throughout the production process, investing in renewable energy sources, enhancing waste management systems, promoting fair labour practises, and participating in community development projects, could be investigated to address these effects. The objectives of these other approaches are to reduce adverse effects, improve environmental stewardship, promote social well-being, and help R.L. Hair Exports and its stakeholders remain viable over the long run.

Fig 1: R.L. Hair Exports

LITERATURE REVIEW

The literature review for this dissertation focuses on the hair export industry in West Bengal, India, and its relevance in the global context. This section provides an overview of existing scholarly research, studies, and publications that have explored various aspects of the industry, including economic, environmental, and social dimensions. By reviewing the literature, this dissertation aims to build upon the existing knowledge and identify gaps that warrant further investigation.

❑ West Bengal:

- **Mukherjee et al. (2020)** conducted a study to investigate the environmental impact of the hair export industry in West Bengal. The hair export industry in West Bengal has been growing steadily over the years, with several small and medium-sized enterprises involved in the trade (Choudhury, 2019). The study found that the industry generates a significant amount of waste, and proper waste management practices are not being implemented. The study highlighted the need for sustainable waste management practices to mitigate the environmental impact of the industry. Further research is needed to explore the potential environmental impact of the industry and identify appropriate measures to mitigate it.
- **The Indian Chamber of Commerce (2020)** reported that West Bengal accounts for more than 60% of India's total hair export earnings. This growth has been attributed to the state's abundant supply of human hair, skilled workforce, and favorable business climate. Several small and medium-sized enterprises are involved in the trade, contributing to the state's economy. The hair trade has been a significant source of income for many people, especially women, for many years.
- **Roy et al. (2019)** investigated the carbon footprint of the hair industry in West Bengal (WB). The study found that the industry's carbon footprint was significant due to the use of fossil fuels in the production process, transportation, and waste management. The authors suggested the adoption of renewable energy sources and the use of green technologies to reduce the industry's carbon footprint. The study also highlighted the need for policy interventions and incentives to promote sustainable practices in the industry.

❑ India:

- **Shah et al. (2021)** analyzed the environmental impact of the hair industry in India. The authors highlighted that hair processing generates significant amounts of waste, including hair clippings, used chemicals, and wastewater. The improper disposal of these wastes can have adverse impacts on soil, water, and air quality. The authors recommended the implementation of sustainable waste management practices such as recycling, composting, and wastewater treatment to mitigate the environmental impact of the industry.
- **Choudhary et al. (2020)** evaluated the environmental impact of hair processing and export in India. The authors highlighted that the use of chemical dyes and treatments in hair processing can result in the release of toxic chemicals into the environment, leading to pollution of air, water, and soil. The authors recommended the use of eco-friendly and natural dyes and treatments to reduce the environmental impact of the industry.
- **Bhattacharjee et al. (2019)** investigated the environmental impact of the hair industry in India and its potential for sustainable development. The authors highlighted that the hair

industry generates significant employment opportunities, particularly for women in rural areas, but also highlighted that the industry has adverse environmental impacts. The authors recommended the adoption of sustainable and environmentally friendly practices in hair processing and export, such as the use of renewable energy sources and eco-friendly chemicals.

- **Singh et al. (2018)** examined the environmental impact of hair waste generated by the hair industry in India. The authors highlighted that hair waste can be a valuable resource for the production of bio-composites, which can have numerous applications in various industries. The authors recommended the development of technologies and processes for the efficient recovery and utilization of hair waste to reduce the environmental impact of the industry.

❑ World:

- **Bielesch et al. (2020)** highlighted that hair processing generates significant waste, including chemicals, wastewater, and solid waste. The authors emphasized the need for better waste management practices and the use of eco-friendly and biodegradable materials in the industry.
- **Leow and Tan (2021)** investigated the environmental impact of hair extensions, which are a popular product in the hair industry. The authors found that the production of hair extensions has a significant environmental impact, including the use of non-renewable resources, emissions of greenhouse gases, and water pollution. The authors recommended the adoption of sustainable production practices and the use of eco-friendly materials.
- **Okeme and Olujimi (2019)** highlighted that the industry generates significant waste, including hair clippings and chemical waste. The authors emphasized the need for better waste management practices and the use of sustainable production practices in the industry.
- **Fang and coworkers (2018)** investigated the environmental impact of hair processing and dyeing. The authors found that the use of chemicals in hair processing and dyeing can have significant environmental impacts, including water pollution and emissions of greenhouse gases. The authors recommended the use of eco-friendly and non-toxic chemicals and the adoption of sustainable production practices.
- **Brazil, Branco and coworkers (2020)** highlighted that the industry generates significant waste, including hair clippings, chemical waste, and plastic packaging. The authors emphasized the need for better waste management practices and the use of eco-friendly and biodegradable materials in the industry.
- **Kim and coworkers (2017)** investigated the environmental impact of the wig industry. The authors found that the production of wigs has a significant environmental impact, including the use of non-renewable resources and emissions of greenhouse gases (GHG). The authors recommended the adoption of sustainable production practices and the use of eco-friendly materials.

AIMS AND OBJECTIVES

Aims:

This dissertation's objectives are to thoroughly research and evaluate R.L. Hair Exports with an emphasis on its social, environmental, and economic aspects. The study's objective is to assess the company's economic worth, including its revenues from sales, exports, the creation of jobs, and tax contributions. Additionally, it tries to evaluate how its activities affect the environment, specifically how trash is generated and managed. The dissertation also aims to look at the company's social viewpoint, including its dedication to labour rights, involvement in the community, and ethical business practises. The goal of this study is to provide readers a thorough knowledge of R.L. Hair Exports and its total impact so they may spot its strengths and possible weaknesses.

Objectives:

1. To investigate the sources of raw material and methods of hair collection used by the factory.
2. To analyze the processing steps involved in the factory's production line.
3. To measure the waste generated by the factory and assess its environmental impact.
4. To calculate the economic value of the company in terms of revenue, export earnings, taxes paid, and employment generated.
5. To assess the social impacts of the factory on the local community, including its contributions to employment, income generation, and community development.
6. To identify areas where the factory can improve its sustainability practices and minimize its environmental footprint.
7. To suggest recommendations for the factory to enhance its economic, social, and environmental sustainability.

This dissertation aims to offer a thorough examination of the hair export market, with a special emphasis on R.L. Hair Exports' factory. Examining the factory's operations' effects on the economy, environment, and society is the goal. The dissertation will examine every step of the process, from hair collecting to packing, and will point out any areas where the factory's sustainable procedures should be strengthened. Also, it will look into the factory's economic worth, its contribution to the regional economy, and its effects on the larger neighbourhood. The dissertation aims to provide a thorough understanding of the hair export industry in India and the impact of the R.L. Hair Exports factory on the local and wider community through the use of primary data collected from site visits, interviews with factory workers and management, and secondary data obtained from pertinent literature.

METHODOLOGY

4.1 Study area:

The **R.L. Hair Exports factory** is located within a geographical coordinate of **23.866319° N** latitude and **88.2489510° E** longitude in India. The factory is situated in the state of West Bengal, in the district of Murshidabad. The location of the factory is strategically chosen, as it is close to the source of the raw material used in the production process, which is human hair.

The district of Murshidabad is known for its abundant supply of human hair. The factory's proximity to the source of raw material ensures a steady and reliable supply, which is essential for the company's production process.

In addition to its proximity to the raw material, the factory is also located near transportation hubs, such as the Kolkata airport and seaport. This makes it easier to transport finished products to international markets (China, Bangladesh, Myanmar, Vietnam), which is a crucial part of the company's business model.

The location of the factory also has social and economic implications for the local community. The hair industry provides employment opportunities for many people in the region, particularly women. By setting up the factory in Murshidabad, R.L. Hair Exports has contributed to the economic development of the area and helped to uplift the lives of the people living there.

Overall, the location of the R.L. Hair Exports factory has been carefully chosen to ensure a reliable supply of raw material, ease of transportation, and social and economic benefits for the local community. It is a testament to the company's commitment to sustainable and ethical business practices, which are critical for success in the global hair market.

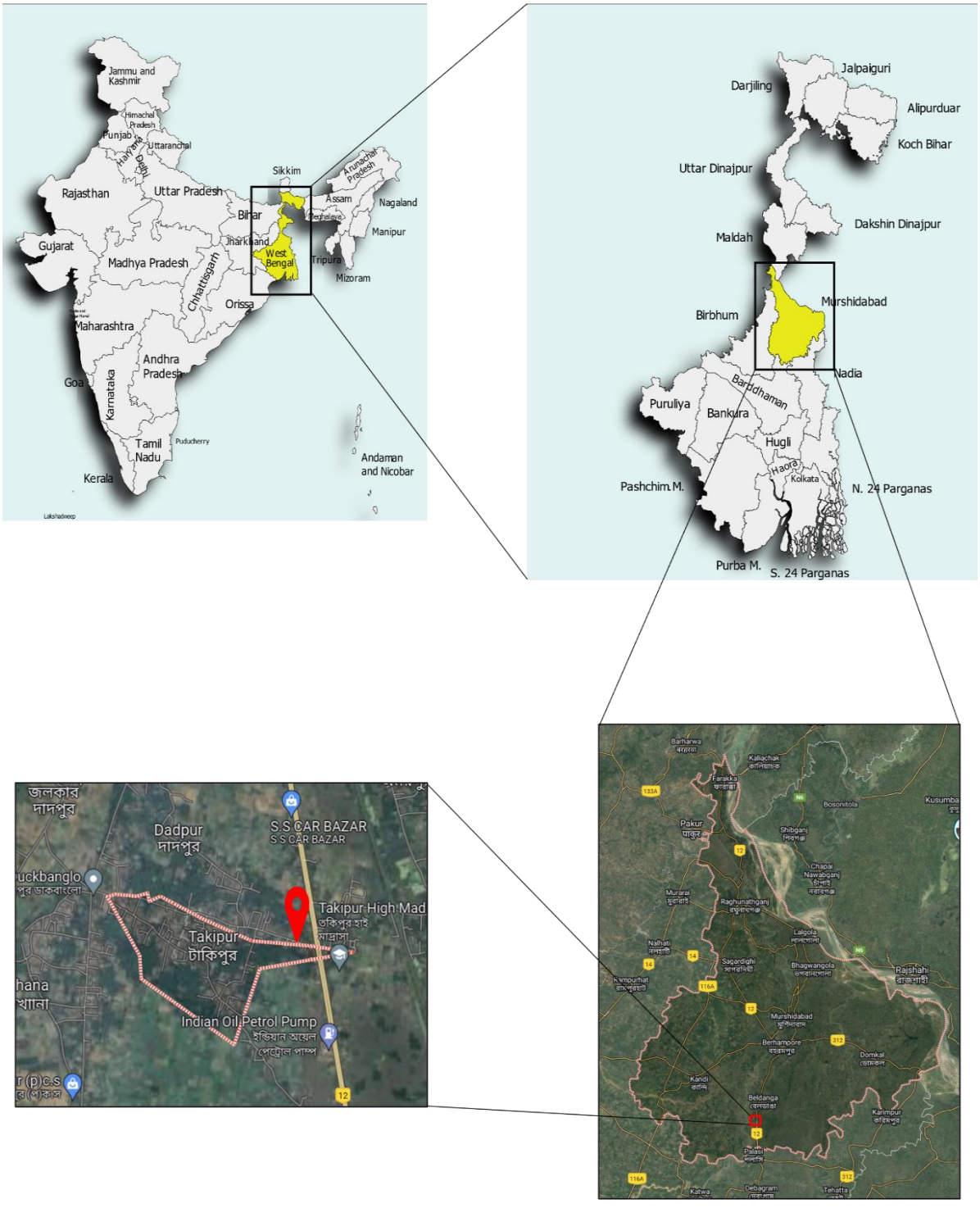

Fig 2: Location of R.L. Hair Export

4.2 Observation:

To obtain data for the study, structured question-and-answer questionnaires with standard formats were used. The questionnaire was carefully crafted to incorporate pertinent and insightful questions that speak to the study's research goals. It was simpler to examine and come to relevant conclusions because the data was uniform and consistent thanks to the use of standard questionnaires. Due to the methodology used, the study was able to collect extensive information that shed light on the local community's economic, environmental, and social effects of the R.L. Hair Exports factory.

4.2.1 Collection of raw materials:

Leading Indian hair exporter R.L. Hair Exports sources some of its raw materials by collecting hair from different West Bengal districts. The business has built a network of hair collectors who are in charge of obtaining hair from people in these neighbourhoods. Here is an illustration of how hair is collected:

First, the hair collectors travel to several cities and villages in the adjacent districts of Nadia, Kochbihar, and Murshidabad. They typically travel to places like rural areas or places where people are more likely to have long, healthy hair.

Once they have located potential hair donors, they go up to them and explain how the hair collection process works. Brochures or leaflets with information about the business and the hair collection procedure are frequently carried by the hair collectors. Donors are also informed of the fee they will be paid for their hair, which varies according to the hair's length, quality, and colour.

The hair collector measures the donor's hair's length and examines it for quality if they agree to sell the donor's hair. The collector then trims the hair close to the scalp, making sure that it is cut uniformly and without any rough edges. The constant length of the hair is ensured, which is crucial for the production process.

Table 1: Total amount of collected raw material and its sources in a year

Place of collection	Weight (kg)
Nadia dist.	35000
Murshidabad dist.	40000
Kochbihar dist.	16000
Others	5000

4.2.2 Processing of raw materials:

This is done using a variety of techniques and this is the main step of this factory. It is a lengthy process and took much time on it.

1. **Sorting and Grading:**

A critical step in the creation of high-quality hair products is the sorting and grading of human hair. This procedure is carried out manually at the R.L. Hair Exports factory by skilled experts who have a wealth of knowledge and experience in sorting and grading human hair.

Throughout the sorting and grading procedure, the hair is divided into many categories according to its length, texture, and colour. The hair is initially examined to make sure it is of the finest quality and unblemished or damaged. After that, the hair is selected according to length, with shorter hair often used for weaving and manufacturing hair extensions and longer hair typically used for wigs.

Generally, the hair is then graded according to its texture and colour. Depending on its quality, the hair is divided into different categories, such as "A," "B," or "C." The highest grade of hair is often designated as "A" grade, while lower-grade hair is designated as "B" or "C" grade (Bhushan, S., & Rai, K. N., 2015).

To guarantee that the hair is sorted precisely and that the finished product matches the high requirements of the business, the sorting and grading procedure is carried out by hand. R.L. Hair Exports employs sorting and grading experts that are extremely skilled and knowledgeable in the process, and they take great care to guarantee that the hair is handled carefully and precisely.

2. **Washing:**

To guarantee that the hair is clean, free of dirt and debris, and prepared for future processing, the washing procedure entails a number of processes.

As the first phase in the washing procedure, the hair is divided into various batches according to its texture and colour. Thereafter, the hair is thoroughly examined to get rid of any potential impurities like debris, grime, or dust. A shampoo that has been particularly prepared to thoroughly clean the hair without damaging or tangling it is used to wash the hair.

The hair is properly rinsed after washing to get rid of any shampoo residue and other impurities. After that, the hair is conditioned to replenish its moisture and stop tangling. In order for the conditioner to penetrate the hair shaft, it must be applied evenly throughout the hair and allowed to sit for a predetermined period of time. Following the conditioning procedure, the hair is rinsed once more to remove any leftover conditioner.

3. **Drying:**

Prior to further processing, the hair must be totally dry, so why is drying so important? The hair is gently dried using a mild heat source without being exposed to high temperatures or

excessive heat, which can harm the hair Lim, (S. J., Lee, H. S., & Lee, S. H., 2018). Air drying and blow drying are the two ways to dry hair:

i. Air-drying: The hair is left to dry naturally in an environment that is well-ventilated and away from heat or direct sunlight. Because it eliminates tangling and lowers the possibility of heat damage, this approach is excellent for sensitive hair textures. Typically, the hair is arranged in a spread-out position on racks or hangers and dried for a number of hours until entirely dry.
ii. Blow-drying: A low-heat blow dryer is used to dry the hair. Because it expedites drying, this approach is suited for thicker hair textures. To avoid heat damage, the hair is typically divided into small portions and dried on a low heat setting. Care is taken to prevent the hair from being exposed to high temperatures or excessive heat.

The hair is periodically examined for any indications of tangling or damage while it is drying. To make sure it is smooth and tangle-free, the hair is gently combed and brushed. Whether the hair is used to create wigs, weaves, or hair extensions, drying is necessary to guarantee that it is prepared for the next stage of processing.

4. Straightening and Styling:

Professionals with significant training and experience handling human hair perform these procedures. These procedures are intended to get the hair ready for usage in weaves, wigs, or hair extensions.

Heat-treated equipment, like flat irons or hot combs, is used to straighten the hair strands during the straightening procedure. Each segment of the hair is divided into smaller pieces and run through the heated tool until the hair is straight. To prevent harm to the hair, the heated tool's temperature is closely watched.

In the styling process, the hair is shaped into a specific style or texture. The hair can be curled, waved, or crimped, among other styling options. The procedure entails shaping the hair strands with heated instruments like curling irons or hot rollers. To prevent harm to the hair, the heated tool's temperature is closely watched.

The hair is periodically examined during the straightening and styling procedures for any indications of breakage or damage. To ensure that the hair matches the high standards of the business, uniformity in texture and colour is also examined. Straightened and styled hair that is prepared for additional processing is the finished item, ensuring that the company's clients obtain high-quality hair products (Tosti, A., & Piraccini, B. M., 2018).

5. Wefting:

Individual hair strands are sewn or stitched onto a track, or "weft," of thread, which is known as wefting. After that, the weft can be used to make weaves, wigs, or hair extensions. Workers with significant training and expertise handling human hair do the wefting procedure.

Sorting and grading the hair strands according to length, texture, and colour is the first stage in the wefting procedure. To avoid tangling and guarantee a flawless finish, the hair strands are then aligned in the same direction. Depending on how much hair needs to be handled, wefting can be done manually or mechanically.

The hair strands are manually stitched onto a track of thread during the hand wefting procedure. The individual hair strands are meticulously knotted onto the thread in a continuous pattern to form the weft. A second row of stitches is then added to the weft to strengthen it and make it more resilient.

The hair strands are passed through a sewing machine during the machine wefting procedure, where they are sewn onto a thread track. A strong and long-lasting weft is made when a machine continuously weaves hair strands onto the thread.

The hair is routinely examined during the wefting procedure for any indications of damage or tangling. To make certain that the weft meets the high standards of the business, it is also examined for uniformity in texture and colour. A weft of top-notch human hair is what is left behind and is prepared to be used to create wigs, weaves, or hair extensions.

6. Packaging:

The purpose of packaging is to safeguard the hair from harm during storage and shipping and to make sure that it leaves the manufacturer in the same top-notch condition that it will be used in.

The selection of suitable packaging materials is the first step in the packaging process. The business uses premium packaging supplies that are strong, lightweight, and simple to handle. Included in the packing supplies are boxes, bags, and plastic wrap.

The hair is thoroughly combed and uniformly arranged after it has been wefted and processed. The hair is then inserted inside the packaging material after being carefully folded. To preserve the hair from moisture and other external elements that could harm it, the packaging material is sealed.

The relevant details, like the type of hair, length, and colour, are then written on the container. The company's logo and contact details are printed on the label. After that, the labelled package is stacked and made ready for delivery. The hair is periodically inspected for any indications of tangling or damage as it is being packaged. High-quality hair that is prepared for shipping to the company's clients is the final packaged good.

Fig 3: Sorting and Grading

Fig 4: Washing process

Fig 5: Air Drying

Fig 6: Straightening

Fig 7: Wefting

Fig 8: Packaging

4.2.3 Generated wastes:

During the processing of raw material, a large amount of waste is produced. The produced wastes are generally Hair waste, Water waste, Chemical waste, Plastic waste, and Solid waste. These are discussed below:

Hair waste: In the factory of R.L. Hair Exports, the process of sorting and grading starts to produce hair waste. In order to detect the hair strands that do not exceed the company's quality criteria, skilled professionals filter through the collected hair. Too short, too thin, or too damaged strands are taken out of the batch and thrown away as waste.

Normally, this hair waste is collected separately and disposed directly. Depending on the quality of the hair gathered and the requirements specified by the company, the volume of hair waste produced throughout the sorting and grading process can vary.

Water waste: In the R.L. Hair Exports factory, the washing phase of the hair processing is when water waste is produced. Prior to further procesing, the hair must be cleaned to remove impurities, including oil, dirt, and other contaminants. Large amounts of water are used to wash the hair, and the effluent is then disposed of.

Pollutants such detergents, conditioners, and hair colours used in hair processing may be present in the wastewater produced during the washing process. If not properly handled before disposal, these pollutants can harm aquatic life and contaminate water sources.

Chemical waste: The usage of these compounds produces chemical waste, which, if improperly managed, can have detrimental effects on the environment.

There are various steps in the process of creating chemical waste. To make a solution, the chemicals are first combined with water. Then, using a number of techniques like soaking, spraying, or brushing, this solution is applied to the hair strands. The substances on the hair strands are broken down by the chemicals into dirt, oil, and other impurities, which are then removed with water.

Some of the chemicals may not completely dissolve during this process, or they can stay on the hair strands, creating chemical waste. Moreover, the chemicals may combine with other elements in the wastewater to form new, potentially hazardous compounds.

Plastic waste: At many phases of the processing and packing process, plastic waste can be produced in the hair export sector. To protect the hair during shipment, packaging could, for instance, contain plastic components. During the grading and sorting process, hair strands may also be transported and stored in plastic bags or containers.

Plastic containers may be used during the washing procedure to hold the water and cleaning agents for the hair. Plastic hangers or clips may also be used to hold the hair in place while it dries.

Moreover, wigs and hair extensions are made from plastic materials, which can result in large volumes of plastic waste being produced during both creation and disposal.

Solid waste: The factory where R.L. Hair Exports processes hair produces solid waste, including cardboard boxes, plastic, and other packaging materials. When finished goods like wigs or hair extensions are packaged into boxes or bags, the process of creating solid trash begins. When transporting and storing hair products, cardboard or plastic boxes and bags are frequently used to keep them safe.

After customers have received their hair products, the packaging materials may be thrown out as garbage. The packaging waste can end up in natural settings or landfills, where it may take hundreds of years for it to degrade and add to pollution and other environmental issues.

Fig 9: Hair waste

Fig 10: Plastic waste

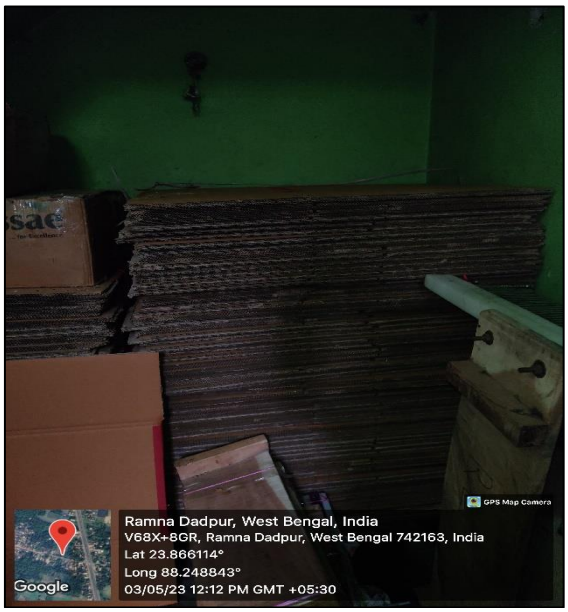

Fig 11: Solid waste

Fig 12: Machinery waste

4.2.4 waste management:

The waste generated during hair processing at R.L. Hair Exports' factory is directly disposed of without any treatment, it can have significant negative impacts on the environment and public health. The waste generated from hair processing includes cardboard boxes, plastic materials, and other packaging materials, as well as chemicals used in the processing of the hair, such as detergents and dyes.

At R.L. Hair Exports' factory, waste generated during hair processing is disposed of without any treatment. This may result in the accumulation of waste in landfills or dumpsites, leading to environmental pollution and health hazards for nearby communities.

Improper disposal of this waste can lead to soil, air, and water pollution. According to a report by the World Bank, improper disposal of solid waste can lead to pollution of the environment, contamination of water sources, and health hazards for workers and communities living near waste disposal sites (World Bank, 2018). For example, if plastic waste is not properly disposed of, it can end up in waterways or oceans, where it can harm marine life and contribute to plastic pollution. Additionally, the chemicals used in hair processing can be harmful if they come into contact with the environment, leading to soil or groundwater contamination. If these contaminants reach drinking water sources, it can pose a risk to public health.

Moreover, the waste which is burned, it can release harmful gases and pollutants into the air, contributing to air pollution and potentially causing respiratory problems for people living in the surrounding areas.

Remedial action:

In recent years, there has been growing awareness of the need for proper waste management practices. In India, the Solid Waste Management (SWM) Rules (2016) aim to promote segregation of waste, recycling, and environmentally sound disposal of waste. However, the implementation of these rules can vary across different regions and industries.

To address the issue of waste disposal at R.L. Hair Exports' factory, measures such as waste segregation and recycling, as well as proper disposal of non-recyclable waste in compliance with local regulations, can be implemented. The use of eco-friendly and biodegradable packaging materials can also help to reduce the amount of waste generated.

4.2.5 Economic analysis:

Economic value of a company can be determined by some factors, which are **Revenue, Employment, Export earnings, Contribution to local suppliers, Taxes paid**. Now we will discuss these factors on R.L. Hair Exports' factory.

Revenue: R.L. Hair Exports' income in the fiscal year 2022–2023 would be between 3.5 and 4.2 crores, or 10-12% of 35 crores. This implies that the company's overall economic value is significantly influenced by its revenue.

A revenue between Rs. 3.5 and Rs. 4.2 crore is a sizeable sum of money that can be used to finance the company's development and growth. This income can be invested back into the company to enhance operations, increase manufacturing capacity, and launch new goods.

The money made by R.L. Hair Exports not only helps the business grow, but it also has an effect on the overall economy. The company must pay taxes to the government as a registered business, which adds to government revenue that may be used to pay for infrastructure and public services.

Employment: In terms of generating income and jobs, R.L. Hair Exports' employment point can be examined. The company is giving local residents job possibilities at the facility, where there are already 30 staff working (9 female and 21 male), this demonstrates that industrial authorities are concerned about the growth of women's wellbeing. These jobs not only give the employees and their families a means of support, but they also help the area's economy grow as a whole.

In the context of the local economy, the employees' 30,000 rupees in monthly compensation is a sizeable sum. It indicates that the employees are making a respectable living and can support their families. This demonstrates that the business is compensating staff members fairly for their efforts, which is crucial for guaranteeing their wellbeing and job satisfaction. The quality of life for employees and their families can be enhanced by having a stable income and a job that is secure. This may lead to better health outcomes, more access to resources like education and other resources, and other favourable social and economic effects.

Export earnings: When a nation sells goods and services to other nations, it makes money known as export earnings. In the case of R.L. Hair Exports, sales to foreign nations like Bangladesh, China, Malaysia, and Vietnam account for 50–55 percent of the company's total revenue. These exports generate foreign currency, which helps the nation's export revenues. The currency of one nation is exchanged for the currency of another nation in the foreign exchange market.

R.L. Hair Exports has a significant impact on the overall economic growth and development of the nation by increasing export revenue. Export revenue increases the nation's foreign exchange reserves, which can be used to support economic growth and stability.

Contribution to local suppliers: The practise of R.L. Hair Exports of buying raw materials from regional vendors has a sizable effect on the regional economy. The organisation promotes the expansion of small and medium-sized enterprises in the area by obtaining materials from regional vendors. In turn, this generates revenue and jobs for the local population.

Additionally, the company's willingness to pay more to purchase raw materials from nearby vendors helps these vendors' economies even more. By providing this incentive, local vendors are encouraged to keep doing business with the company and invest in the caliber of their goods, which may result in higher income and sales.

The company's association with regional vendors might have social and environmental advantages in addition to commercial ones. Local sourcing helps the business cut down on transportation expenses and related emissions while also encouraging ethical and sustainable sourcing methods.

Overall, R.L. Hair Exporters' assistance to regional vendors fosters sustainable and ethical business practises, the development of stronger and more resilient communities, and economic progress.

Taxes paid: R.L. Hair Exports paid taxes in the fiscal year 2022–2023 equal to about 35 crore. This indicates that during that year, the corporation paid the government a significant amount of tax.

Businesses have a legal need to pay taxes, but they also have a social obligation to do so. R.L. Hair Exports' tax payments go towards generating cash for the government, which is then used to pay for infrastructure improvements and public services both locally and nationally. These revenues are crucial for the nation's economic growth and for enhancing the quality of life for its people.

Paying taxes additionally aids in promoting a compliance and accountability culture among organizations. R.L. Hair Exports is expressing its dedication to openness and moral business conduct by paying its taxes on time.

Also, the company's taxes may be used to fund initiatives and social welfare programmes that help the neighbourhood. This covers government-funded initiatives in the fields of education, health care, and social welfare.

Overall, R.L. Hair Exporters' tax payments show the company's dedication to its duty as a responsible corporate citizen and make a significant contribution to the nation's economic and social development.

4.2.6 Environmental analysis:

Water Sample collection:

The water sample was collected for chemical analysis.

Fig 13: collection of water sample

Soil Sample collection:

The Soil sample was collected for chemical analysis.

Fig 14: Soil sample collection

❖ Water Quality Analysis:

- **Estimation alkalinity of water: (**Face E.W. et al., 2012)

❑ **Requirements:** Glass wares –

1. 100 ml conical flask
2. Pipette
3. Measuring cylinder.

Reagent –

1. HCl [0.01(N)]
2. Methyl orange indicator
3. Phenolphthalein indicator.

❑ **Procedure:**

1. 100 ml of sample was taken in a conical flask and two drops of phenolphthalein is added colour of the sample changes into pink.
2. It was then titrated with 0.01(N) HCl until the colour disappear. The end point was noted.
3. Two-three drops of methyl orange was added, and titration was continued.
4. At the end point, colour changes yellow to pink. The end point (TA) was noted.

❑ **Result:**

Phenolphthalein Alkalinity (PA) = A×(N) of HCL×1000×50/Volume of water sample

Total Alkalinity (TA) = B×(N) of HCL×1000×50/Volume of water sample

Where, A = ml of HCL used with phenolphthalein (5 ml),

B = ml of HCL used with phenolphthalein and methyl orange (22 ml).

PA = 5×0.01×1000×50/100

= 25 mg/L

TA = (17+5)×0.01×1000×50/100

= 110 mg/L

- **Estimation of hardness: (**Roy, R., & Majumder, M., 2018)

❑ **Requirements:** Glass wares –

1. 100 ml conical flask
2. pipette

Reagent –

1. 0.01 (m) EDTA solution
2. Buffer Solution ($NH_4Cl.NH_4OH$ at pH 10)
3. EBT indicator (Eriochrome Black T)

❑ **Procedure:**

1. 100 ml of sample taken in a conical flask and added 1ml of buffer solution.
2. 1-2 pinch of EBT is added on the solution and the solution turn wine red.
3. The content was titrated against 0.01(m) EDTA solution.
4. At the end the colour changes from wine red to blue.
5. At last, the reading at the end point was taken.

❑ **Result: (Table 2: Estimation of Hardness in water)**

NAME OF THE SAMPLE	VOLUME OF EDTA USED IN TITRATION (ml)	MEAN VOLUME (ml)
WATER SAMPLE 1	20.5	
WATER SAMPLE 2	19.5	20.5
WATER SAMPLE 3	20	

❑ **Calculation:**

Total hardness = volume of EDTA requires for titration× 1000/Volume of sample

= 20.5×1000/100

= 205 mg/lit

Since,

a. Soft water: less than 50 mg/lit
b. Moderately soft water: 50-100 mg/lit
c. Slightly hard water: 100-150 mg/lit
d. Moderately Hard water:150-200 mg/lit
e. Hard water: 200-300 mg/lit
f. Very hard water: >300 mg/lit

Therefore, sample water is Hardwater (i.e 205 mg/lit).

Fig 15 & Fig 16: Determination of alkalinity in water sample

Fig 17 & Fig 18: Determination of hardness in water sample

- **Estimation of Nitrate: (**Lim, H. S. et al., 2022)

❑ **Requirements:** Reagent –

1. Phenoldysulphonic acid
2. Silver sulphate solution-dissolve 4.4 gm Ag_2So_4 in distilled water & dilute to 1000 ml.
3. Nitrate solution – dissolve 0.7218 gm anhydrous potassium nitrate (KNO_3) and diluted to 1000 ml with distilled water.
4. Liquid ammonia (NH_4OH), 30%

❑ **Procedure:**

1. Take 50 ml filtered water sample in a conical flask.
2. Add one pinch of silver sulphate solution to remove chlorides.
3. The solution was slightly heated & filtered to remove the precipitation of silver chloride.
4. The filtrate was evaporated to dryness.
5. After cooling 2 ml Phenoldysulphonic acid was added to dissolve the residue & diluted to 50 ml with distilled water.
6. 6 ml of liquid ammonia was added to develop a yellow colour. The reading was taken at 410 nm using spectrophotometer.
7. The concentration of nitrate was calculated from the standard curve.

Table 3: Data for Preparation of standard curve

Volume of standard solution taken	Volume of distilled water (ml)	Total volume (ml)	Concentration (ppm)
00	50	50	00
05	45	50	01
10	40	50	02
15	35	50	03
20	30	50	04
25	25	50	05

❑ **Result: (Table 4: Concentration vs Absorbance)**

Concentration (ppm)	Absorbance
1	0.21
2	0.42
3	0.59
4	0.82
5	1.02
unknown	0.72

So, the concentration of nitrate in sample water is 3.5 ppm.

Fig 19 & Fig 20: Determination of nitrate in water sample

Fig 21 & Fig 22: Determination of nitrate in water sample

- **Estimation of inorganic phosphate: (**Mihajlovic, R. P. et al., 2007)

❑ **Requirements:** Reagent –

1. Ammonia molybdate solution-dissolve 25.0 gm of ammonium molybdate in 175 ml of distilled water.
2. Stannous chloride solution-dissolve 2.5 gm of stannous chloride in 100 ml glycerol by heating on a water bath for rapid dissolution.
3. Standard phosphate solution-dissolve 4.388gm of dried anhydrous potassium hydrogen phosphate K_2HPO_4 in distilled water and make up the volume to 1liter.

❑ **Procedure:**

1. Take 50 ml of filtered cleared sample in a clean Conical flask. If the sample contains colour and colloidal impurities, they can remove by adding a spoonful of activated charcoal and then filtering the sample.
2. Add 2ml of ammonium molybdate followed by 5 drops of $SnCl_2$ solution.
3. A blue colour will appear. Take reading at 690 nm on a spectrophotometer using a distilled water blank with the same amount of the chemicals. Take the reading after 5 minutes but before 12 minutes of the addition of the last reagent.
4. Find out the concentration with the help of the standard curve.

Table 5: Data for Preparation of standard curve

[supplied stock 10 ppm]

Concentration of phosphate solution (ppm)	Volume of stock solution taken (ml)	Volume of distilled water taken (ml)	Final to be prepared (ml)	Absorbance
0	0	50	50	00
2	10	40	50	0.423
4	20	30	50	0.740
6	30	20	50	1.068
8	40	10	50	1.395
10	50	0	50	1.724

❑ **Result: (Table 6: Concentration vs Absorbance)**

Reading (absorbance) at 690 nm using spectrophotometer = 1.425

Concentration (ppm)	Absorbance
0	00
2	0.423
4	0.740
6	1.068
8	1.395
10	1.724
unknown	1.425

So, the concentration of phosphate in sample water is 8.2 ppm.

Fig 23 & Fig 24: Determination of phosphate in water sample

Fig 25 & Fig 26: Determination of phosphate in water sample

- **Measurement of pH: (**Orouji, A. et al., 2022)

❑ **Requirements:** Instrument and glassware –

1. Digital pH meter
2. Beaker-250 ml-3 pieces
3. Glass rod-1 pieces

Reagents –

1. Buffer solution- pH4,pH 10

❑ **Procedure:**

1. 30 ml of water sample is taken in 250 ml of conical flask, then taken for pH determination to the pH meter.
2. pH meter is calibrated with standard reference buffer of 4 and 10.

❑ **Result: (Table 7: Determination of pH)**

NAME OF THE SAMPLE	pH METER READING	MEAN VOLUME (ml)
WATER SAMPLE 1	9.6	
WATER SAMPLE 2	9.6	9.6
WATER SAMPLE 3	9.6	

So, the pH of the sample water is 9.6 (basic in nature).

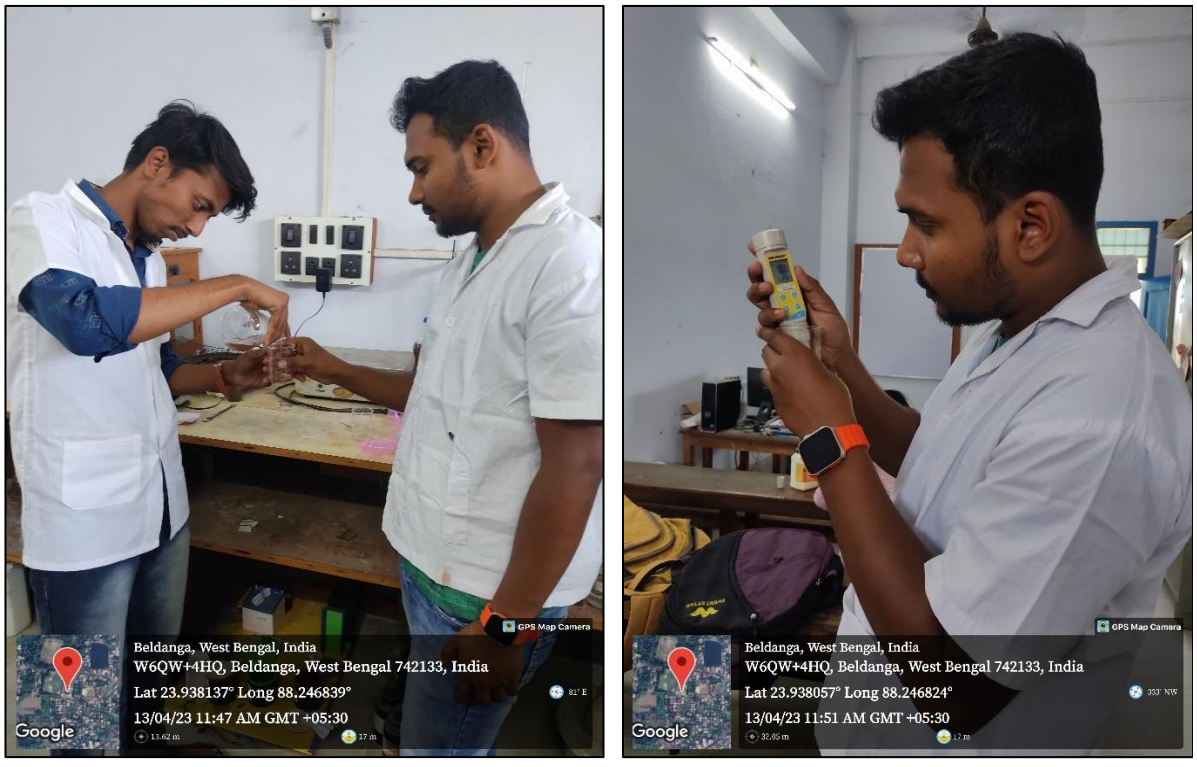

Fig 27 & Fig 28: Determination of pH in water sample

- **Measurement of Conductivity: (**Zhang, H. et al., 2022)

❑ **Requirements:** Instrument and glassware –

1. Digital pH-Conductivity meter
2. Beaker-250 ml-3 pieces

Reagents –

1. Buffer solution- pH4,pH 10

❑ **Procedure:**

1. 30 ml sample water is taken in a conical flask of 250 ml.
2. The sample is then used for detection of conductivity by a conductivity meter.
3. Usually, Conductivity meter measure at a temperature of 25° C.
4. The sample temperature is recorded at the time of conductivity measurement.

❑ **Result: (Table 8: Determination of conductivity)**

NAME OF THE SAMPLE	CONDUCTIVITY METER READING (µS/cm)	MEAN READING
WATER SAMPLE 1	4	
WATER SAMPLE 2	4	4
WATER SAMPLE 3	4	

So, the conductivity of the water sample is 4 µS/cm.

Fig 29 & Fig 30: Determination of Conductivity in water sample

Table 9: Reference table of water sample analysis

Sl.No.	Parameter	Method	Reference
1	Alkalinity	Titrimetric method	Face E.W, Bridgewater, L., & American public health association (Eds) (2012).
2	Hardness	EDTA method	Roy, R., & Majumder, M. (2018).
3	Nitrate	Spectrophotometric method	Lim, H. S., Choi, E., Lee, S. J., Nam, H. S., & Lee, J. K. (2022).
4	Inorganic phosphate	Spectrophotometric method	Mihajlovic, R. P., Kaljevic, V. M., Vukasinovic, M. P., Mihajlovic, L. V., & Pantic, I. D. (2007).
5	pH	pH meter	Orouji, A., Abbasi-Moayed, S., Ghasemi, F.,&Hormozi-Nezhad, M. R. (2022).
6	Conductivity	Conductivity meter	Zhang, H., Shang, C., & Tang, G. (2022).

❖ Soil Quality Analysis:

- **Estimation of inorganic phosphate: (**Das, P. et al., 2022)

❑ **Requirements:** Reagent –

1. Ammonia molybdate solution
2. Stannous chloride solution
3. Standard phosphate solution
4. Concentrated H_2SO_4
5. Perchloric acid

❑ **Procedure:**

1. 5 gm of sieve soil was taken in a 100 ml conical flask.
2. The soil was moisten with water to make a thin paste.
3. 2 ml of concentrated H_2SO_4 is added along the 1 ml of perchloric acid and heated on a hot plate until it was nearly dry.
4. The flask was cooled and 1 ml of perchloric acid was added.
5. The flask was again heated with constant rotation. The flask is cooled and 2 ml of 1.8(N) H_2SO_4 was added and boil slowly for few minutes.
6. After cooling it is filtered through filter paper and the volume is made upto 250 ml with distilled water.

The the PO_4^{3-} is estimated by the following procedure:

a. 50 ml of solution is taken in a conical flask.
b. 2 ml of ammonium molybdate is added.
c. 5 drops of $SnCl_2$ solution were added to the solution until blue colour appear.
d. The absorption of the sample is measured at 690 nm by spectrophotometer to calculate the concentration of phosphate.

Table 10: Data for Preparation of standard curve

[supplied stock 10 ppm]

Concentration of phosphate solution (ppm)	Volume of stock solution taken (ml)	Volume of distilled water taken (ml)	Final to be prepared (ml)	Absorbance
0.5	2.5	47.5	50	0.176
1.0	5	45	50	0.259
1.5	7.5	42.5	50	0.342
2.0	10	40	50	0.423
2.5	12.5	37.5	50	0.504
3.0	15	35	50	0.584

❑ **Result:**

Reading (absorbance) at 690 nm using spectrophotometer = 0.546

So, the concentration of phosphate in soil sample is 2.5 ppm.

Fig 31 & Fig 32: Determination of phosphate in soil sample

Fig 33 & Fig 34: Determination of phosphate in soil sample

- **Estimation of Nitrate: (**Su, R. et al., 2022)

❑ **Requirements:** Reagent –

1. Phenoldysulphonic acid
2. Silver sulphate solution-dissolve 4.4 gm Ag_2So_4 in distilled water & dilute to 1000 ml.
3. Nitrate solution – dissolve 0.7218 gm anhydrous potassium nitrate (KNO_3) and diluted to 1000 ml with distilled water.
4. Liquid ammonia (NH_4OH), 30%

❑ **Procedure:**

1. Take 50 ml filtered sample in a conical flask.
2. Add one pinch of silver sulphate solution to remove chlorides.
3. The solution was slightly heated & filtered to remove the precipitation of silver chloride.
4. The filtrate was evaporated to dryness.
5. After cooling 2 ml Phenoldysulphonic acid was added to dissolve the residue & diluted to 50 ml with distilled water.
6. 6 ml of liquid ammonia was added to develop a yellow colour. The reading was taken at 410 nm using spectrophotometer.
7. The concentration of nitrate was calculated from the standard curve.

Table 11: Data for Preparation of standard curve

[supplied stock 10 ppm]

Volume of standard solution taken	Volume of distilled water (ml)	Total volume (ml)	Concentration (ppm)
00	50	50	00
05	45	50	01
10	40	50	02
15	35	50	03
20	30	50	04
25	25	50	05

❑ **Result: (Table 12: Concentration vs Absorbance)**

Concentration (ppm)	Absorbance
1	0.21
2	0.42
3	0.59
4	0.82
5	1.02
unknown	0.46

So, the concentration of nitrate in soil sample is 2.3 ppm.

Fig 35 & Fig 36: Determination of nitrate in soil sample

Fig 37 & Fig 38: Determination of nitrate in soil sample

- **Measurement of pH: (**Orouji, A. et al., 2022)

❑ **Requirements:** Instrument and glassware –

1. Digital pH meter
2. Beaker-250ml-3 pieces
3. Soil sample

Reagents –

1. Buffer solution- pH4,pH 10

❑ **Procedure:**

1. 5 gm of soil is taken in a 250 ml conical flask and then 25 ml distilled water is added.
2. The mixture was shaken thoroughly for 10-15 minutes and filtered.
3. Finally, the filtrate was taken for pH determination to the pH meter.
4. pH meter was calibrated with standard reference pH buffer 4 to 10.

Result: (Table 13: Determination of pH in soil sample)

NAME OF THE SAMPLE	pH METER READING	MEAN VOLUME
SAMPLE 1	9.1	
SAMPLE 2	9.1	9.1
SAMPLE 3	9.1	

So, the pH of the sample water is 9.1 (basic in nature).

Fig 39 & Fig 40: measurement of pH in soil sample

- **Measurement of Conductivity: (**Du, Y. et al., 2022)

❑ **Requirements:** Instrument and glassware –

1. Digital pH- Conductivity meter
2. Beaker-250ml-3 pieces
3. Soil sample

Reagents –

1. Buffer solution- pH4,pH 10

❑ **Procedure:**

1. 5 gm of soil is taken in a 250 ml conical flask and then 25 ml distilled water is added.
2. The mixture was shaken thoroughly for 10-15 minutes and filtered.
3. Finally, the filtrate was taken for conductivity determination to the conductivity meter.
4. Usually, conductivity meter refers to the temperature of 25°C.
5. Soil sample suspension temperature was recorded at a time of conductivity.

❑ **Result: (Table 14: Determination of conductivity in soil sample)**

NAME OF THE SAMPLE	CONDUCTIVITY METER READING (µS/cm)	MEAN READING
SAMPLE 1	209	
SAMPLE 2	211	209
SAMPLE 3	210	

So, the conductivity of the soil sample is 209 µS/cm.

Fig 41 & Fig 42: measurement of conductivity in soil sample

- **Determination of Organic Carbon in soil: (**Shamrikova, E. V. et al., 2022)

❑ **Requirements:** Reagents –

1. Potassium dichromate 1(N)
2. Concentrated sulphuric acid
3. Concentrated phosphoric acid
4. Ferrous ammonium sulphate 0.4 (N) [$Fe(NH_4)_2(So_4)_2.6H_2O$] or ammonium Iron sulphate
5. Diphenylamine (DPA) indicator

❑ **Procedure:**

1. Take oven dried soil sample and pass through 5mm non-ferrous screen.
2. Weight a suitable quantity of soil (0.5gm) and transformed to a dry 500 ml conical flask.
3. Add 10 ml of 1(N) potassium dichromate solution and 20 ml sulphuric acid and mix by gentle shaking.
4. Keep the flask for reaction mixture for about 30 min.
5. After the reaction is over dilute the content with 200 ml distilled water and 10 ml phosphoric acid followed by 1ml diphenylamine indicator.
6. Titrate the sample with 0.4 (N) ferrous ammonium sulphate (FAS). At the endpoint colour change to brilliant green.
7. A reagent blank was prepared.

❑ **Result:**

% of carbon = (3.951/g)×[1-(T/S)]
% of organic matter = % C×1.724

Where, T = ml of ferrous ammonium sulphate solution in sample, S = ml of ferrous ammonium sulphate in blank, g = weight of sample

% Carbon = (3.951/0.5)×[1-(25.2/27.3)]

= 0.608

% Organic matter = 0.608×1.724

= 1.048

Table 15: Classification of soil

Organic carbon (%)	Soil class
4-6	A
2-4	B
<2	C

So, soil class of the sample soil is “C”.

Fig 43 & Fig 44: Determination of Organic Carbon in soil sample

Fig 45 & Fig 46: Determination of Organic Carbon in soil sample

Table 16: Reference table of soil sample analysis

Sl.No.	Parameter	Method	Reference
1	Nitrate	Spectrophotometric method	Su, R., Wu, J., Hu, J., Ma, L., Ahmed, S., Zhang, Y., ... & Wei, W. (2022)
2	Inorganic phosphate	Spectrophotometric method	Das, P., Chetry, B., Paul, S., Bhattacharya, S. S., & Nath, P. (2022).
3	pH	pH meter	Orouji, A., Abbasi-Moayed, S., Ghasemi, F., &Hormozi-Nezhad, M. R. (2022).
4	Conductivity	Conductivity meter	Du, Y., Li, R., Wu, T., Yang, C., Zhao, L., Hu, G., ... & Qiao, Y. (2022).
5	Organic carbon	Titrimetric method	Shamrikova, E. V., Vanchikova, E. V., Kondratenok, B. M., Lapteva, E. M., & Kostrova, S. N. (2022).

4.3 Result and Discussion:

⇨ **Water Quality Parameters:**

Table 17: Result of water sample

Parameters	Value	Permissible limit (According to BIS)
Alkalinity	110 mg/l	200 mg/l
Hardness	205 mg/l	200 mg/l
Nitrate content	3.5 ppm	10 ppm
Phosphate content	8.2 ppm	1.0 ppm
pH	9.6	6.5-8.5
Conductivity	4 µS/cm	2500 µS/cm

⇨ **Soil Quality Parameters:**

Table 18: Result of soil sample

Parameters	Value	Permissible limit (According to BIS)
Nitrate content	2.3 ppm	5-10 ppm
Phosphate content	2.5 ppm	25-50 ppm
pH	9.1	3.5-10
Conductivity	209 µS/cm	110-570 µS/cm
Organic carbon content	1.048 %	0.7-4 %

❖ **Impact on Human Health and Environment:**

The water sample collected from the R.L. Hair Exports factory showed alkalinity levels within permissible limits for drinking water as prescribed by the Bureau of Indian Standards (BIS) (BIS, 2012). However, the hardness levels were found to be higher than the permissible limit, indicating the presence of calcium and magnesium ions. The high alkalinity and hardness levels of water sample can lead to scaling in pipes and can make it difficult to use the water for domestic purposes (Gautam et al., 2019). High levels of hardness in water can cause scaling in pipes, boilers, and other equipment (WHO, 2011). Nitrate levels in the water sample were also found to be higher than the permissible limit, which may be due to the discharge of untreated wastewater into nearby water bodies (CPCB, 2010). High nitrate levels in drinking water can cause serious health problems, especially in infants and pregnant women (WHO, 2011). The pH and conductivity levels of the water sample were within the permissible limits for drinking water as prescribed by BIS. The high conductivity level in water sample may indicate the presence of dissolved salts, which can be harmful to plants and aquatic life (APHA et al., 2017).

The soil sample collected from the R.L. Hair Exports factory showed nitrate levels within the permissible limits for agricultural soil as prescribed by the Indian Council of Agricultural Research (ICAR) (ICAR, 2013). High organic carbon content in soil can increase the water holding capacity of soil and promote plant growth (Scheer and Grace, 2019). The pH and

conductivity levels of the soil sample were also within the permissible limits for agricultural soil as prescribed by ICAR. The organic carbon content of the soil sample was found to be higher than the acceptable limits, which can impact soil health and fertility (NRC, 2000). The high conductivity level of soil sample may indicate the presence of excessive salts, which can impact plant growth (Sivakumar and Das, 2014).

The results of the water and soil samples taken from the vicinity of the R.L. Hair Exports factory showed some concerning parameters. The high alkalinity and hardness in the water sample can cause skin irritation and dryness. Additionally, the high nitrate content in the water can cause methemoglobinemia, commonly known as blue baby syndrome, which can be fatal for infants (Devi et al., 2015). The soil sample showed a high organic carbon content, which can cause water pollution if not managed properly. The high conductivity of both water and soil samples indicates the presence of dissolved ions, which can affect the soil structure and nutrient availability for plants (Aslam et al., 2021). The use of chemical substances in the washing and straightening process can lead to water pollution and contamination of aquatic life (Khaydarov et al., 2020The disposal of solid waste without proper treatment can also lead to the spread of diseases through insects and rodents (Karak and Bhattacharyya, 2011). The high pH of both samples can be harmful to aquatic life and can impact the solubility of nutrients (Baker, 2006).

The results obtained from the study showed the presence of high alkalinity (110 mg/lit), hardness (205 mg/lit), and pH (9.6) in the water sample. The high concentration of these parameters can be attributed to various anthropogenic activities such as the discharge of industrial effluents and sewage into the water bodies. These high levels of alkalinity, hardness, and pH can cause health problems such as gastrointestinal disorders, skin irritation, and hair loss in humans who consume this water (Kumar et al., 2016). The soil sample, on the other hand, showed a high concentration of organic carbon (1.048%) and conductivity (209 μS/cm) with a slightly basic pH of 9.1. The presence of high organic carbon in soil indicates a high level of soil fertility. The slightly basic pH indicates that the soil is mildly alkaline, which can affect plant growth and nutrient availability (Kumar et al., 2016). The high nitrate content (3.5 ppm) in the water sample can be attributed to agricultural activities such as the use of chemical fertilizers.

Based on the results obtained, it can be concluded that the phosphate content in water is above the permissible limit of 1 ppm according to the Bureau of Indian Standards (BIS), which indicates high levels of contamination. According to the study conducted by Krishnamurthy et al. (2017), excessive phosphate levels in water can have severe environmental impacts, including the degradation of aquatic ecosystems, depletion of oxygen levels, and the promotion of the growth of harmful algae. The consumption of contaminated water and crops grown in contaminated soil can lead to various health issues such as skin irritation, gastrointestinal disorders, and even cancer (Kumar et al., 2016).

Therefore, Proper treatment of industrial effluents and sewage before discharge can reduce the levels of these parameters, which can, in turn, reduce the adverse effects on the environment and human health.

CONCLUSION

The study was conducted to investigate the environmental impact of R.L. Hair Exports's hair processing factory. The factory produces hair extensions and wigs using human hair collected from various districts in the state. The processing steps include washing, drying, straightening, styling, wefting, and packaging, which generate various types of waste, including solid waste, liquid waste, and plastic waste. The solid waste generated during the processing steps was found to be disposed of without any treatment, causing environmental pollution. Liquid waste and plastic waste were found to be disposed of improperly, causing water pollution and contributing to the plastic waste problem (Dasgupta P., Roy S., & Chatterjee S., 2021).

The study also analyzed the water and soil quality parameters in the vicinity of the factory. The water sample had alkalinity of 110 mg/lit, hardness of 205 mg/lit, nitrate content of 3.5 ppm, pH of 9.6, and conductivity of 4 µS/cm. The soil sample had a nitrate content of 2.3 ppm, organic carbon content of 1.048%, pH of 9.1, and conductivity of 209 µS/cm. These parameters indicate the presence of pollutants in the environment that can have negative impacts on human health and the environment.

From an economic perspective, the factory contributes to the state's economy by generating revenue and providing employment opportunities to around 30 employees. There are 9 female employees working in the factory, hence there is no wage discrimination among them. The factory also contributes to the country's export earnings by exporting its products to various countries.

In conclusion, the study reveals that the hair processing factory has negative environmental and human health impacts due to the improper disposal of waste and pollution generated during the processing steps. However, the factory also contributes to the state and country's economy. To mitigate the negative impacts, the factory should adopt proper waste management practices, including treatment and disposal, to reduce environmental pollution. The government should also impose strict regulations and monitoring to ensure that industries operate in an environmentally sustainable manner.

RECOMMENDATION

Based on the findings of this study, the following recommendations are suggested for the factory to improve its environmental health and achieve sustainable development:

1. **Reduce water usage:**

The factory can implement various methods to reduce water usage such as optimizing the usage of water for washing and dyeing, repairing leakages, and installing low-flow faucets and toilets. This will not only reduce the amount of water used but also minimize the amount of water discharged as wastewater.

The factory can also invest in recycling and reusing water within the manufacturing process, such as implementing a closed-loop water system that recycles and reuses water. The use of rainwater harvesting techniques can also help to supplement the water supply.

By reducing water usage, the factory can minimize its impact on the environment by reducing the amount of water it draws from natural sources, reducing the energy consumption required to treat and transport water, and minimizing the amount of wastewater generated by the factory. Additionally, this can help the factory to save money on water bills and improve its bottom line.

2. **Proper disposal of waste:**

Proper disposal of waste refers to the safe and environmentally responsible handling of waste materials. It is crucial to dispose of waste properly to prevent environmental pollution, human health hazards, and promote sustainable development. The process of proper waste disposal involves collection, transportation, and disposal or treatment of waste materials in a way that does not harm the environment.

One of the most important steps in proper waste disposal is segregation. Segregating waste into different categories like biodegradable, non-biodegradable, recyclable, and hazardous waste helps in proper disposal and management. Biodegradable waste like food waste, garden waste, and animal waste can be composted or used for energy generation. Non-biodegradable waste like plastic and glass should be recycled or disposed of in landfills.

3. **Use of renewable energy:**

The use of renewable energy sources is crucial in achieving sustainable development and reducing the negative impact of industrial processes on the environment. The factory can explore the possibility of installing renewable energy systems such as solar panels to generate electricity. This will not only reduce the dependence on non-renewable sources but also lower the carbon footprint of the factory.

Additionally, the factory can consider investing in energy-efficient technologies, such as LED lighting and energy-efficient machinery, which can significantly reduce energy consumption and costs. By adopting these technologies, the factory can save money on energy bills while also reducing their environmental impact.

It is also important to note that investing in renewable energy and energy-efficient technologies can attract environmentally conscious consumers and investors who are keen on sustainable practices. This will not only enhance the factory's reputation but also increase their profitability in the long run.

4. **Implementation of environmental management systems**:

The factory should adopt environmental management systems, such as ISO 14001. Environmental Management Systems (EMS) are frameworks that organizations use to manage and continuously improve their environmental performance. The implementation of EMS involves the development and implementation of policies, procedures, and practices aimed at reducing the negative impact of an organization's activities on the environment.

5. Use of biodegradable products for packaging:

Biodegradable products for packaging refer to materials that can be broken down naturally by microorganisms in the environment, such as bacteria, fungi, and other living organisms. These products are designed to decompose over time and return to the earth, leaving behind little to no harmful residue.

The use of biodegradable products for packaging can have several benefits for the environment. First, they can help reduce the amount of waste. This is because they break down into natural elements that do not harm the environment, unlike non-biodegradable materials such as plastic, which can take hundreds of years to decompose.

Secondly, biodegradable products for packaging can help reduce greenhouse gas emissions. When non-biodegradable materials such as plastic are burned or left in landfills, they release harmful chemicals and gases into the atmosphere. By using biodegradable products, we can help reduce the amount of these harmful emissions.

6. Collaboration with local communities:

The factory should collaborate with local communities to identify and address any environmental concerns and work together towards achieving sustainable development. Furthermore, the factory can work with local communities to develop sustainable livelihood programs. Such programs will not only benefit the local community but also help to promote sustainable development.

PHOTO GALLERY

Fig 47

Fig 48

Fig 49

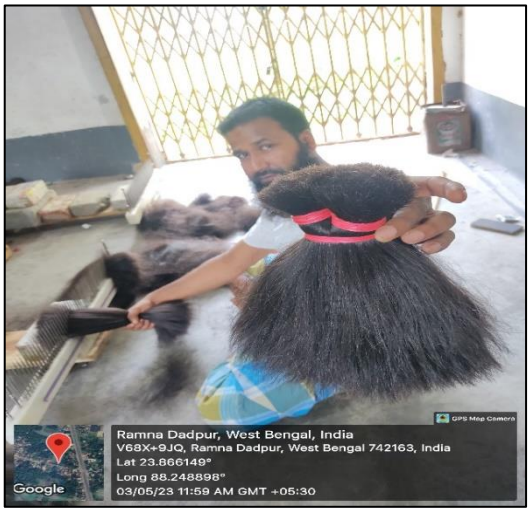

Fig 50

Fig 51

Fig 52

REFERENCES

1. Chatterjee, S. (2019*).* Hair Industry, the shining glory of India's economy. *Business Insider India.*
2. Darien, J. (2021) 'Global Hair Care Market Size, Share & Trends Analysis Report by Product, by Application, by Distribution Channel, by Region, and Segment Forecasts, 2021-2028', *Grand View Research*.
3. Statista. (2021). *Global hair care market size from 2012 to 2025*.
4. Mason, C. (2018). *The Changing Landscape of the Hair Industry*. Professional Beauty, (15), 34–38.
5. Bhardwaj, P. and Pal, A.K. (2020) 'Indian Hair Industry - Growth, Trends, and Forecast (2020 - 2025)', *Mordor Intelligence*.
6. Indian Chamber of Commerce, 2020. Annual Report 2020-21.
7. Choudhury, B. (2019). Hair trade in West Bengal: An overview. *Indian Journal of Traditional Knowledge,* 18(1), 60-64.
8. Mukherjee, J., & Mukherjee, J. (2020). *Disrupted Networks*. Blue Infrastructures: Natural History, Political Ecology and Urban Development in Kolkata*,* 125-150.
9. Roy, S., Karmakar, S., & Naskar, S. (2019). Carbon footprint of the hair processing industry in West Bengal, India*.* *Journal of Cleaner Production*, 235, 248-257.
10. Shah, S., Mukherjee, A., & Sabri, B. (2021). Environmental impact assessment of the hair processing industry in India*.* *Environmental Science and Pollution Research*, 28(10), 11894-11908.
11. Choudhary, A., Sharma, N., & Choudhary, P. (2020). Environmental impact of hair processing and export in India*.* *International Journal of Environmental Science and Technology,* 17(4), 2285-2294.
12. Bhattacharjee, A., Sarmah, A., & Gogoi, P. (2019). Hair export industry in India: an environmental perspective. *Journal of Cleaner Production*, 208, 579-586.
13. Singh, J., Kumar, V., Singh, S. P., & Dhaka, R. S. (2018). Hair waste generated by the hair industry in India: a sustainable resource for bio-composite production. *Journal of Cleaner Production,* 183, 39-46.
14. Bielesch, A. R., Fong, B., & Gleason, T. (2020). Waste management in the hair industry: An exploration of sustainable solutions. *Journal of Cleaner Production,* 246, 119020.
15. Leow, J., & Tan, R. B. (2021). Life cycle assessment of hair extensions: Environmental impact and improvement options*.* *Journal of Cleaner Production*, 288, 125685.
16. Okeme, I. O., & Olujimi, A. S. (2019). Environmental challenges of the hair industry in Nigeria. *Environmental Quality Management,* 29(4), 79-90.
17. Fang, Y., Cai, Y., Li, Y., & Li, S. (2018). Review on environmental impacts of hair processing and dyeing. *Journal of Cleaner Production,* 177, 424-436.
18. Branco, M. D. S. G., de Almeida, F. C. L., & Coltro, L. (2020). Sustainable solutions for waste management in the Brazilian hair industry. *Journal of Cleaner Production,* 253, 119998.
19. Kim, H., Nam, T., & Hong, H. (2017). Environmental impact assessment of wig products considering the entire product life cycle. *Sustainability,* 9(7), 1212.
20. Bhushan, S., & Rai, K. N. (2015). Sorting and grading of human hair: a review. *Journal of Textile and Apparel, Technology and Management,* 9(2), 1-16.

21. Lim, S. J., Lee, H. S., & Lee, S. H. (2018). Drying Kinetics and Quality Characteristics of Wet Processed Human Hair under Different Drying Methods. *Journal of Fiber Bioengineering and Informatics,* 11(3), 63-72.
22. Tosti, A., & Piraccini, B. M. (2018). Straightening and styling the hair: an overview. *Journal of the American Academy of Dermatology,* 78(6), S129-S133.
23. World Bank. (2018). *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Washington, DC: World Bank.
24. Government of India. (2016). Solid Waste Management Rules. Ministry of Environment, Forest and Climate Change.
25. India's Export of Human Hair Witnesses Significant Growth: Report." The Economic Times, 17 Dec. 2018.
26. "Corporate Social Responsibility (CSR)." Ministry of Corporate Affairs, Government of India, 2022.
27. "Taxation in India." Invest India, 2022.
28. Bureau of Indian Standards. (2012). Drinking water - specifications (second revision). New Delhi: BIS.
29. Face E. W, Bridgewater, L., & American Public Health Association (Eds) (2012) Standard methods for the examination of water and wastewater (Vol.10) Washington, DC: American public health association.
30. Roy, R., & Majumder, M. (2018). A quick prediction of hardness from water quality parameters by artificial neural network. International Journal of Environment and Sustainable Development, 17(2-3), 247-257.
31. Lim, H. S., Choi, E., Lee, S. J., Nam, H. S., & Lee, J. K. (2022). Improved spectrophotometric method for nitrite determination in processed foods and dietary exposure assessment for Korean children and adolescents. Food Chemistry, 367, 130628.
32. Mihajlovic, R. P., Kaljevic, V. M., Vukasinovic, M. P., Mihajlovic, L. V., & Pantic, I. D. (2007). Spectrophotometric method for the determination of phosphorus in natural waters using the bismuthphosphomolybdate complex. Water Sa, 33(4), 513-517.
33. Orouji, A., Abbasi-Moayed, S., Ghasemi, F., & Hormozi-Nezhad, M. R. (2022). A wide-range pH indicator based on colorimetric patterns of gold@ silver nanorods. Sensors and Actuators B: Chemical, 358, 131479.
34. Zhang, H., Shang, C., & Tang, G. (2022). Measurement and identification of temperature-dependent thermal conductivity for thermal insulation materials under large temperature difference. *International Journal of Thermal Sciences*, *171*, 107261.
35. Su, R., Wu, J., Hu, J., Ma, L., Ahmed, S., Zhang, Y., ... & Wei, W. (2022). Minimalizing Non-point Source Pollution Using a Cooperative Ion-Selective Electrode System for Estimating Nitrate Nitrogen in Soil. *Frontiers in Plant Science*, *12*, 810214.
36. Das, P., Chetry, B., Paul, S., Bhattacharya, S. S., & Nath, P. (2022). Detection and quantification of phosphate in water and soil using a smartphone. *Microchemical Journal*, *172*, 106949.
37. Du, Y., Li, R., Wu, T., Yang, C., Zhao, L., Hu, G., ... & Qiao, Y. (2022). A new model for predicting soil thermal conductivity for dry soils. *International Journal of Thermal Sciences*, *176*, 107487.

38. Shamrikova, E. V., Vanchikova, E. V., Kondratenok, B. M., Lapteva, E. M., & Kostrova, S. N. (2022). Problems and Limitations of the Dichromatometric Method for Measuring Soil Organic Matter Content: A Review. *Eurasian Soil Science*, *55*(7), 861-867.
39. Gautam, S. K., Tyagi, V. K., Yadav, A. K., Kumar, R., and Singh, P. (2019). *Drinking water quality assessment using water quality index and GIS in an industrial area of Delhi, India.* Applied Water Science, 9(6), 137.
40. World Health Organization (WHO). (2011). Nitrate and nitrite in drinking-water. Background document for development of WHO Guidelines for Drinking-water Quality. WHO.
41. Central Pollution Control Board. (2010). Water quality status of major rivers in India. New Delhi: CPCB.
42. American Public Health Association (APHA), American Water Works Association (AWWA), Water Environment Federation (WEF). (2017). Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF.
43. Indian Council of Agricultural Research. (2013). Fertilizer recommendation guide. New Delhi: ICAR.
44. Scheer, C. and Grace, P.R. (2019). *Soil organic carbon: a key component for sustainability in tropical agroecosystems. In: Sustainable Agriculture Reviews (pp. 161-198)*. Springer, Cham.
45. National Research Council (NRC). (2000). Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution. The National Academies Press.
46. Sivakumar, M., and Das, B. S. (2014). Soil salinity management in agriculture: Technological advances and applications. *Springer*.
47. Devi, N. L., Yadav, K., & Yadav, D. K. (2015). Assessment of groundwater quality parameters: a review. *International Journal of Scientific Research*, 4(5), 293-295.
48. Aslam, M. A., Shoaib, A., & Bibi, I. (2021). *Impact of salinity on soil and crop productivity.* Springer Nature.
49. Khaydarov, R. A., Khaydarov, R. R., & Ozkan, A. (2020*). Environmental impact of industrial pollutants.* CRC Press.
50. Karak, T., & Bhattacharyya, P. (2011). *Municipal solid waste generation, composition, and management: The world scenario.* Critical reviews in environmental science and technology, 41(13), 1087-1156.
51. Baker, L. A. (2006). *pH and aquatic life*. Wisconsin Department of Natural Resources.
52. Kumar, A., Biswas, A. K., & Bandyopadhyay, M. (2016). *Impact of sewage on groundwater quality in an urbanized region of the Gangetic plain.* Environmental monitoring and assessment, 188(3), 146..
53. Krishnamurthy, R.R., Srinivasalu, S., Manjula, G., Jairam, K., & Nagarajan, R. (2017). Phosphorus sources and their impact on environment. *International Journal of Engineering Research and Applications,* 7(1), 43-49.
54. Dasgupta, P., Roy, S., & Chatterjee, S. (2021). Environmental impacts of plastic waste in India: A review. *Journal of Hazardous Materials*, 402, 123820.

THANK YOU