Industrial sector led best practices for climate change mitigation in Punjab, Pakistan

Thesis submitted

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THESIS ACCEPTANCE CERTIFICATE

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ABSTRACT

Throughout the mid-20th century, government and industry have contributed to transforming the way industry interacts with the environment. Climate change has emerged as one of the biggest challenges in the world. There is a call to mitigate climate change risks by limiting carbon emissions and adopting environmentally friendly practices. This study identifies role model corporations that integrate environmental protection measures into their operations. It also explores the specific strategies /practices adopted by such corporations. It investigates sensitizing other businesses in Pakistan by sharing the information collected through the best practices of corporations. The study concludes by providing suggestions for refining strategies and policies based on the research results. A critical in-depth review of international studies was conducted. The review of international practices of cement, textile, chemical, leather, and paper and pulp industry helped in designing localized questionnaires for Pakistani industries. A case study approach was used, and industries from the oil, chemical, and clothes sector were chosen. These industries were interviewed based on selected indicators. Based on the analysis, the study proposed guidelines and recommendations for Pakistani industries to adopt environmentally friendly and climate change mitigation measures for sustainable development and cleaner production.

DECLARATION

I hereby declare that this research is purely the product of my own arduous work and has not been published anywhere else before in any format. The findings from other papers used in the text are properly referred to and acknowledged.

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SACHAL KHAN

DEDICATION

This project is dedicated to my beloved parents, who have been a source of inspiration and support. I also dedicate this project to my siblings and friends, who have always helped and encouraged me during this whole time. This project is also dedicated to the people of Pakistan for whom this initiative has been taken.

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Chapter 1

1 INTRODUCTION

According to U.N.F.C.C.C. (1992), climate change means "a change of climate", attributed directly to human activity. That alerts the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable periods."

1.1 Industrialization and climate change

When we talk about Natural greenhouse effect with the enhanced greenhouse effect, Natural levels of greenhouse gases in the atmosphere are essential for life on earth. Since the industrial revolution, GHG emissions have increased, carbon dioxide (CO2), causing an enhanced greenhouse effect. The enhanced greenhouse effect by us has led to global warming (climate change).

Global warming gradually increased because of greenhouse gasses. It can be identified these gases like carbon dioxide (CO2), methane (CH4), nitrous oxide(N2O), Hydro fluorocarbons (HFCs), per fluorocarbons (P.F.C.s), Sulphur hexafluoride (SF6) and water vapor. As we know, the greenhouse effect is natural. However, human activities like industrialization lead to global warming and attendant anomalies in local temperature, humidity, wind speed, precipitation, soil moisture, and sea level. Different studies reveal that the oceans have a high contribution to controlling greenhouse gas concentration because the ocean has a storehouse of carbon dioxide, and it controls the movement of this gas to and from the atmosphere. That means the ocean represents a large reservoir for CO2 because it covers 70% of the earth's surface.

However, that natural event becomes an environmental problem because of human activities. Natural fluxes of CO2 through the atmosphere and anthropogenic activities like fossil fuel burning and deforestation are also released CO2 into the atmosphere. The industrial revolution had played a significant role in emitting greenhouse gases in the past two centuries because human activities led to the use of machines and the mechanization of processes, which were erstwhile performed by hand. So, technological innovations, rapid transportation of economies, territorial expansions, unprecedented population growth, emergency of urban

areas, and transformation of the global science system are leading to the beginning of the industrial revolution.

Since the industrial revolution, humans have migrated to the urban areas, and as a side effect, population growth enlarges around urban areas. Because of that, agricultural, industrial practices, and the pumping of greenhouse gases into the atmosphere tremendously increase. As a side effect, deforestation rises due to land use for agriculture and urban areas, fossil fuel burning rise to accomplish energy requirements.

Throughout the mid-20th century, government and industry have helped transform the way industry interacts with the environment The focus of this industry transformation is environmental protection from business activities by promoting clean production techniques.

What is cleaner production?

"The continuous application of an integrated preventative environmental strategy applied to processes, products, and services to increase economic efficiency and mitigate the hazardous effects on general public and the environment" Principles of cleaner production, which are in practice, are waste minimization, minimize pollution and increase economic efficiency. These objectives can be achieved by the well know strategy "four R's": ***reduce, reuse, recycle and reformulate.***

In the past decade, several initiatives have been taken in industry to treat energy issues, wastewater and recycling the products at source and efforts are undertaken to elevate the awareness of cleaner production. It is assumed that cleaner production is the best strategy for sustainable production. Cleaner production aims to minimize the effect of production on the environment. Sustainable and Cleaner Production in the Manufacturing Industries of Pakistan.

Most of studies have estimated the cost of these environmental damages (World Bank, 2006) and concluded that environment-related transience and disease which indicate as high as 9 % of Gross domestic product (GDP) and major contribution to GHG emissions by industries. Most industries do not take place the environmental and health damages while executing production activities, in result growth of these industries is overestimated. Industrial Real contribution to GDP depends upon emission produced by their economic activities.

Sustainable development demands clean technology to minimize the contribution of industrial pollution to air, water and toxic waste. By adopting cleaner production

technologies, firms produced goods according to IS014001 certification and play vital role to encourage international competition.

Industrial pollution affects the water quality; Pakistan does not make substantial improvements in water quality and conservation. Thus, major changes are required, since treatment facilities are inadequate. Despite, since 1983 “federal environmental regulation”, in 1997 an important development of regulatory authorities made, then explanation of regulatory powers was made in 2005 but there are still significant gaps in industrial environmental. It is indispensable that prevailing standards need to be revised to make them more convincing and achievable under current situations in Pakistan (Larsen B. and Strukova E., 2011and World Bank, 2008). Cleaner production centers apply an integrated environmental policy to products, services, and processes to enhance the efficiency of business activities and decrease the risk to human life and environmental damage.

1.2 Problem statement

The economy and the environment are two sides of a coin, and both require attention. Industrial technologies and solutions define the state of the environment and worth of product produced. The bigger the industry, the more waste and pollution is generated. The impact on the environment will be larger as well. Industrial activities are foremost sources of air, water, and land pollution. Like these industries

- Chemical industries are most dangerous to health and environmental quality. In the past decade, the chemical industry has caused serious accidents and incidents within the industry and to the population where it is located.
- The textile industry played a significant role since the industrial revolution started and became a famous source of income in low-cost nations. Textile industry is major water consuming sector of economy and threaten the environment in form of contaminated water, but it is also a largest contributing sector for developing nations
- Cement industry is one of the polluted industries of the world and has extraordinarily strong negative impacts on human health and environmental quality. Cement industry is causing environmental damage by their greenhouse gas emissions; such as SO2, NOx, CO2, and CO.

Without a doubt, Industrialization is a central pillar of the development of economy of any country, but this is also a fact that rapid industrial growth has made water, air and hazardous waste pressing environmental problem in many areas of the developing world. Industrial

emissions combined with vehicle exhausts caused extensive air pollution, while concentrations of heavy metals and ammonia loads are often high enough to cause major threat to life down-river from industrial areas. The lack of hazardous waste facilities compounds the problem, with industrial wastes often discarded on fallow or public lands

The rise of industrialization would raise the pollution of industrial waste, toxic goods, and heavy metals, destroying the efficiency of the atmosphere in tandem with greenhouse gases and growing the energy consumption.

1.3 Objectives

To tackle the issues of climate change in Pakistan and best industrial practices for environment protection, research was carried out. The Objectives of this study are

- To review international practices adopted by various industries for climate change mitigation.
- To identify best practices adopted by local industries for environmental protection and climate change mitigation.
- To prepare general guidelines for climate change mitigation for local industries
- To provide suggestions and recommendations for industry policy keeping in view the research results

1.4 Rationale of Study

Such type of study has not been conducted in context of Pakistan. Internationally, there is much research on industrial climate change mitigation but specifically its impacts on industries growth have not been studied. So, this research is useful in our country, Scenario, where it is a new initiative.

1.5 Organization of Thesis

This Research thesis is consisting of following parts:

Chapter 1 is the introduction of thesis. This chapter provides an idea about the research, areas Which are covered in this research and a general view about all chapters and their structure? This Chapter defines the statement of problem, Research Objections and Linkage of research with Sustainable Development Principles etc.

Chapter 2is literature review that covers the past research which have done on this topic Nationally and internationally, this chapter link research topic with previous research by finding research gap.

Chapter 3 defines the overall methodology and procedure step by step adopted for the execution of this study. A general to specific approach is adopted to complete the study. This chapter describes all the procedures from selection of the topic till suggestion of recommendations and compilation of the thesis document.

Chapter 4 is simple results or derived from collected data in form of different case studies of industry, interviews, figures, lesson learnt etc. This Chapter also consists of detailed discussions of results.

Chapter 5is about general guideline for awareness, through the information collected from best practices of industry

Chapter 6is Conclusion and recommendations which is based upon results and discussions. Conclusion summarizes the results and policy Recommendations are based on results.

Chapter 2

2 LITERATURE REVIEW

2.1 What is cleaner production?

Throughout the mid-20th century, government and industry have helped transform the way industry interacts with the environment. The focus of this industry transformation is environmental protection from business activities by promoting clean production techniques (Cairncross et al., F, 1991). Concept of "Cleaner Production" devised by UNEP DTIE (United Nations Environment Programmed, separation of Technology, Industry and Environment) in 1989 as "The continuous application of an integrated preventive environmental strategy applied to processes, products, and services to increase overall efficiency and reduce risks to humans and the environment" (UNEP 2001; UNIDO (United Nations Industrial Development Organization), 2014). Cleaner production is defined as "The continuous application of an integrated preventative environmental strategy applied to processes, products, and services to increase economic efficiency and mitigate the hazardous effects on general public and the environment." Khan, 2008 explains concept of cleaner production (CP), it can be associated with "Economic efficiency". Economic efficiency means production and delivery of goods/services at some reasonable price to market, while gradually decreasing the adverse effect of these activities on ecology. By coincidence CP and Economic efficiency firms can achieve divine public and private benefits. Firms can meet improved environmental quality and international standards by implementing clean production technology (Humphrey., 1994, Aspen Institute., 1996) Thus, this emphasis on valuable effects for industry that extricates CP from rest of environmental improvement methods. Cleaner production has been widely used in different sectors for example in cellulose, mining, ceramics, and food industries (Abbasi and Abbassi, 2004; Avşar and Demirer, Huang et al., 2013; 2008; Jia et al., 2013; Yi et al., 2001). Meanwhile, most firms are not in favor of adopting cleaner production due to excessive cost and skilled management requirements. (Dieleman et al., 2007)

There is huge literature that explains the pros and corn of adapting methodologies for cleaner production (Khan, 2008; Stone, 2006a). But researchers failed to explain the formula which is a compulsory factor for success of cleaner production at major firms. (Lopes Silva et al. 2013; Dobes, 2013; Zhang, 2000) found that lack of detailed information and policy concerns are reasons of failure of CP. (Calia et al., 2009; Staniskis, 2011) concluded that organizational culture features need to be addressed for accomplishment of CP.

Most firms consider clean production process as example of “end-of pipe” environmental solutions. End-of-pipe is industrial development before toxin/impurities go into the environment such as filtration device on the end of smokestack to avoid the air pollution, but clean production in contrast to “end-of pipe” is process of changing the management process (Australian Manufacturing Council 1992, 1993). Thus End-of-pipe is curative, cleaner production is preventative (Clinton et al, 1995). Clean production follows the procedures which encourage more efficient and productive technology- resultantly air, soil and waste pollution is being decreased. Clean production also requires changes from board room to shop floor to yield effective outcomes (Christie.Iet al., 1995, Chynoweth. E., 1993, EPA et al., 1993). Clean production methodology is a combination of environmental management and innovation of environmentally friendly technologies.

It is well known fact that additional environmental benefits can be achieved by making greenhouse gas reduction investment (Wang X, Smith KR., 1999, Aaheim et al., 1999, Aunan K et al., 2004, Cifuentes L et al., 2001, Ekins P., 1996, Krewitt W et al., 1999, Lee Davis D et al., 1997, Wang X and Smith KR., 1999) and these reimbursements are huge in developing countries. (Martinez et al.,2009) study reveals that, in present scenario sustainability without damaging environment is a key challenge and company strategies play a significant role to yield sustainable and environmentally friendly production in any industry.

2.2 Awareness and success of clean production

More than a decade has been taken to create the awareness of clean production and found fruitful and essential tool to alleviate negative environmental effects among industries. Principles of cleaner production, which are in practice, are waste minimization, minimize pollution and increase economic efficiency. These objectives can be achieved by the well know strategy “four R’s”: ***reduce, reuse, recycle and reformulate.***

Human activities are affecting the environment quality adversely. Thus, to protect the environment from human activities-industrial environmental management (IEM) is inevitable. Clean production and industrial environmental management entails more efficient and environmentally friendly technology, attitude change and responsibility for environmental quality. To achieve necessary economic and environmental efficiency – adoption of cleaner production at every stage of business activities is unavoidable.

In 1998 the Fifth International High-level Seminar on Cleaner Production described the common practices of clean production adopted worldwide during the last ten years.

According to(Chaiyod Bunyagidjet al.,1996) Vice President and Director of Thailand Environmental Institute, clean production gained preliminary success in Asian Pacific region. In Asian Pacific region first roundtable conference on CP with more than 150 subscribers and 30 countries is a key step being taken. But concept of clean production is not completely being placed due to certain reasons such as lack of industries participations, legislative support, lack of coordination between industry and regulatory bodies, financial constraints, and lack of technical education (UNEP, 1999).

Several case studies have investigated the implementation of CP and its effectiveness in different regions of the world. (ChaiyodBunyagidj and David Greasonet al.,1996) have investigated the CP methodology imposed by Thailand's government and industry cope with ISO 14001 EMS. They found that in a targeted industry sector, CP approach is successful-but in border scope, CP venture failed to be self-prompting in selected segments. In the result, Government of Thailand introduced the pollution abatement policy. After implementation of pollution reduction, behavior of industries has been distinctively changed from “wait and see” to more enthused and practical. From 1997-199 in “Ho Chi Minh City Reduction of Industrial Pollution” project has been initiated and supported by UNIDO. They have implemented clean production methodology in six plants pulp and paper, textile and dying and food processing sectors and found the acceptability of cleaner production.

2.3 Barriers to clean production

Some attitudinal, financial, environmental issues, lack of interest, resistance to change, trade and economic problems have been followed in targeted sectors of UNIDO project. Thus, these projects concluded that, success of CP exercises is not sufficiently influential to transform management concepts "Experiences from international CP projects documenting environmental and economic benefits were often not enough to gain management support (UNIDO., 1999)”. Efficiency of targeted sectors is also being affected by administrative, monetary, and decision-making structure of organizations. The integrated decision-making debilitates are motivational factors to encourage low quality production. Additionally, lack of economical tools to execute the CP practices and regulatory guidance are also identified as hurdles.

National Cleaner Production Centers (NCPCs) provide another angle of CP development in the region. It was MOU of United Nations Industrial Development Organization (UNIDO) and UNEP for developing foundation for CP in developing countries being financed by third party. For instance, NCPC (National Cleaner Production Centers) was established in Hungary

with financial assistance of Austria and counterpart of NCPC was in Vietnam subsidized by Switzerland.

Clean production is promising for the upgradation of the bottom line of industries (along with better environmental quality. But the firms that rush in implementing it without knowing the basic understanding of it may not be able to get full benefits out of it and may get themselves into loss.

To know the facts behind failure of CP, industry representatives are inclusively being consulted (Atkeson E et al., 1996, Ayres, I & Braithwaite, J., 1992, Bennett, M & James, P et al., 1997) and they found two reasons of disappointment, which are barriers and motivators

2.3.1 Internal barriers

There is an inclusive range of possible internal barriers to the implementation of CP. Main internal barriers comprise:

- **A lack of information and expertise**

A major problem with implementing clean production methodology is lack of complete information and proficiency. Due to lack of information, firms cannot explore the opportunities of substantial benefits of CP, which contributes to dirty and imprecision adoption of technology. Along with lack of information, unskilled labor and expertise opinion deficiency is major contributor to preclude the adoption of CP technology.

Small and medium scale firms are in more vulnerable situations due to lack of information, unskilled labor force and lack of expert opinions. So, as a result small firms/industries cannot yield the environmental benefits of adopting clean production. They also failed to understand the concept and terminology of clean production. On contrary to small and medium scale firms, large scale firms are suffering “information overload’ and they need proper guidance for that. It is difficult for large scale firms to manage massive information on CP and decide which environmental policy is more appropriate for their business plan.

- **Lack of awareness of environmental issues**

Most of firms have conceptual issues of pollution prevention and adaptation of CP. Firm mis-understands the management of environmental affairs with insurance against public disasters. (Staniskis et al., 2011)

Conceptual impediments to cleaner production may comprise:

- Environmental issues being undervalued in industry policy
- Narrow association between industry policy and pollution prevention
- Idea of environmental protection is too inflated
- Need to view legal standers and guideline

- **Environmental Accounting**

(Nagel et al., 2003) Financial accounting plays a vital role in decision making in both private and public industries/firms. Transparent financial and legal accounting helps planners to generate extra benefits. Transparent financial and legal accounting requires encouraging cap and trade policy, pollution tax and introducing precautionary laws within industry. However social and environmental costs and benefits are not inclusively part of financial accounting and project appraisal. In the result, consequences of bad environmental practices are being ignored and the positive aspects of cleaner production are never considered. This is because policies of the industries are not aptly integrated with environmental issues.

Quantifying the environmental cost and benefits is not an easy task. Likewise, payback and discounting methods have failed to fully cover the project's cost and benefits. Thus, inefficient environmental accountability is one of major reasons of slow adoption of CP approach in industries (Dobes et al., 2013; Rosa et al., 2013; Gale et al., 2006).

- **Firms' priority is short term profit**

The prime motive of every firm or industry is to earn profit. Short run profit is one important obstacle to managing better-quality environment by adopting clean production. In 1991 survey was conducted by Tufts University's senior Centre for Environmental Management and they concluded that 53% of chief executives of industries emphasis on short term profits and this is momentous reason to impede improving environmental quality. Industries short term profit motives causing reduction in both tangible and intangible investment, which decreases the competitiveness in future (Baas, 2007). On contrary, objective of long-term profit encourages investment in research, development of flexible production processes,

customer's loyalty, and high-quality production, which leads to origin of cleaner production (Dieleman et al., 2007; Dobes et al., 2013).

- **Bounded rationality decision**

If we assume that industries have perfect information, even then this information may not be used in an efficient way is known as "bounded rationality." Management ideas of "stakeholders" and "satisfying the stakeholders" can be closely related to concept of "bounded rationality" (Dobes et al., 2013; Lopes Silva et al., 2013). These theories explain that industries management agenda is to satisfy key stakeholders and once this is done, they can move towards managerial preference. Industries are busy doing business and concentrating on downsizing but lacking in exploring CP due to managerial preferences. Use of environmentally friendly technology is not a top priority objective of industries.

- **Financial constraints**

(Daddi et al. 2013) explains economies of scale, internal financial issues and cost saving techniques of firms is main obstacle in adaptation of pollution prevention technologies. Firms are reluctant to invest in CP, which adversely affects the efficiency and performance of management code of practices and technologies. Performance of business is being deteriorated by internal bestowed interests in retaining the status quo, less waste disposal charges, incompatible internal investment strategies, or partial provision of conservational costs (Staniskis et al., 2011; Dieleman et al., 2007; Dobes et al., 2013; Gombault and Versteege et al., 1999).

- **Communication barriers**

(Staniskis et al., 2011) believes lacks communication inter industry or intra firm is key obstacle to accept clean production. This communication gap between employee and employer of industry is referred to as "the silo mentality." If an industry lacks effective communication skills within and outside the industry, it breaks the entire clean production system. In the result, higher and lower management does not have any idea of benefits of clean production technique due to poor communication system. Effective communication strategy plays an enthusiastic role in implementation of CP (Calia et al., 2009; Staniskis et al., 2011; Dobes et al., 2013; Lopes Silva et al., 2013) Communication gap can be overcome by under-taking following steps:

- Improving communication skills between environmental affairs administrators and their crew members
- Balancing “top-down communication strategy “and “bottom-up approaches”
- Promoting sense of responsibility for safe environment and public health
- By eradicating structural complications, for instance bureaucratic and inflexible structures
- **Lack of skilled labor force**

Besides internal management inertia, labor force of industry is also contemporary impediment of CP (Vickers and Cordey-Hayes et al., 1999; Baas et al., 2007; Dobes et al., 2013). Difficulties may transpire as follows:

- Lack of implementation of residual reduction technology
- An incapability to accomplish an additional program within the firm;
- Implementation of waste reduction technologies may have demanded more management skills;
- Reluctance behavior of industry to involve in restructuring essential for CP
- Confrontation by engineers who are assimilated with professional techniques, and they do not want to transform existing technology to CP.

- **Difficulties in implanting CP**

The OECD (1995) has identified structural factors, such as the need to renovation of already installed equipment’s is one of key issue to install cleaner technology. (Daddi et al., 2013) large scale and mature industries are not very welcoming the environmentally friendly technology with already existing technologies. On the other hand, it is impossible to plant new equipment in an already established setup. Similarly, it is too costly to install advanced cleaner production technologies in an outdated/ small scale entrepreneur industry (Baas et al., 2007; Dobes et al., 2013) Industries are making huge investment in advanced technologies- which require skilled and expert labor. Due to lack of skilled labor force firms are reluctant to change the existing machinery with advanced one before retirement time and this is obstacle to implement CP.

2.3.2 External barriers

Together with internal barriers, there are some important external barriers to cleaner production. Industries do not have control over the main external obstacles which are as follows:

- **Failure of exiting regulation**

(Zhang, 2000; Vickers and Corday-Hayes et al., 1999) Conventional regulatory approaches in many cases proved to be counterproductive in acceptance of cleaner production. Industries assume that regulators are finest route to determine appropriate action and stimulate industries satisfaction, thus there is no need to take responsibility to integrate environmental clean technology to industries policy. Whereas Conventional regulatory system is ineffective compared to cleaner production methodology- they failed to lodge significant discrepancy in solution of environmental problems and implementation of cleaner technology among different industrial segments (Daddi et al., 2013; Taylor et al., 2006). New competitors in industry can encourage sophisticated environmentally friendly methods of production. Although they are discouraged by strict law of entering in market and lengthy procedure of approval (Lopes Silva et al., 2013; Staniskis et al., 2011)

- **Problems in accessing clean technology**

Whether to invest in environmentally friendly technology or not is a key decision taken by industries. Cleaner production technology is costly and difficult to adopt because of potential external obstacles. Small medium enterprises are particularly facing issues to adopt cleaner production, even they are rich in profit earning (Staniskis et al., 2011; Baas et al., 2007; Kubota and da Rosa et al., 2013) Problems firms/industries are facing to adopt CP are summarized as:

- Sophistication of innovative technology.
- Innovative technology needs trained and skilled labor force to operate, thus it is difficult to transfer one operator to another.
- The performance of technology depends on certain economic conditions and standards.
- There is a huge technology which is not improved by authorities.
- There is no proper integrated system from providers.

- Green production methods are more expensive and bad in quality, due to low productivity and substandard material

- **External finance constraints**

Subsides and economic resources are essential for cleaner production. For example, energy prices have a significant impact on business activities and adaptation of cleaner production technologies. Unreasonable prices per unit of energy improve the efficiency of existing methods and increase the demand for clean technologies (Stone et al., 2006; Zhang et al., 2000; Lopes Silva et al., 2013)

- **No recycling facility**

Many industries are discouraged from recycling their products due to there being no market for them. In fact, recycling products are "demand driven" rather than "supply driven", by encouraging recycling activities and demand for recycling goods, waste can be minimized that produced by business activities (Fresher et al., 2010; Stone et al. (2006a; 2006b))

2.4 Cleaner production in textile industry

Textile industries are contributing to cloth production in different countries of world, such as China, India, Pakistan, Turkey, Egypt, and Bangladesh. Most countries use traditional methods to produce fabric and related products. Traditional practices are negatively affecting the environmental quality and productivity of industries. For improved environment of doing business and country growth cleaner production technology is essential. Clean production technologies help industries to increase productivity and decrease environmental damage. Policy uses to adaptation of CP conforms EMS (e.g., ISO 14001 standard) operated by intermediate and large industries.

Cleaner production practices minimize the operating costs together with improved product quality. Small and medium scale industries are up to getting optimistic economic and environmental advantage from CP. By adopting CP in textile industries (polyester, cotton and lycra based women's wear textile industry), cut water use to 54% (E. Alkaya et al., 2012). In the current situation, CP is apprising with idea of "resource efficiency noted as RECP." Chemical, thermal and electrical, load management, ETP management, fuel management, water saving, and health and safety are part of RECP.

2.4.1 Sustainable cleaner production

Water and chemicals are used in the wet processing unit of textile industries. Water is a basic component to eradicate scum after dyeing and finishing (N.U. Haq and H. Nasir et al., 2012). Sustainable cleaner production is vital to improve productivity and mitigate the damage to the environment. Improvement in current adopted technology can be split into six types.

- Replacement for material or another feedstock
- Changes in equipment use or procedure
- Training the labor force
- Inventory purchasing,
- spill and leak preclusion
- Recycling and reuse at source

2.4.2 Cleaner production in textile industry in India

India is one of growing economy and they have adopted the CP technology in their textile industries. A textile house situated at Narol, Ahmedabad, Gujarat, India, the unit earned around INR 85, 67,712 with an investment of INR 20, 57,500. In Vatva, Ahmedabad in the state of Gujarat of India, a unit of textile is located, and they are earning INR 9, 28,290 annually with an investment of INR 17, 10,000.

2.4.3 Cleaner production in textile industry in other countries of world

(Dumitrescu et al. 2008) described advantages of CP technologies in Romania. Nova textile Pitesti, Romania has adopted the CP techniques and yield high productivity and lessens environmental damages. Similarly, Lithuanian textile industry yields 30% higher national industrial production, which is consists over 50 companies with 35000 workers. By adopting CP in better housekeeping and environmental unit, it decreases the water discharge and enhances efficiency of water and energy.

In textile industries of South Africa CP approach was adopted with help of Danish Cooperation to improve Environment and increase Development. In South African industry 17 participants installed CP technology in wet processing units and achieved desired results. (B. S. Kipkoech et al.,) 2016 a cleaner production study was conducted in Kenya and analysis the effect of skilled labor force in CP process. Study concluded that, “Implementation of cleaner production equipment help to improve manager support”.(M.Sirait et al., 2018) conduct a study in Indonesia to identify the CP effects in Boutique industry. Objective of this

study was to identify the improved environmental performance during manufacturing of batik industry. Synthetic dyes have huge adverse effects on environmental quality thus, use of natural dyes helps to improve the environmental quality.

(O. Tong et al. 2012) also examined CP implementation in printing industry of China. Textile printing industry of China has significant contribution to their GDP. The study concluded that the CP technique is an efficient way to save water and decrease waste emission. Cleaner production system integration provides a solution to industrialists to decrease their pollution quotas.

2.4.4 Cleaner production practices in Pakistan

Pakistan has a vibrant, enthusiastic, and export-oriented textile industry. The textile industry of Pakistan is the prime manufacturing industry and the second largest employment generating sector. In Asian region, textile industries of Pakistan rank at 8th position as exporter and 4th at producing cotton. It also has 3rd largest spinning unit and spinning unit of Pakistan contributes 5% globally (APTPMA, 2012). Pakistan possesses around 600 to 800 wet processing unit which turn grey fabric into finished fabric and contribute 9.5% to GDP of country. This economic engine is the most polluted sector of textile industry (FCCI et al., 2012a, 2012b), because all steps involved in this process e.g., dyeing, printing, and finishing are extensive water use activities that discharge polluted water in huge quantity.

In the past decade, several initiatives have been taken in industry to treat energy issues, wastewater and recycling the products at source and efforts are undertaken to elevate the awareness of cleaner production. It is assumed that cleaner production is the best strategy for sustainable production. Cleaner production aims to minimize the effect of production on the environment. Sustainable and Cleaner Production in the Manufacturing Industries of Pakistan (SCI-Pak) project is conducted to enhance the energy efficiency in textile and tannery industry of Pakistan. This step has been taken to increase the capacity and knowledge of textile and tannery industry and promoting environmentally friendly technologies. Aim of initiatives is to decrease the Pakistan share in greenhouse gas emissions and global climate change. This also helps to promote the renewable energy production and use- which encourage the links between European Union and Pakistan industries policies. It was joint venture of “Pakistan Textile Processing Mills Association, Pakistan Tanners Association and Ministry of Environment of Pakistan and financial institutions.”

2.5 Greening Pakistan's Industrial Sector to Enhance International Competitiveness

Impact of air pollution, lethal waste and other types of pollution has substantial hazardous on environmental quality. Most of studies have estimated the cost of these environmental damages (World Bank, 2006) and concluded that environment-related transience and disease which indicate as high as 9 % of Gross domestic product (GDP) and major contribution to GHG emissions by industries. Most industries do not take place the environmental and health damages while executing production activities, in result growth of these industries is overestimated. Industrial Real contribution to GDP depends upon emission produced by their economic activities.

Sustainable development demands clean technology to minimize the contribution of industrial pollution to air, water and toxic waste. By adopting cleaner production technologies, firms produced goods according to IS014001 certification and play vital role to encourage international competition.

The Greening of Pakistan's Industrial Sector is based on studies completed under the NLTA on "Evaluation of Industrial Environment Management (IEM) in Pakistan," "Evaluation of IEM in Developing Countries with Extensive IEM Experience" and "Evaluation of Cleaner Production Initiatives in Pakistan." Industrial pollution affects the water quality; Pakistan does not make substantial improvements in water quality and conservation. Thus, major changes are required, since treatment facilities are inadequate. Despite, since 1983 "federal environmental regulation", in 1997 an important development of regulatory authorities made, then explanation of regulatory powers was made in 2005 but there are still significant gaps in industrial environmental. It is indispensable that prevailing standards need to be revised to make them more convincing and achievable under current situations in Pakistan (Larsen B. and Strukova E et al., 2011and World Bank et al., 2008). Cleaner production centers apply an integrated environmental policy to products, services, and processes to enhance the efficiency of business activities and decrease the risk to human life and environmental damage. Three cleaner production centers are working in major city of Pakistan successfully (Sialkot, Lahore and at the national level).

In current scenario public environmental interventions are inadequate; accordingly controlled instruments are best option (ISO 14001 Certification). ISO 14001 certification plays a significant role in controlling industrial environmental damage. This is also essential to compete internationally as many international firms unambiguously demand their supplier

should be ISO 140001 certified. Thus, it is difficult for firms to enter the international market without ISO 140001 certification (World Bank et al.,2006 and World Bank et al.,2008).

Firms need an environment management system (EMS) to be certified under ISO 14001, that consistently follows ISO 14001 standards and (EMS) rules and regulations. In Pakistan situation is poor, several textiles and all sugar mills are not ISO 14001 certified.

To carry out a scheme for sustainable industrialization needs effective establishments. Rodrik, D. (2004) discusses that "information externalities and coordination of externalities" is basic reason of market catastrophe in initial phase of growth. Philip E. (Auerswald and Ammar Malik et al. 2011) explain these outcomes are impediments for industrialists who are always up to profit maximization and industrial growth. Dani Rodrik et al.,1995, argue that the Korean model is a solution to this problem, which needs up-to-date civil service and well-established bodies for policy design and execution. At level of the federal government "Pakistan's Ministry of Industries report in 2005 "A Policy for Rapid Industrial Growth" is the best effective policy coordination. Several of the strategies being suggested for prompt industrial growth do not fall straight under perspective of the Ministry of Industries.

Prime Minister proclaimed formation of the "Ministry of Disaster Management (MDA)" at the Federal level on October 26, 2011, which converted into "Ministry of Climate Change (MCC)" in 2012. All tasks related to "Environmental management," which were fall under "Ministry of Environment before the 18th Amendment to the Constitution were combined and allocated to new Ministry (except for those under the Pakistan Forest Institute (PFI) and The National Energy Conservation Center (Enercon))". It was expected that the new Ministry will come into action by the mid of 2012, synchronization of international etiquettes and environmental protection within country. Thus, Pakistan might take advantage; precisely, the duties allocated to the central government, irrespective of decentralization, include strategy and enactment of national environmental policies and standards, trans-boundary concerns, research and development related to climate change and synchronization of regional activities. By setting coordination with sub-national environmental entities, Pakistan could be strengthened at the national level.

2.6 International industrial practices

The economy and the environment are two sides of a coin requiring attention. Industrial technologies and solutions define the state of the environment and the worth of the product produced. The bigger the industry, the more waste and pollution are generated. The impact on

the environment will be larger as well. Industrial activities are the foremost sources of air, water, and land pollution.

2.6.1 Chemical Industry

Chemical industries are most dangerous to health and environmental quality (Amine Dakkoune et al., 2018; Malichetal., 1998). Moreover, the location of chemical industries dealing with risky substances is critical (Reniers et al., 2006). In the past decade, the chemical industry has caused serious accidents and incidents within the industry and in the population where it is located (Gomez et al., 2008; Nivolianitou et al., 2004). (Rathnayaka et al. 2011) have divided accidents into five categories (Near miss, Mishap, Incident, Accident, and Catastrophic accident). According (to the EU, 2012), the frequency of accidents has been minimized, but the chemical industry still poses risks to the environment and humans. Some world-leading chemical industries are doing different practices for climate change mitigation.

2.6.1.1 The Sherwin-Williams Company

Established in 1866, The Sherwin-Williams Company is an overall chief and best paint organization in the assembling, improvement, dissemination, and offer of paints, coatings, and related items to proficient, modern, business, and retail clients.

Sherwin-Williams fabricates items under notable brands like Sherwin-Williams, Valspar, HGTV HOME by Sherwin-Williams, Dutch Boy, Krylon, Minwax, Thompson's, Water Seal, Cabot, and more.

Beginning around 2009, they have had an environment strategy zeroed in on lessening their ozone-depleting substance (GHG) emanations, as well as outflows from their activities (Scope 1) and the age of bought energy (Scope 2). In 2019, they spared discharges information connected with our upstream and downstream worth chain (Scope 3).

In 2020, they started adjusting their environment system to reflect a science-based objective methodology, affected by worldwide Endeavour to restrict an unnatural weather change to well underneath 2.0 degrees Celsius. They have embraced another way to deal with better reflection and line up with specific worldwide challenging work, including setting new GHG discharges to diminish targets. They want to decrease our preeminent Scope 1 and Scope 2 emanations by 30% by 2030, contrasted and a 2019 gauge. In their view, the advantage of defining an outright objective rather than a strength objective is that it adjusts best to what the

planet needs - a flat-out decrease of GHG emanations. They intend to assess our environment-related dangers and valuable open doors additionally.

Sherwin-Williams have set an objective to increase environmentally friendly power to half of the all-out power utilization by 2030. They will investigate an assortment of sustainable power components and instruments to assist them with accomplishing this objective and their other 2030 carbon and environment objectives. However, their choices might not be restricted to on-location sustainable power age at some Company areas, power purchasing arrangements (PPAs), and environmentally friendly power credits (RECs).

2.6.1.2 PPG industries, Inc.

PPG works consistently to broaden and convey the paints, coatings, and materials that organization clients have trusted for over 135 years. Through responsibility and imagination, The Company settles clients' greatest difficulties, working together to find the correct way forward.

Their most significant way to deal with dropping ozone-depleting substance (GHG) outflows is to reduce their energy utilization. They diminish air emanations globally through superior working practices, item reformulations, and were fundamental, discharges control gear. The structure of their emanations fluctuates by capacity because of the distinct items created and fabricating processes utilized. In that capacity, they are supplanting outdated and wasteful gear, like boilers, chillers, and air blowers, in their activities.

They Endeavour these substitutions after some time to enhance the effect, zeroing in on needed destinations because of progress potential open doors and assets expected to accomplish those decreases. They want to diminish their GHG emanations force by 15%, estimated in absolute tons released by 2025 from a 2017 benchmark. In 2020, they accomplished a 12.5% decrease in force and a 24.0% decrease in outright immediate (Scope 1) and roundabout (Scope 2) GHGs from the baseline.

2.6.1.3 Nippon Paint Holdings Co., LTD

Nippon Paint is situated in Japan and has more than 139 years of commonality in the paint business. This is the main paint producer in Asia. What is a more driving paint producer on the planet? Nippon Paint produces premium paints and covers for auto, modern, and decorative areas. Throughout the long term, Nippon Paint has consummated its items through

innovative paint innovation, with an unmistakable sound on development and eco-kind disposition.

For the impact of their conduct on environmental change, they have arranged methodologies to such an extent that they have identified environment-related dangers and potentially open doors that are important to the procedures of their Group and are attempting to evaluate their financial way. Considering the expanding revenue in environmental change offset measures as of late, there are worries that a worldwide temperature alteration assessment will be raised, bringing about an increment in working energy costs and extra costs connected with capital speculation and innovation advancement for decarbonization.

Furthermore, in case of an expansion in the mercilessness and recurrence of floods and various occasions brought about by outrageous climate, there is a danger of deals decreasing because of the harm on their undergrowth bringing about the suspension of creation.

A worldwide temperature alteration, then again, is important to unblemished society, including their Group's significant clients. While a worldwide temperature alteration involves physical and restricted dangers, it may be related to potential chances to broaden their business by decisively tending to it. Specifically, such open doors incorporate developing deals of items that further develop transport fuel efficiency, assist with diminishing CO2 discharges at vehicle fabricating plants, and alleviate the ascent of street surface temperature.

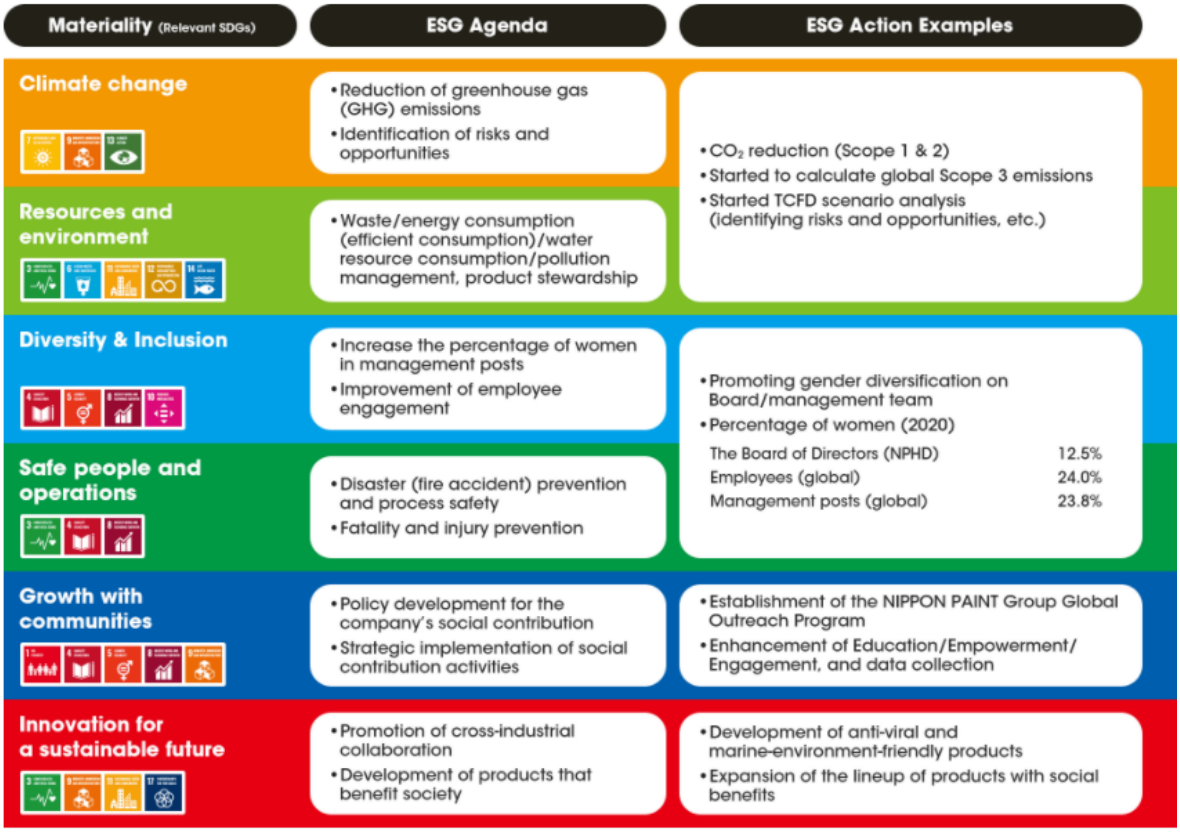

Figure 1 figure can easily summarize their future commitments to SDGs and ESG

Figure 2 Summarizing their overall business operation

2.6.1.4 RPM International INC.

RPM International Inc. claims auxiliaries that produce and market superior execution coatings, sealants, and specialized topic synthetics, most importantly for support and improvement applications.

The organization utilizes around 14,600 individuals worldwide and works 124 assembling offices in 26 nations. Its items are sold in the locale of 170 nations and domains. Financial 2020 merged deals were $5.5 billion (about $17 per person in the US).

For better supportability and purposes that might not adversely affect the climate or be additive among different elements prompting environmental change, it is smarter to monitor the work being done and how much the way in which it will impact the climate. For this reason.

Table 1 The RPM company has drafted a table

CY 2020	Approximate Total	Approximate Intensity (per Ton Produced)
Total Energy - Mj	1,727,100,000	1,276
Potable Water - gal	216,500,000	160
CO2 - tons	200,000	0.15
Waste		
Hazardous - lbs	25,500,000	18.80
Non - Hazardous - lbs	41,000,000	30.29
Recycled - lbs	24,000,000	17.61
Landfill - cubic ft	4,000,000	3.23

08/15/2021

This data comprises actual and estimated data for their locations and company vehicles. Estimates and assumptions used include domestic data and external data from third-party providers and use factors believed to be rational under the circumstances.

2.6.2 Cement industry

The cement industry is one of the most polluting industries in the world and has extraordinarily strong negative impacts on human health and environmental quality. (Suess et al., 1985) explained that the process of cement production can be divided into three stages: “extraction and preparation of raw materials, calcining, and finally grinding of the clinker.” (Isikli et al., 2003; Kalafatoglu et al., 2001; Sidhu et al., 2001; Alcock et al., 1999; Brzuzy and Hites et al, 1996) studies show evidence that cement industry is causing environmental damages by their greenhouse gas emissions; such as SO2, NOx, CO2, and CO. Likewise (Yang et al., 2003; Legator et al., 1998) analyzed the data on health and environmental risk to the population living near cement factory’s and results showed extensive threats to the health of the communities nearby. Some world-leading cement-leading industries are doing different practices for climate change mitigation.

2.6.2.1 Holcim

Holcim is the world's driving concrete organization, with a presence in 90 nations worldwide. Laid out through the consolidation of Lafarge and Holcim in July 2015, the organization has an aggregate of 180 plants and a yearly creation limit of 386 million tons. Holcim whose

settle is arranged in Switzerland, is likewise a significant maker of total and prepared blended cement. Holcim is dealing with four basic development switches to speed up the development to net zero.

- Rising low-carbon building materials like ECO Pact green concrete and ECO Planet green cement.
- Enabling smart design to build more with less.
- Driving the circular economy, doubling the number of materials we recycle to 100 million tons by 2030.
- And introducing innovative technologies to not only offer greener products to builders but to decarbonize the way we make them.

2.6.2.2 Anhui Conch Cement (Collab with CAMCO)

Established in 1997, Anhui Conch Cement Company confined is the biggest concrete maker and allocator in the business area of China and the second greatest on the planet. The organization possesses 32 concrete plants with an assembling capacity of 288 million tons per year.

Beginning around 2006, Anhui has been working alongside Camco on the ascent and executing a program of energy viability projects at different creation offices. Though in December 2011, a new arrangement was made among the two gatherings, which concerned 27 energy proficiency projects, of which 24 are capacity and utilize high-effectiveness squander heat recuperation innovation to catch heat from the concrete-making process and reuse it to designer power in on-location power plants.

The ventures can get U.N.- gave carbon credits because the power they produce will migrate power that would beforehand have been taken from the neighborhood framework controlled by non-renewable energy sources that are liable for warming the planet. The undertakings catch and take advantage of waste heat from the concrete-making interaction to create power in on-location power plants from 8 to 47 MW. Helpfully the activities are intended to create 29.5 million carbon credits and purported ensured outflow decreases (CERs) somewhere in the range of 2012 and 2020, the proclamation said.

2.6.2.3 Cemex

Settled in San Pedro, close to Monterrey, Mexico, CEMEX is a development materials organization gaining practical experience in producing concrete, totals, and pre-projected

cement. It was established in 1906 and had an event in more than 50 nations and regions all over the planet with 56 concrete plants and a yearly creation limit of 87 million tons

As indicated by a report, the CEMEX sets another objective of under 475 kg (about 1047.19 lb) of CO2 for 2030, an over 40% decrease in discharges, and adjusts the objective to the science-based targets drive (SBTi) under the Well under 2-degree Celsius conditions. They anticipate accomplishing their 2030 objective of 520 kg (about 1146.4 lb.) of CO2 by 2025, five years in front of the plan. They have additionally presented a medium-term carbon drop objective for cement of 165 kg (about 363.76 lb) of CO2 for every cubic meter by 2030. The organization hopes to contribute US$60 million yearly under its Future in a real-life program intended to recoil its carbon impression.

2.6.3 Textile industry

The textile industry has played a significant role since the industrial revolution started and became a famous source of income in low-cost nations. Starting with the late 18th century, the textile industry shifted to Japan in the 50s to 60s. Taiwan, Hong Kong, and Korea were rich in textile industries from the ’70s to the ’80s, and the industry moved to China, India, Pakistan, Sri Lanka, Bangladesh, Indonesia, and Malaysia. With this geographical shifting of the textile industry, toxins caused by textile industries also have been shifted. With the shifting textile industry, pollution caused by textile processing is also shifting. The textile industry is a major water-consuming sector of the economy and threatens the environment in the form of contaminated water. It is also the largest contributing sector for developing nations (Lin and Moubarak et al., 2013; Ranganathan et al., 200). According to (Dong et al., 2015), dyeing enterprises manufactured more than 69.5 billion meters of dyeing cloth in 2014. In 2015 gross industrial value was$82.3 billion (about $250 per person in the US), and exports were $19.0 billion (about $58 per person in the US). As textile industries are major water and energy users, they also discharge polluted water and become challenging (Guo et al., 2012). Moreover, efforts on end treatment are not an appreciated action and cannot complete the "win-win" purpose of enterprises. Some leading textile industries are playing a vital role in environmental change.

2.6.3.1 TJX Companies

TJX has been committed to seeking after earth responsible and brilliant drives for their business. As an enormous, complex global business, they work tediously to put forth progress

on their natural maintainability attempts and assist with alleviating their effect on the climate. They center their endeavors on four regions:

Environment and energy

This includes organization and moderating TJX Climate Impact of their natural manageability program. They have examined the fossil fuel byproducts effect of their business activities and set science-based emanations to decrease targets, including the 55% decrease in Green House Gas discharge from their immediate effects. This drawn-out objective is science-based in collaboration with the United Nations' Paris Agreement rules. It supports an emanations development that confines a worldwide temperature alteration to 1.5 degrees Celsius.

Decreasing their worldwide environment sway through a sensible arrangement of outflows decrease conduct zeroed in on overseeing and rationing energy and fuel usage and cost and keeping away from and balancing emanations by obtaining low carbon and environmentally friendly power. Further, the consequences of their environment system as well as dangers and open doors to their business by planning as per the United Nations Sustainable Development Goals (#13 Climate Action and # 7 Clean Energy)

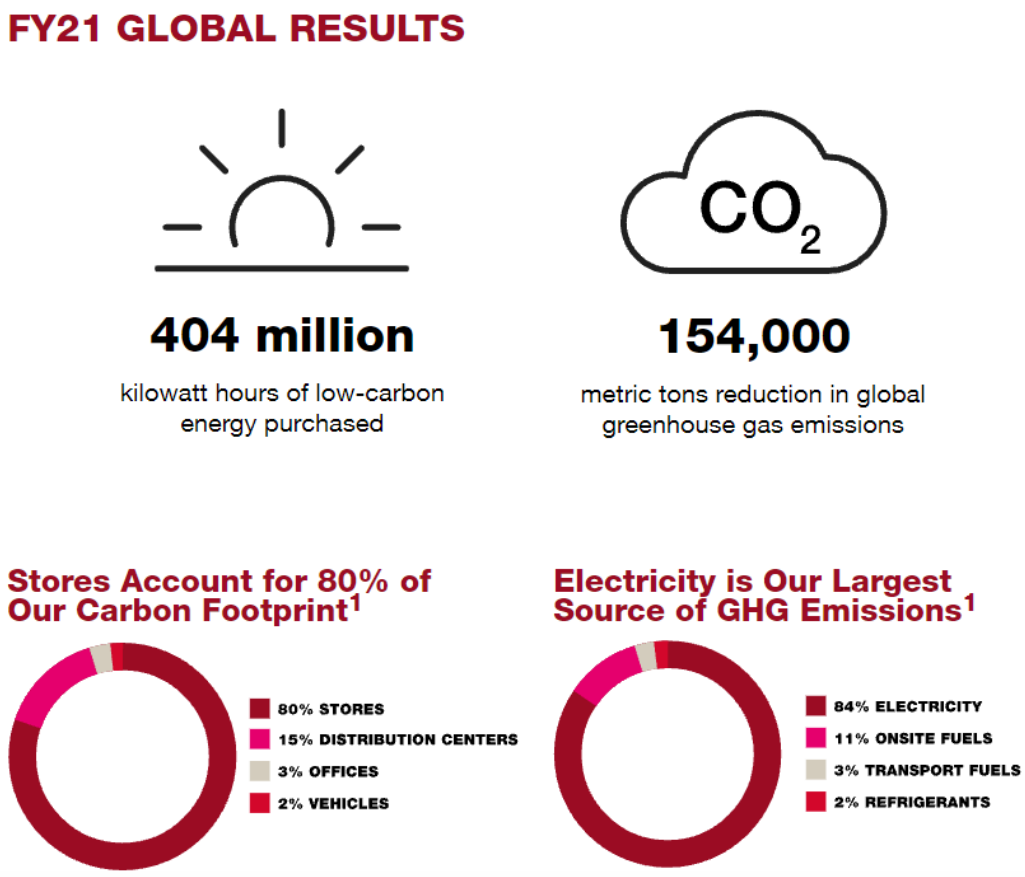

Figure 3 The figure shows their Fiscal Year 21 Global Results due to steps taken by the Company

Responsible waste management

Groups directly through their business work apply savvy techniques and cycles to deal with the few distinct kinds of waste materials coming about because of their tasks. While many of these projects center around redirecting normal waste, like cardboard bundling, from landfills, their drives are creating zero in on an assortment of materials. Their system incorporates:

- Attempting to diminish, reuse and reuse the wrapping used to ship products directly through our organization where it is functionally doable and savvy.
- Declining single-use plastics in our activities.
- Investigating expected open doors for specific geologies to extend stock recuperation and reuse programs.

Because their means are taken to decrease the creation of nursery gases from their waste, it has been accounted that 5% of nursery gases come from their waste. The organization has likewise stepped up on plastics cleanup endeavors from the climate that incorporates four significant drives:

- Ocean Clean Up
- Plastic Collective
- Neighborly
- Plastic Pioneers

Chemicals management

They are using the framework of the Chemical Footprint Project (CFP) and areas of now embraced an audit of the Management Strategy segment of the CFP study to survey related industry center regions for their approaches improvement. They have focused on specific regions in their business that incorporates, however, are not restricted to business activity and certain classes of product and item wrapping.

Their drives inside business activity include exchanging their register receipts across all U.S. retail brands without phenol paper in 2021, effectively killing these synthetic compounds of worry in their timetable receipts. They additionally want to change out compostable serve-product in their U.S. Corporate office cafeterias, so the compostable serve-product they use is liberated from PFAS synthetic substances.

Their drives inside product and wrapping incorporate pressing answers for paper and paperboard materials and individual other options, dispensing with PVC from the bundling of specific top-of-bed items, and utilization of their party esteems in their source items that limit the utilization of specific synthetic compounds at grouped phases of the handling and assembling technique

Further, they have joined the Green Chemistry and Commerce Council (GC3) for the outer industry union in compound administration, the shut circle accomplice's consortium to reexamine the retail sack and have drawn in an external expert to direct a scene audit of synthetic administration for specific individual consideration items. The heads of the ecological maintainability group have been occupied with a portion of their bigger product merchants and other enormous retailers to discuss the compound administration plans and procedures.

Sustainable products.

They have fostered a design to characterize maintainable items ascribed, which they accept to have a positive, significant natural effect in their creation or assembling processes. A reliable outsider interaction or certificate can check that. A portion of that positive ecological effect might incorporate utilizing less damaging synthetic substances and supporting dependable afforest the board rehearses.

2.6.3.2 Lululemon Athletica

Meanwhile, the second most leading business in the file of textile mentions their track in two major categories on how they are to create a healthier environment.

Climate and Energy:

Among the two methodologies on the best way to handle the ecological issue, the first express their environment system, which tends to fossil fuel byproducts across their own worked offices and production network with attention on expanding effectiveness, progressing towards sustainable power, putting resources into natural substance advancement, and teaming up across enterprises for development. The following are their primary concerns:

- They utilize 100 percent of sustainable power for their claimed and worked offices.
- Target till 2030 to do a 60% outright decrease of GHG emanations in the entirety of their claimed and worked offices
- Target till 2030 to do a 60% force decrease of GHG outflows across our enormous scope supply chain

Further, the organization has expressed obtaining sustainable power in our activities through a mix of sustainable power credits (RECs) and a virtual Power Purchase Agreement (PPA) in North America. They intend to draw in their assembling partners for energy proficiency and sustainable power progress. Likewise, they are making strides to obtain more manageable unrefined components and filaments, including reused and sustainable substance polyester and nylon. In conclusion, they have focused on diminishing fossil fuel byproducts in their inbound coordinated factors.

The organization has joined The Climate Group's RE100 and marked the UN Fashion Industry Charter for Climate Action. The main undertaking is an endeavor of compelling

organizations to work closely together, expanding corporate interest and supply for environmentally friendly power. At the same time, the subsequent venture is an industry-wide task that works overall to decrease fossil fuel byproducts across the design and more extensive material areas.

Packaging and Recycling

This broader topic further classifies into two portions involving packaging and recycling

a. Packaging

They have a practical bundling strategy that diagrams their methodology, including steps to downplay their item bundling, pick ideal materials, and guarantee their bundling is completely recyclable at the end of life. The means they have taken are exchanging their paper-based bundling for FSC-Certified materials, which make up their item hangtags, occasion boxes, and their gift vouchers and sleeves.

Their completed products sellers send their items in polybags to their conveyance places. They use polybags because this proposition is the best safeguard for their items. But then, these are one of the more extreme parts of retail bundling and are difficult to reuse in numerous locales. Different organizations face a similar test and, like them, are finding that wiping out polybags expands from scratched items. They further case that their customers are exceptionally tough and reusable.

2) Recycling

Through inner drives and extraordinary firms, the organization with more than 90% of its harmed and overabundance of items is exchanged, given, or reused. Their accomplices have made strides, where they rebrand, reuses their clothing to be utilized as home protection, stuffing for sleeping cushions, furniture, and vehicles, and surprisingly in sporting gear like boxing gloves and punching sacks, and their yoga mats are reused into an equestrian balance item called Reiten Right. Few difficult-to-reuse things are shipped off waste to energy offices to create power.

At their reusing at appropriation focuses, four of their five worldwide dispersion communities have accomplished zero waste. This implies they have reused and reused more than 90% 100% of the time of their waste materials for the north of a year, and their freshest dissemination place is on target to accomplish no loss by this year.

Their container reuse program saves more than one million boxes consistently, and their groups reuse every one of the delicate plastics and creases used to move their items to their offices. Besides, the organization continues to do studies of their reusing offices to gauge and find ways to create and modernize their reusing programs, including preparing apparatuses.

2.6.3.3 V.F. Corporation. Denver, CO, USA

This is the third greatest material organization on the planet, and they have devoted themselves to driving the way toward a lower-carbon future. They have laid out five significant objectives to counter environmental change by embracing manageability and responsibility.

1- Decarbonizes their worth chain by 2030; the meeting decided on science-based targets.
2- Use 100 percent sustainable power by 2025
3- Drive a 35% decrease in the effect of their secret weapons by 2025
4- Achieve carbon-nonpartisan activities by 2050, following the United Nations (UN) Fashion Industry Charter for Climate Action.
5- Spark worldwide developments that draw in, teach, and empower activity around the environmental emergency

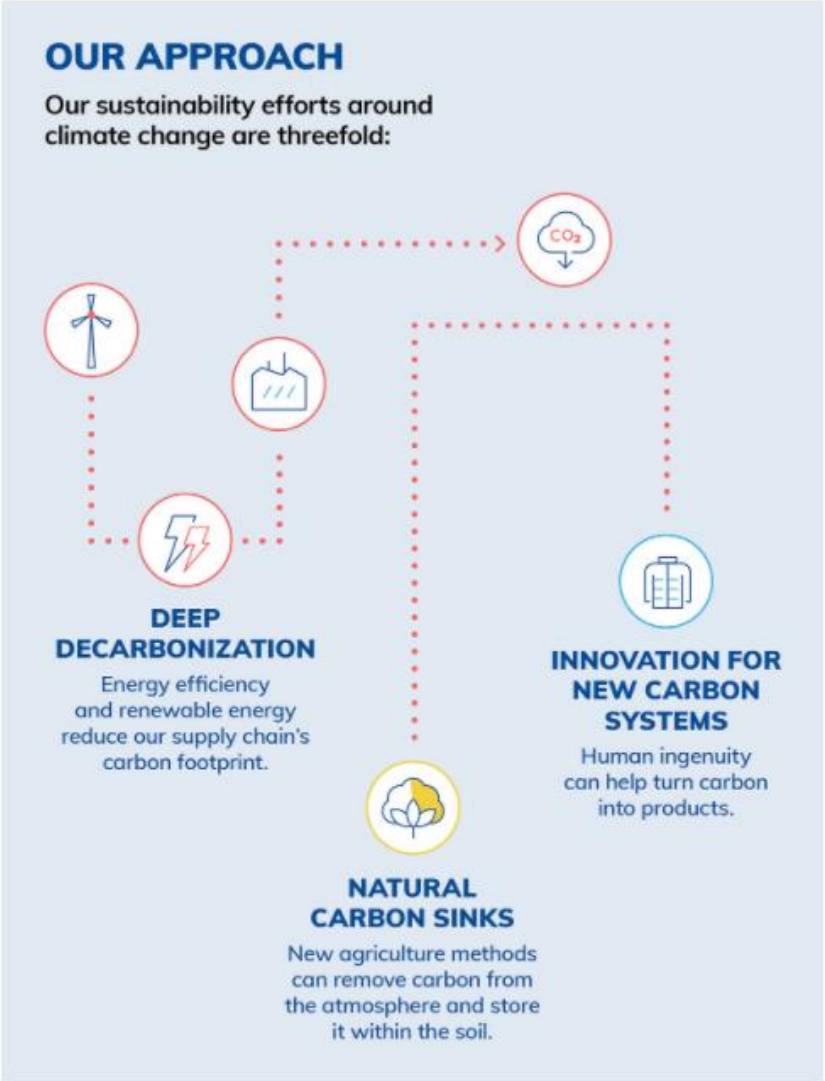

Figure 4 This diagram will depict their approach to sustainability efforts which are summarized threefold:

They have laid out their objectives utilizing the Science-Based Targets Initiative (SBTi), a collective endeavor between the Carbon Disclosure Project, the World Resources Institute, the World Wildlife Fund, and the UN Global Compact. A portion of their SBT includes:

An unrestricted decrease of Scope 1 and 2 ozone-depleting substance discharges of 55% by 2030 from a 2017 standard year. An outright decrease of Scope 3 ozone-harming substance emanation by 20% by 2030 from a 2017-gauge year zeroing in on ranch to retail materials, obtaining tasks, and operations. Further, in 2018, alongside 40 other style and attire organizations, we marked the Fashion Industry Charter for Climate Action as a feature of the UN Framework Convention on Climate Change to meet the resulting targets:

- Accomplishing net-zero emanations by 2050
- Lessening total ozone-depleting substance discharge by 30% by 2030
- Setting a solid science-based decarbonization passageway for the design business
- Supporting the development toward roundabout plans of action
- Building exchange with the public authority to empower the energy framework expected for fundamental change

2.6.3.4 PRADA, Italy

Prada is continually given to decreasing its ecological effect inside the association by continually raising staff mindfulness and with outsiders working with the Group to battle environmental change and safeguard biodiversity and marine conditions. To add to this worldwide objective, the Prada Group has estimated its Carbon Footprint as an initial phase in a more extended way attempted for the dynamic reduction of GHG emanations straightforwardly connected with its tasks and those brought about by the upstream and downstream activities of the worth chain. Following are their key climate figures

- 100% direct stores with leg lighting
- 89% reused and guaranteed paper
- 100% power from inexhaustible sources in Italia, 43% of sustainable power bought at a Global Scale
- 10 photovoltaic frameworks where these plants covered 24% of the energy needs of modern Italian destinations
- 699 tons of co2 outflows were saved because of photovoltaic
- 58 LEED confirmation
- 20 possessed creation locales in Italy

Claimed creation destinations in Europe

Prada bunch has likewise made the accompanying strides in various areas of their business for an economic climate.

Prada Re-Nylon

The Prada Re-Nylon project is the result of an organization between Prada and the material yarn maker Aquafil, an Italian organization with over 50 years of ability in making manufactured filaments. For instance, Econyl is being utilized as a recovered nylon yarn made of reusing disposed of plastic gathered from landfill locales and seas across the entire planet.

They have assessed that for 10,000 tons of Econyl made, 70,000 barrels of oil saved, decreasing the ecological outflows of CO2 by 65,100 tons with - 90% effect of oil-fueled nylon-creation on Global Warming.

1- Similarly, to other material and style businesses, Prada is likewise an individual from the designed settlement, which depends on the Science-Based Targets (SBT) zeroing in on three viewpoints;

- Stop Global Warming: by making, to keep an Earth-wide temperature boost beneath 1.5 C pathway among now and 2100
- Restore Biodiversity: by accomplishing destinations that utilized SBT to reestablish normal biological systems and safeguard species,
- Protect the seas: by diminishing the design business' adverse consequence on the world's seas through functional drives, for example, bit by bit eliminating the utilization of single-use plastics

2- In the field of energy effectiveness, the organization has sent off a multiannual money growth strategy focused on energy proficiency, the effect of which will be progressively noticeable after some time. This incorporates the utilization of energy provided from ensured practical sources worldwide to the establishment of photovoltaic frameworks from the change to LED lighting to the workers' attention on a decent and honest utilization of energy.

3- Prada has additionally declared the hide-free strategy and has joined the global hide-free retailer program, albeit this drive has begun from SS2020

4- Prada further has made a stride additionally alluded to as garden industrial facilities where the organization site expressed that this comprises of the buying and rebuilding of existing plants to the structure of new ones. They have done finishing building instead of landing utilization.

2.6.3.5 Ralph Lauren Corporation USA

The leading fashion industry in the USA has divided its steps into four major categories to tackle climate change and protect and maintain the planet’s natural resources.

Carbon and Energy

The vital reason for this progression is to diminish ozone-depleting substance (GHG) discharges across their worth chain. They are making strides for Net Zero development by resolving to accomplish net-no discharges across their worth chain by 2040, they will start the scale interest in carbon evacuations by FY22 with plans to build those expulsions to 2040 and keep up with the net-zero outflows from thereon. For this, the objective set us to diminish outright GHG outflows by 20% by 2030, contrasted and FY20 levels. For this, their spotlights are on

- Accomplishing 200% inexhaustible power use in their claimed and worked offices
- Moving to maintainable creation rehearses for their unrefined substances
- Decreasing emanations from assembling in their item production network

Figure 5 This figure can easily depict their goals

Water Stewardship

They are growing new advancements to lessen their water utilization. In their FY21, they presented shading on Demand, an innovator coloring stage that will change how their

industry shades the cotton (versatile zero wastewater cotton coloring framework). Their attention is on the accompanying places.

- Protection: defend and safeguard water assets where they work through relevant water targets and aggregate activity programs in need geologies with high water pressure
- Cotton: Sustainably obtained cotton and speed up the reception of regenerative cultivating rehearses
- Local area: Partnership with associations center around watershed wellbeing and local area WASH (Water, Sanitation and Hygiene) arrangements

They want to accomplish somewhere around a 20% decrease in all-out water use across their activities and worth chain by 2025

Waste Management

They are coordinating zero-squander standards across their activities and production network. They are finding ways to limit their items from turning into the squanderer, remembering to lessen overabundance of stock, and saving materials for use as far as possible. They are searching for better approaches to avoid sending materials to cremation or landfills to limit the activity squandering. In FY21, they started utilizing recyclable corn board beds, preoccupied all holders from their North Carolina conveyance focus from landfill to reusing, and reused and reused more than 20,000 pounds (about 9071.84 kg) of texture squander through our association with Fa scrap. They want to accomplish no loss to landfills across their dispersion communities by 2023

Sustainable Packaging:

They have found ways to make their pressing material eco-accommodating, reusable, or obtained by 2025. Their timberland security strategy helps guide their work around here and submits them to capably source any texture, mash, and paper utilized in bundling. They have likewise made strides, for example, following where their material is being involved and distinguishing the need for decrease and substitution. Likewise, their need materials distinguished in this cycle have found high-volume utilization things like enhancing labels and polybags. They have given their shoppers the choice assuming their items are requested on the web, they can eliminate upon demand these superfluous things that cosmetics side-effects. They want to accomplish 100 percent of their bundling material is recyclable, reusable, or obtained by 2023.

2.6.4 Leather industry

(Garai et al., 2014) the clarified climate is regularly tainted by modern, human, atomic, and other poisonous compound squanders. Bangladesh is the most extravagant country in cowhide businesses; Hazari bag 270 tanneries units are found, fundamentally harming the climate, and living souls. Bangladesh produces 8.47 million liters (about 2237536.84 gal) of fluid waste and 98 MT of strong waste each day (Gain and Moral 2002). In like manner, (Azom et al. 2012) presumed that Hazari bag tannery enterprises are utilizing filthy innovation and releasing untreated wastewater. Biswas and Hamada, 2012; Roy Da and Chen R. 2006) found "The Buri Ganga River in Bangladesh" is one of the most polluted waterways on the planet.

As indicated by (Ghafoor et al., 2012; Siddiqui et al., 2016), in Pakistan, the second biggest sending-out area is the Leather business, which contributes 5% of the GDP to Pakistan. (Chowdhury et al, 1996; Kankaria et al, 2011) clarified that 170 sorts of synthetics are utilized in the cowhide tanning process, including sodium chloride, fat, sulphuric corrosive, ammonium, sodium sulfate, lime, chromium sulfate, non-ionic wetting specialists, bactericides, soft drink debris, calcium oxide, ammonium sulfate, ammonium chloride, sodium bisulphate, sodium chlorite, sodium hypochlorite, formic corrosive, sodium bicarbonate, vegetable tannins, systems, polyurethane, fat emulsion, formaldehyde and various colors. So, the release of the calfskin tinning industry has a more terrible impact on human well-being and causes environmental change gravely (Ramesh et al., 2014; Samreen et al., 2006).

2.6.5 Paper and Pulp

The pulp and paper industry are one of the largest world industries. Simultaneously, it is one of the most water and energy-consuming industries. Globally total paper production was 403 Mt in 2013 (Bajpai et al., 2015). According to (FAOSTAT, Doble M, and Kumar A et al., 2005) supply of paper (pulp and paper industry production) increased to 390 million tones in 2005 because of extensive demand. FPAC, 2009 reported that in the pulp and paper industry, around a 3-billion-meter cube of wastewater must be managed: otherwise, it adversely affects the climate and humans' lives (Avsar and Demirer et al., 2008; Chandra and Sankhwar et al., 2011; Kinnarinen et al., 2016). Rules and regulation related to wastewater have been made strict over time; it discourages the discharge of untreated waste from the paper and pulp

industry widely (Korosec K et al., 2013; Kamali and Khodaparast et al., 2015; Wen et al., 2016; Meyer and Edwards et al., 2014).

Chapter 3

3 Methodology

3.1 Case study research approach:

Case study research methodology has been employed to collect detailed information about the environmentally friendly production practices of role model business organizations in their own operations as well as in their supply chains.

Case study is an established form of in-depth qualitative investigation (Yin et al., 2003a and 2003b; Birkenhoff et al., 2003; and Feagin, Orum and Sjoberget al., 1991). The case study approach (Merriam et al., 1988; Hamel et al., 1993 and Yin 1994) includes a review of documents and in-depth interviews (Yin et al., 1984 and Hagan et al., 1993).

3.2 Content Analysis:

Content Analysis of available annual reports as well as of the sustainability reports prepared by the organizations has also been conducted in order to find out their sensitivity and examine the written policies relating to environment protection and climate change issues This technique is commonly used for finding out the words, themes as well as for providing the explanation and interpretation of paragraphs or visuals from print or electronic media such as reports, newspapers, videos, images etc. (Scott and Morrison et al., 2006, Lachlan et al., 2005; Payne and Payneet al, 2004; Ramasubramanian et *al.,* 2003 and Durant et al., 2003)

3.3 Identification of Role Model Organizations and Setting a Benchmarking for their Practices:

The identification of role model business organizations materialized after an in-depth discussion with the business forums such as Lahore and Islamabad Chamber of Commerce, the concerned non-governmental organizations such as SDPI, WWF-Pakistan, ACCA Pakistan, and IUCN.

Global Reporting Initiative is an independent international organization, but its efforts for preparing corporate reporting guidelines for promotion of sustainability in businesses is totally supported by United Nations and its allied organizations. It guides and helps businesses to play a responsible and positive role in tackling environment and climate change

related issues. Its great contribution comes in the form of a comprehensive set of indicators related to economic, environmental, and social dimensions of sustainability.

Several performance indicators enshrined in G4 Global Reporting Guidelines related to environmental protection and tackling the challenge of climate change have been used to explore innovative strategies adopted by role model corporations corresponding to the indicators (Please see the interview schedule attached as Annex 'A')

Contact with the identified role model businesses in terms of embodying best environmental protection measures in their own operations and in their supply, chains were made. Their consent was sought to visit the plants and collect necessary information from the offices concerned. All the necessary information has been collected through in-depth interviews, document analysis and ocular observation.

The following identified business organizations has been included in this internationally and locally study:

1. Attock Refinery Limited
2. Ittehad Chemicals
3. Nishat Linen
4. Ali Murtaza Associates

4 Case Studies

4.1 Attock Refinery Limited

The oil industry can harm the environment in many ways for example industry tends to produce nitrogen and Sulphur which after a reaction can become a poisonous chemical in the atmosphere. Adding more to it the oil spills in the sea can be dangerous for marine life and if on land can contaminate the ground water and much more. Apart from the poisonous gases released in the atmosphere, methane release that contribute to climate change, oil spills can also affect biodiversity as it may force species to move out of the place due to high noises and smoke. However, the model industry has become aware of the environmental issues and has shown resolve to overcome the issue by carrying out responsible operational activities.

4.1.1 Industrial Profile:

The industry was established in 1922. The core business of the industry is refining of crude oil and supply of the major and minor products produced out of it. With experience of over 90 years, the industry has upgraded its working equipment and processes to remain in the competition and meet the challenges of the modern world. Attock Refinery Limited present capacity remains at 53,400 bpd (barrel per day) and it could process lightest to heaviest (10-65 API) crudes. The Company has certifications of ISO 9001, ISO 14001, ISO/IEC 17025, OHSAS 18001 and is the main refinery in Pakistan voluntarily complying with standards prescribed in ISO 50001.

The following map shows the location of the Attock Refinery Limited headquarters in Rawalpindi.

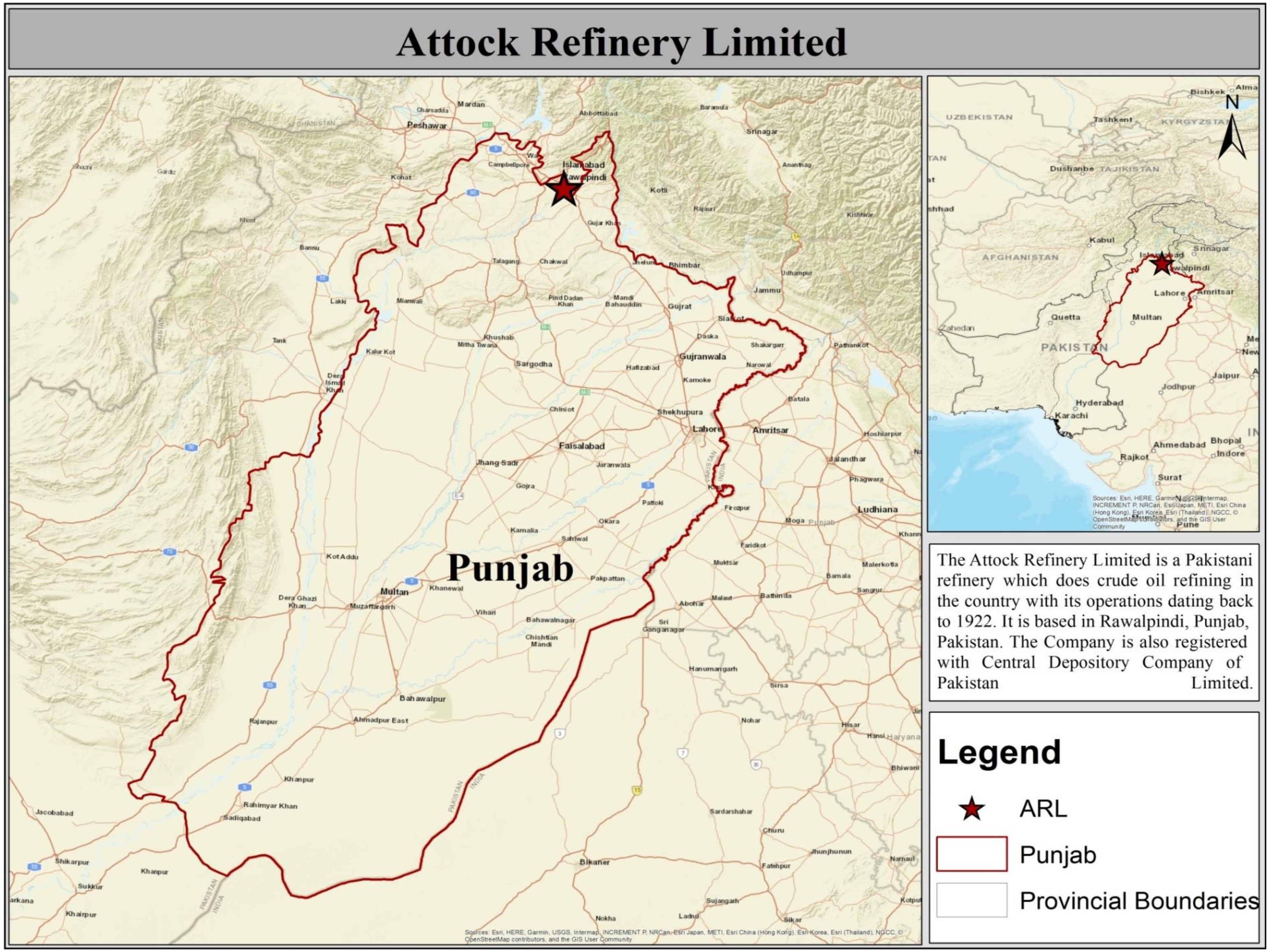

Figure 6: Location of Attock Oil Refinery

4.1.2 Case Study:

Attock Refinery Limited operations are done so that there is minor impact on stakeholders including environment and the community. The industry attaches high priority to the wellbeing and safety of its stakeholders. The efforts made by the business to protect the environment are not just to comply with standard or protocols, but it goes beyond that and considers its moral responsibility. In the light of the beliefs ARL have, it has established grievance committees which look after the complaints lodges by the stakeholders regarding any environmental detrition or any negative impact industry is causing to the environment. The committee on receiving the complaint acts prior to investigating for complaint filed and makes sure that the complainer is satisfied by the actions they take regarding the complaint they receive.

Operation and the way industry works reflect the motives of the industry. The working practices adopted by the management of the ARL reflect the staff's dedication to conserving the environment. The ARL tend to preserve pollution by adopting way of working that consume energy in an efficient way i.e., reuse and recycling of raw material and at any step industry uses the cost-effective techniques of cleaner production hence leading sustainable development. The ARL policies to preserve or conserve environment is not only due to the need and regulations of the current world but it is in the latten of spirit from the very first day of the industry which dates to 1922 when it was the first oil related industry in the area. The work done by the industry for preserving environment is intense and is done in steps like

- **1987** it was the first industry to transfer its major products through pipelines to avoid emissions of greenhouse gases into the environment by the transport vehicles and to avoid the spillage during transport (no spillages observed in the year 2017)
- **1998** it was the first to produce diesel with low Sulphur content in it
- 1999 first to produce gasoline with low lead content and in the same year the industry was the first in the region to get certification of ISO 9002
- **2001** first to get ISO 9001:2000 certification in the region
- **2002** first to get ISO 14001 certification in the region
- **2006** first to get OHSAS 18001 certification in the region
- **2007** first to get ISO 17025 accreditation in oil sector in the region
- **2012** first to declare ISO 50001 implementation in the region

- **2017** one of the major industries to commission pre flash, ISOM, DHDS and Auxiliary units

The fact that environment is fragile is well known to ARL and on that basis, industry has categorized its environment plans into three categories

1. Short term plans
2. Medium term plans
3. Long term plans

Attock Refinery Limited has an excellent record of accomplishment in adhering to strict health and safety compliance rules. They were awarded “Best Sustainability” Award as well as “Best Corporate Report” by the joint Committee of ICAP (Institute of Chartered Accountants of Pakistan) and ICMAP (Institute of Cost and Management Accountants of Pakistan) in 2012. They also won the prestigious ROSPA (Royal Society for Prevention of Accidents) Gold Award in 2013, for the second consecutive year. Furthermore, Attock Oil Refineries holds honor of winning the “Energy Award” by HBUs and OM (Oil Movement II) for the 5th time in 2017.

It is due to the struggle and work ARL is putting to protect the environment that it did not pay any violation fines in the year 2017 (100 percent compliance to environment protocols). The industry's work for environment is not only limited to its production area boundaries, but the industry plants 10,000 to 12,000 saplings each year along with 2,000 fruit plants near the industrial unit. The industry is also donating plants to the educational institutes to promote vegetation and green practices.

4.1.2.1 Energy Conservation:

The fact that the natural nonrenewable energy sources are scary and very precious is very well known to ARL. The policies made by the industry tend to use the energy resources optimally and work on further reducing the consumption of those resources is always there. The industry over a period had replaced the old fashioned (more energy consuming) equipment and utilities with the newer and effective innovative technologies like importing new refinery plants and replacing the basic utilities like ACs (with invertors technology), tube lights (LEDs), streetlights (LEDs) and many like these with the latest effective technology in terms of energy) and this was done in a series of steps. The industry had also commissioned three waste heat recovery plants along with replacement of motors in two different dispatch

pumps with VFD motors resulting in 46 percent and 64 percent energy usage reduction by the pumps. While utilizing the resources efficiently, less energy is consumed, and less greenhouse gases and other hazardous gases emitted into the environment. The industry plans to recover waste heat to maximum extent and had made this as an objective in their long-term plan.

The industry has a never-ending mission of reducing energy consumption and for the sake of it several steps are taken like

- Usage of robust and sound technology for optimal utilization of energy resources
- Effective management of energy by setting goals and managing step by step initiatives to meets those goals
- Realizing the sense of responsibility and making sure to comply with all the applicable legal requirement
- Launching awareness campaigns limited not to industry itself but also to the communities settled alongside the industry and the educational institutes

The industry self-implemented ISO 50001 even though it was not required for any compliance. For monitoring of energy usage, the company has been using the guidelines of ISO 50001 since 2012 and this is being carried out after commissioning the up-gradation project of refinery and is implemented on all the 12 units industry have. All the equipment that is using significant energy inside the industry is being monitored through energy performance indicators (EnPIs). The monitoring of processes like consumption of fuel oil, steam, fuel gas, water, and instrument air per barrel of crude oil is daily, and the report is sent to environment protection agency monthly.

Industry is not only active in terms of conserving the energy but also in terms of spreading the awareness about it like

- Celebrating the energy week in which it spread the words on importance of conserving energy
- Industry also schedules energy ideas competitions and receives such ideas from the stakeholder and top 3 ideas are awarded with prizes
- Industry also goes for talks and sessions about the importance of saving energy and utilizing it effectively

As the world is now shifting towards using green energy sources or renewable energy sources so is this ARL as in 2016 it formulated a task force under the leadership of management of Health Environment Safety and Quality (HESQ) for execution of renewable energy source projects with the approval of millions to execute the project of installing 57kW capacity of solar panels (currently industry is using 1606 MMBtu of renewable industry).

ARL along with carrying out different activities inside the industry is also facilitating different university students on their projects regarding energy conservation. In the year 2016 to 2017 industry had facilitated four graduate and post graduate students in their projects focused on energy conservation.

Meanwhile, the industry plans to get sub-meters for energy consumption monitoring as per the guidelines of ISO 50001.

4.1.2.2 Water Conservation:

Water is a sarcastic resource and is critical for business: this is well realized by industry, and it had taken several steps in reducing its consumption in the previous years. The industry had a target of reducing water consumption to 54000 Gph (Gallons per Hour) and had achieved 38,982 Gph (in year 2016 to 2017) which not depicts the completion of an objective but also the seriousness and dedication of the industry in achieving what is required and necessary. ARL is getting its supply of water form11 shallow and five deep tube wells and industry also have storage tanks to meet supply needs in days with absence of water.

The industry, knowing the importance of water, is recycling about 50 percent of water (reusing it in plants) and plans to get this recycling process extended to tertiary level to extract maximum quality water from wastewater that could be used in plants. The industry, as a long-term plan, tends to start rainwater harvesting so that the amount of water extracted from the ground can be reduced.

4.1.2.3 Air Pollution:

Fresh air is believed as a basic right for every organism on the face of earth and this is well realized by the industry considering it not only as compliance requirement but also a responsibility under the notion of corporate citizenship.

The greenhouse gasses that are crucial in damaging the environment cannot be avoided to full limits but can be restricted to certain limits and this is what ARL is doing restricting the

emission of greenhouse gases to the limits prescribed by the Punjab Environment quality standards (PEQs).

Stack gases like Carbon Monoxide, Sulphur Dioxide, Nitrogen Oxide, and particulate matter from different heaters and boilers are restricted to be in limits as prescribed by PEQs. To recover refinery flare gasses is one of the objectives in the long-term plans industry marked.

ARL also keeps a check on its vehicles for greenhouse gases and the fitness of all its vehicles is checked every two years, vehicles that are producing gases more than the allowable limits are replaced immediately.

4.1.2.4 Waste:

The waste is categorized into two categories: hazardous and nonhazardous. The industry has installed an active sludge unit and the organic waste collected from it is further used to produce biogas in the industry's biogas production unit. As ARL is an oil refinery the hazardous waste is oil, so the oil recovery systems are equipped and are also installed on the drainage systems in order if by chance effluents of oils are about to be drained out it get recovered and reused in refinery. In 2017 about 6,015 metric tons of oil and 28.40 metric tons of bitumen were recovered and recycled. Total hazardous waste produced by the industry in the year 2017 was 26,856 kg (about 59207.27lb) which included Oily rags, Oily sludge, and the waste from the hospital of the corporation and the weight of the nonhazardous waste was 220735 kg (about 486636.8 lb) in the same year which included paper, paper waste, plastic scrap, wood, kitchen waste and miscellaneous iron scraps.

ARL uses water for couple of purposes and during the processes it get polluted so before discharging the wastewater the water is treated well in the treatment unit to bring the pollutants to the acceptable limits as prescribed by the Punjab Environmental quality standards (PEQs). The industry has also reduced its discharge of waste over the past few years like from 2015 to 2017 the quantity has reduced from 64.79 million gallons (about 245256713.9 L)/year to 59.39 million gallons (about 224815499.9 L)/year.

The purpose of managing waste is to

- Reduce the quantity of waste being produced
- Separating hazardous and nonhazardous waste
- Safe disposals

For hazardous waste that cannot be recycled, the industry is handing it over to contractors certified from environment protection agency (EPA) for proper treatment and safe disposal. The industry conducts surprise visits from such contractors to make sure that waste is being handled according to protocols.

4.1.2.5 Lesson Learnt:

Since the establishment of ARL, the industry has been in a continuous struggle to make the processes efficient and investing millions or one can say billions in doing that. To make such investment enforcement of protocols by environment agency cannot be the only reason but the company must have the spirit and motivation for protecting the environment, such motivation was seen in Attock Refinery Limited, their spirit in conserving the environment was so high that the industry had made conserving environment a mission for them. The investment of millions to conserve the environment pays off well too: for instance, as the ARL invested a lot in making sure that there is no spill, less energy is being consumed and the processes are efficient at the same time, this means that the industry is saving time and money at same instance which covers the investment made for conserving environment and eventually the industry starts to make profit out of it (increasing the limits of profit).

4.2 Ittehad Chemicals

Economic activities can help countries grow but most of the times these activities come along with a byproduct called “environmental degradation”. As the industries in order to produce more profits are usually releasing harmful pollutants to the air some waste into water and much more (Croitoru & Sarraf, 2010). If we categorize the damages caused by the poor industrial practices they can be as follow:

- Loss of agricultural lands
- Loss of forests
- Ground water
- Air Quality
- Waste
- Coastal Zones

However, few industries are striving hard to protect the environment. This case study is based on an industry that invested a lot to conserve environment and has worked on the improvement of the following problems:

- Energy Efficiency
- Water Conservation
- Waste disposal
- Gas Emissions

4.2.1 Industrial Profile:

The industry chosen for case study is Ittehad Chemicals. This industry was established in 1962 under the name of “United Chemicals”. The industry is spread over an area of 106 acres and is located on GT road (Kala Shah Kaku) near Lahore. The industry is working on vision to “deliver sustainable chemical products to its customers thus optimizing returns for investors”. The company is one of the largest chemical manufacturing companies in Pakistan; it is producing Caustic Soda, Liquid Chlorine, Hydrochloric Acid, Sodium Hypochlorite, Bleaching Earth (Shaffaf), Chlorinated Paraffin, Sulphuric Acid 80%, Zinc Sulphate, and Barium Sulphate.

Figure 7: Location of Ittehad Chemicals

4.2.2 Case Study:

The industry been visited on 2nd of December 2017 where we met General Manager and Unit Manager Environment, Health and Safety Muhammad Sohail Anwar. The discussion has been started by a talk on hazards industries can cause specially relating to environment. The general manager highlighted the fact that for the sake of saving money environment is not given much importance but meanwhile the Ittehad Chemicals is specially looking into the environmental apprehensions and are taking steps in order to conserve it. The industry in the past done a lot to conserve environment and also satisfied the ISO 9001 (in year 2000) or ISO 14000 standards and moreover Environment, Health and Safety department (EHS) is also formed which specifically looking into the environmental concerns and also making sure that production units are also not effecting the health of the staff working in the premises of the industry. One of the responsibilities of EHS department is to run blood tests of the staff and check if everything is under control or not.

4.2.2.1 Air Pollution:

The industry was using mercury based technology for the sake of production of Caustic Soda; as they were renowned at the time when the industry purchased the manufacturing units back in 1960's. Meanwhile in the line some more units were purchased in 1980's but at that time membrane technology was available in the market but it was quite out of range and awareness was not there in Pakistan about the consequences of mercury emissions in the atmosphere. It was not well known in Pakistan that mercury emissions from the Mercury based Caustic soda production units can pollute the atmosphere and cause brain, kidney and damages to other organs. Industry did not know that it is not only the environment that is getting polluted but also the workers that are working in the vicinity. Over the time industry learned about the corns of Mercury based production units and Pons of membrane based production units. At the same time Environmental Protection Agency also came into action and worked on making the industry aware of the risks of using mercury based production units. The industry keeping in view the risks of mercury based production units and requests made by Environmental Protection Agency regarding decommissioning of Mercury based plants invested RS. 2 billion for the sake of bringing membrane plant and to forbid the use of Mercury technology as it had environment unhealthy practices (release of mercury in atmosphere). The industry always corporate with the government for conservation of environment as some officials from government and industry as a joint venture went to Germany in 2011 to learn more about the risks of using mercury based production units. The

government allowed the industry to use mercury based plant till 2020 but industry knowing the risks of such practices decommissioned its last working mercury based plant in 2016 and replaced it with the membrane technology.

Moreover, within the production units the gasses that are released into the atmosphere are treated by the industry prior to their release for instance during the transfer of hydrochloric acid into tankers the industry has scrubbers which absorbs and neutralizes the harmful acidic and toxic gases as during transfer some gases are meant to escape into the atmosphere so industry detoxicate and neutralize the gasses prior to their escape.

The hazard that chlorine may release into the atmosphere is also well tackled by the industry as the chlorine gas produced in reacted with calcium hydroxide. The system is designed; if sniffs of chlorines are produced they go undergo reaction and changes to calcium hypochlorite. In the same way if the quantity of chlorine is way much then sodium hypochlorite (bleach) is made which is later on sold in the market.

4.2.2.2 Energy Conservation:

The initiative of replacing mercury based production units with membrane technology turned out good in many ways and one was energy conservation as the energy consumption is now reduced by 2/3rd in the past years by the industry. The industry haves its own power plant which fulfils major need of energy and only 10MWis taken WAPDA.

4.2.2.3 Waste Disposal:

Industry has drains equipped with pH control system so all the wastewater that is necessary to drained is first brought to the pH recommended by Environmental Protection Agency. All the wastes in terms of gasses specially that is being produced in the process as further used as raw materials and by products are made, this not only conserves the environment but also maximizes the profit being made by the industry.

Moreover, leakage detection systems are there which detect any leakage of waste gasses and immediately remedial measures are taken.

Motivations to afford costs:

Industry knows it social corporate responsibility so the costs of adding new expensive units and decommissioning the old units were necessary to bear. Moreover the old units were scrap and sold.

4.2.2.4 Lessons Learnt:

Even though the costs are quite high for adopting new and the latest technologies, industries like Ittehad without showing any hesitation, have adopted them for the sake of the environment and the staff working in the industrial area. The cost faced in adopting such technologies did not only turn out to be good for the environment and the population nearby but also for the financial scores of the industry, as with the modern technology more byproducts are being made and sold in the market.

4.3 Nishat Linen

Textile is playing key role in economic growth and significantly contributes to exports of Pakistan. The textile sector is essential for industrial and developing countries to achieve sustainable development goals. Every customer product has an impact on the environment, but consumers dose not bother the environmental impact of product. Consumer even does not have knowledge about the environmental damages of product. So, there is need to produce environmental-friendly products, use and dispose of properly to minimize environmental damages.

4.3.1 Company Profile:

Nishat linen is one among companies who has adopted advanced technology for production of fabric with efficient use of energy. It was founded in 1951 by main Muhammad Manisha in Lahore, Pakistan.

Company also has few subsidiary companies of Nishat mills limited such as “Nishat Power Limited, Nishat Linen (Private) Limited, Nishat Hospitality (Private) Limited, Nishat Commodities (Private) Limited, Lalpir Solar Power (Private) Limited, Hyundai Nishat Motor (Private) Limited, Nishat Linen Trading LLC, Nishat International FZE, Nishat Global China Company Limited, Nishat UK (Private) Limited, Concept Garments and Textile Trading FZE and Nishat USA Inc.

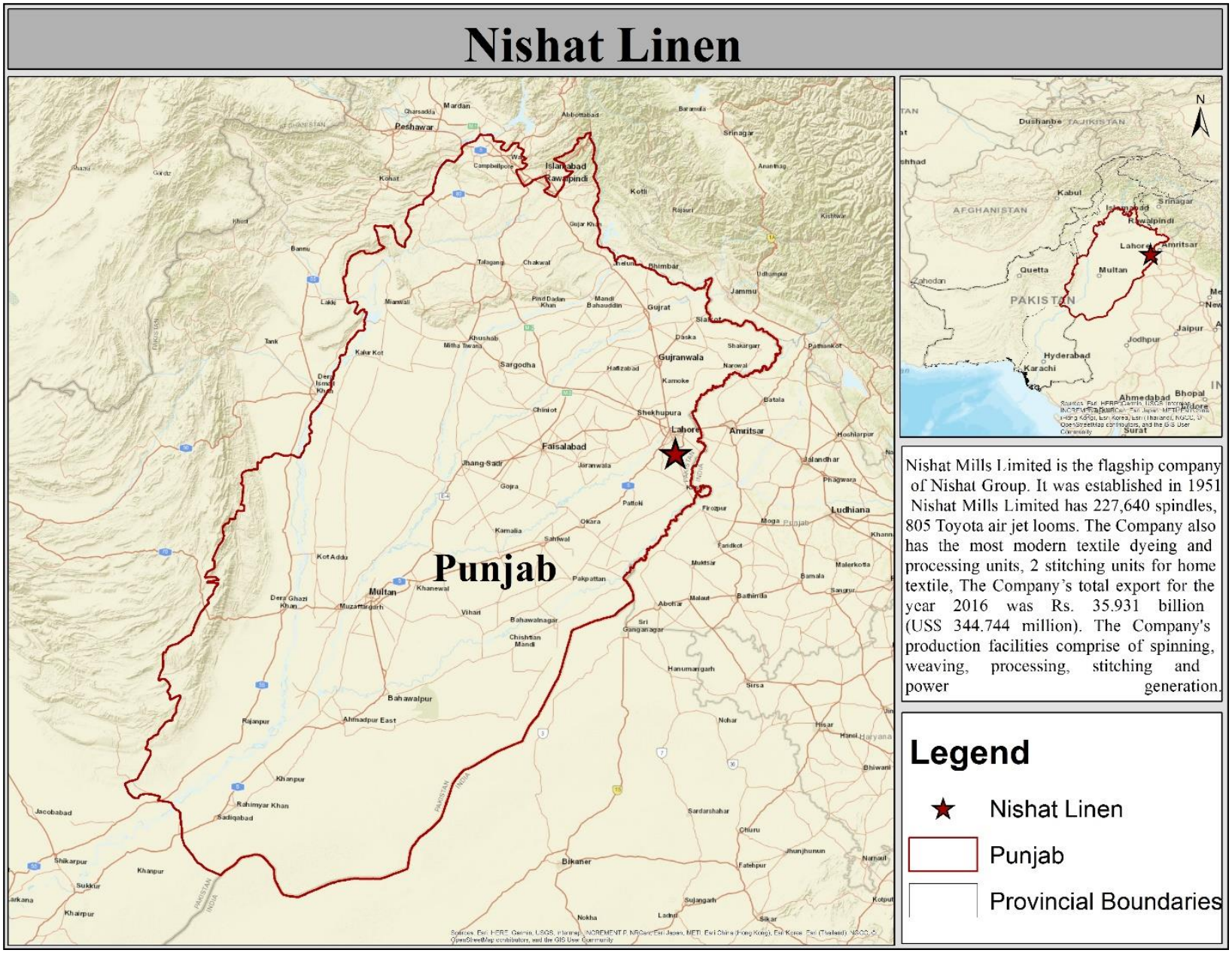

Figure 8: Location of Nishat Linen

4.3.2 Case Study:

Industry was visited on 29th of May 2022 where we had a meeting with senior manager Engineering Muhammad Athar Bashir who enlightened us with the efforts industry had made and still making to make their production environmentally friendly.

Industry produces fabric with an average production of 4.5 million meters per month but quantity of producing fabric may vary seasonally. In a few season industry productions are near to 4.8 million and sometimes it goes down to 2.6 million.

4.3.2.1 Energy Conservation:

Nishat linen is as far most concerned company of environment and ensured to use most efficient and environmentally friendly energy sources at manufacturing units. For this purpose, company have A 9.6 MW Wartsila tri-fuel engine, which directly convert gas to HFO with surplus heat recovery mechanism at Nishatabad. Unit is competently working since October 2016 in Faisalabad and "Solar PV plant for Garments Segment II" also commissioned in December 2016 successfully. 10-ton low pressure coal fired boiler has been installed at waving division, which has started production from 1st quarter of fiscal year of 2017-2018. The Company also uses fly ash to produce pavers – a paver machine has been installed in May 2017 and successfully working since mid of May 2017. In Lahore Dyeing & Finishing unit of NISHAT linen new 65-ton coal fired boiler installation is under consideration. New "captive power plant to cater for the spinning production" situated at -3 Faisalabad Industrial Estate and in the first stage one pure gas fired, three 6 MW Wartsila generators, and two dual fuel generators has shifted to this power plant from other locations of the Company.

Industry uses steam for different purposes and where steam is used there are heat exchangers. As applicable temperature is 90, 92 in washers if the industry drains out the steam at this temperature it means energy is being wasted so they extract out the energy and water is drained at 40 45 .Same way energy towers are installed in machines where heating is done, which captures the escaping heat and reuse it in heating process for example if someone is

heating a cattle with a burner there will be some heat being lost to the surroundings so the industry is technically capturing the surrounding heat and reusing it in the process.

4.3.2.2 Water Conservation:

Many tons of water (210 -220 tons per hour) are used in the processes within the industry but in order to conserve water as it being a sarcastic resource industry is reusing water that is fit for the purpose. The industry has also invested millions in order to get the most expensive water treatment plant in Pakistan which treats the water and from which depending on the quality of recycled water it is either reused in the processes or drained out. Many initiatives are taken to save the water or consume it lesser which also involves cooling of water (coming from the process where steam is used) by extracting extra energy from it and reusing it. According to the senior manager of Industry about 60 to 70 tons of water is being recycled per hour.

4.3.2.3 Gas Emissions:

The industry processes do not produce gaseous emission as done in cement or other industries, but carbon dioxide emission is there from the processes of burning and generators. From the year 2012 and year till date the industry had successfully reduced its emissions by 40 percent all because of using energy efficient means like heat exchangers etc. Nishat linen is also participating to promote solar technology for energy conservation purpose and reducing the CO2 emissions.

4.3.2.4 Waste

Industry tends to produce two types of wastes hazardous and non-hazardous. Waste includes waste water sludge, dye containers, dye waste, lab waste and fabric. The waste on daily basis is either sent back for refilling like some of the waste produced from labs, and some is sold out. For the waste that is hazardous like empty chemical drums are handed over to the vendors that are approved by the Environmental Protection Agency. The vendors do charge the industry per drum which industry is paying on regular basis.

Dyeing and printing process of manufacturing of clothes have serious environmental damages if sufficient procedures are not taken to alleviate environmental damage. Nishat linen has established a waste water treatment plants at printing, dyeing and outfits manufacturing units with cost about 600 million and treats waste water by 200 cubic meters per. Industry also makes sure that not waste water gets drained out without being treated.

4.3.2.5 Lessons Learnt

As far environmental analysis of company is concern shows remarkable efforts are being adopted by Nishat linen limited. Company is putting complete effort to protect the environment industrial damages and sustainable growth. Nishat linen initiated reasonable environmental activities in fiscal years of 2016 and 2017, especially in waste water treatment, recycling and energy conservation.

4.4 Ali Murtaza Associates

Textile industry has high impact on the economy of Pakistan, as per the statistics shared by Ministry of Textile of Pakistan it contributes 57% in total to the exports of Pakistan. Yet lot needs to be worked on in order to improve the supply chains and improve productivity in order to maximize the profit and survive in today's world of high competition (Government of Pakistan, 2018).

Apart from the participation of textile industry to the exports of Pakistan, the textile industry tends to make the environment vulnerable. There are many concerns relating to the environment that textile industry generates like effluents of dyes in the waste water. Water a sarcastic resource, used in abundance during the process of manufacturing. High rate of energy being used produced from nonrenewable resources.

If we talk about the textile industries around the globe as a whole, textile industries due to inefficiency of dying procedures produce around 200,000 tons of dyes as effluents which are usually discharged with the waste water (Ogugbue & Sawidis, 2011).

4.4.1 Industrial Profile:

Ali Murtaza Associates was founded in 1986 as a small trading company but over time the small trading company excelled and it laid foundation to its first production unit in 1990 in Karachi, since then the company is excelling and now has become one of the leading industry in the market. In 2007 the company started a production unit in Lahore and today the production unit has capacity of producing about 10 million garments annually. The company works on the motto "Lead from the front and inspire others". The company has wide capacity of sewing and its washing unit was a setup in collaboration with reputed European laundry.

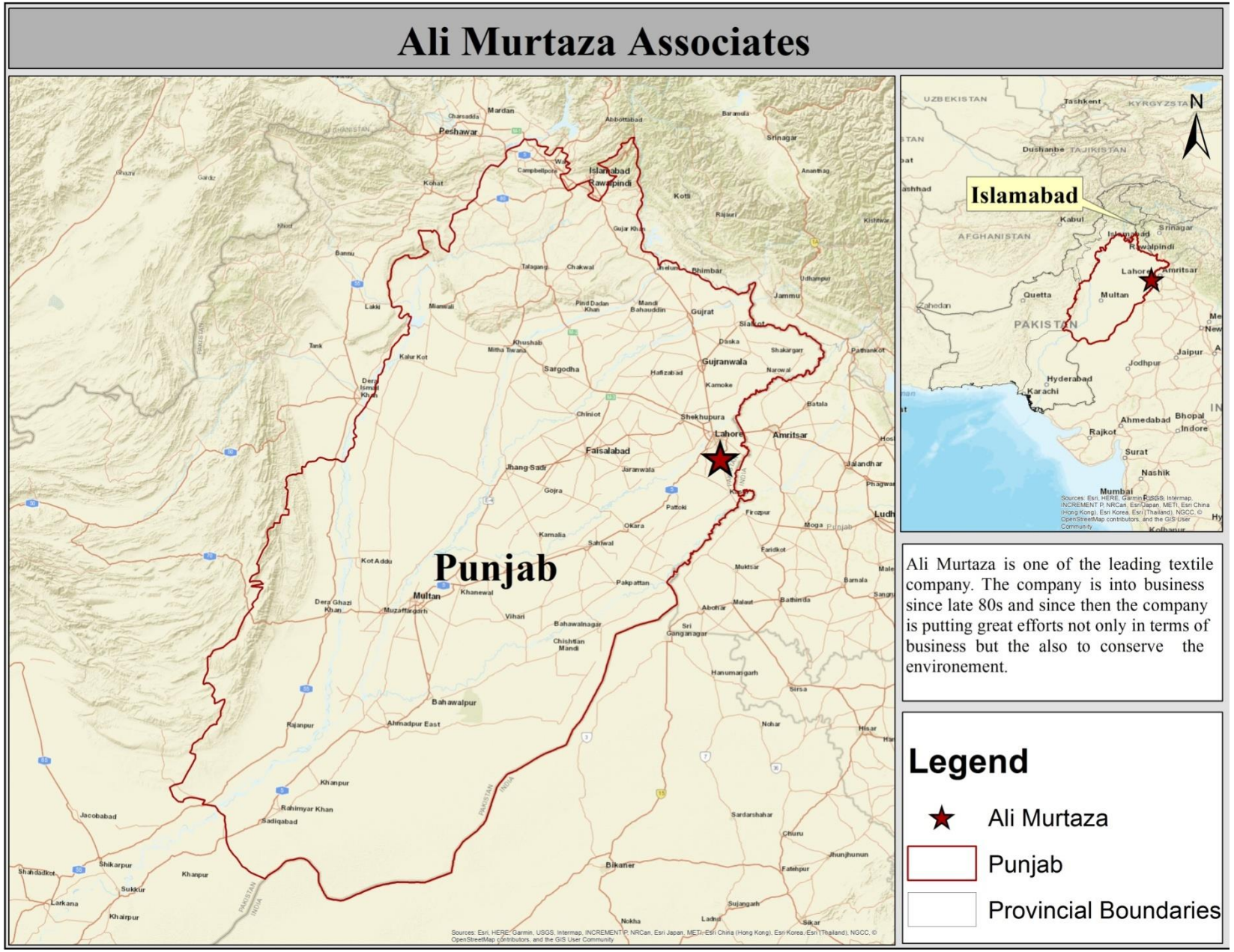

Figure 9: Location of Ali Murtaza Associates

4.4.2 Case Study

The industry was visited on 29th of May 2018 where we met Major(R) Abid Iftikhar Director (Admin/HR). The talk started by discussing the sensitivity of climate change and role that industries can play in conserving the environment.

The primary product of the industry is garment. The average raw material used per month is around 4.0 to 4.5 million meters (about 2796.17 mi). In the manufacturing unit the raw material used is fabric and it is 100 percent renewable.

4.4.2.1 Energy Conservation

Over time the industry had worked hard to conserve energy. In garment stitching unit light is very mandatory even according to the standards. So, a network of lighting is there, when Ali Murtaza Associates first installed the production/manufacturing plant in Lahore, the lights used were normal tube lights (40 Watt per tube light) and 4 were normally provided to one dressmaker. Now industry has replaced all the tube lights with LED lights which are low power consumers. What industry faced as a challenge in it was that all the tube lights that were installed for instance there were 3000 tube lights in one hall cannot be replaced in one go and problem of dumping the tube lights was also their tube light itself is a hazardous waste, so its disposal was an additional cost for the industry. So, they were removed gradually, about 100 to 200 tube lights per month. In 2 years, all tube lights were replaced with LEDs. About 80 to 90 percent of the lights in the processing units are LEDs now. It reduced electricity consumption for lighting by 40 percent. Over time, the company also manages to attach small LEDs to the sewing machines' needles to reduce the requirement of roof-based LEDs, which also reduced the energy requirement. The extra cost for installing new lights was recovered within a year by the cost of electricity industry saved from it. Lights in outer parameters were also replaced by the industry with LEDs.

Adding more to energy conservation the old motors attached with stitching machines were consuming more energy so eventually servo motors were installed replacing the old motors which saved the electricity consumption in the process by 40 percent.

4.4.2.2 Water Conservation:

Industry has heavy requirements for water and for the purpose of fulfilling the requirement two turbines are used, each having a capacity of 26638.5 Gallons per hour. Water is used in dying and pressing the garment. In pressing steam is used as the water in liquid state leave stains onto the garment, but eventually when the steam starts to loss temperature it becomes useless, so I order to stop water from being wasted condensate system is their which again directs the water in liquid state to the boiler which again changes it to steam (water is being recycled in the process). This process not only saves water from being wasted but also conserves energy as more energy is required to convert water which is at room temperature as compared to water that is already at elevated temperature of about 90 degrees.

Moreover, the industry has also invested millions to get Reverse osmosis plant which softens the water used in the process of washing, previously where a garment had to be washed twice or thrice to get the results now one wash does the work.

The industry has its own water treatment plant and industry is making sure that all the water that is being drained out does not possess effluents of dye or any other chemical.

4.4.2.3 Gas Emissions:

Industry does not tend to produce any gas emissions except for one being produced from generators, industry is continuously struggling to overcome these issues as new expensive generators were imported but still, they emit gases. The industry tends to strive until it achieves compliance regarding non emission of carbon dioxide into atmosphere coming out of generators.

4.4.2.4 Waste:

There are two types of waste from industry, one is hazardous and nonhazardous. Nonhazardous is one that is from office stationery and things like that and hazardous are the dyes that may get drained with wastewater, but water treatment plant is installed by the industry to overcome the issue and make sure that effluents of dye or other sort of chemicals do not get drained out prior to treatment as per the standards.

Apart from this there are drums in which the industry gets its supply of dyes; these drums are also a waste once the chemical inside the drum is used. Those drums are supplied to

Environmental Protection Agency approved vendors which charged us with 50 rupees per drums and takes away those drums.

4.4.2.5 Remarks:

Ali Murtaza Associates have struggled to conserve the environment in all major sectors like energy, water, gaseous emission (from generators, as importing new and latest models require huge capital) and industrial waste. The administration has concerns about employing greater amount of investment and effort into environmental protection as government of Pakistan gives no incentives or rewards to the industries that comply with these standards. The government of Pakistan also does not provide them with landfill sites where they can dump their solid nonhazardous waste due to which the industries have to bear extra cost and pay to different vendors to get rid of the solid waste.

5 GUIDELINES FOR CLIMATE CHANGE MITIGATION

We know that many companies are suffering from the consequences of climate change and will continue to suffer in the future. However, many individuals are confused about how they can help in the fight. Here are some actions that all companies may take to help fight climate change.

a) Reducing industry's greenhouse gas emissions

- It is imperative that industries must invest in sustainable energy solutions
- Enhancing Industrial energy efficiency better for climate
- Deliberation of renewable energy for productive use
- Keeping in view the multiple benefits of sustainable energy solutions
- Endorsement of the Montreal Protocol and GHG emission reductions is necessary.

b) Climate resilient industry

- Businesses should encourage the components of an industry that is climate resilient.
- It is necessary to implement a good technology transfer method.
- Emerging technologies should be developed for climate-resilient businesses.
- Collaboration on climate action with multiple industries

c) Transportation source for employees

- A fuel-efficient transportation system should be implemented. (Such as hybrid vehicles or fuel-efficient vehicles).
- Employee carpooling should be improved.
- Public transportation/buses should be used whenever possible.
- Short-distance walking should be preferred.
- Bicycling should be promoted because it is both healthier and more environmentally friendly.

d) Industrial waste

- Reducing the primary sources of industrial waste
- Waste materials need to be reused.
- It is important to offer new techniques and recycle items.
- Businesses should work to use garbage to produce energy resources.

- promoting appropriate waste treatment and disposal practices to protect the environment

e) Sustainable packaging

- Products should be shipped in a smaller package.
- Recycled packing materials will protect the environment
- Using plant-based packaging will help protect the environment.
- Companies should encourage edible packaging since it will help cut down on waste.
- Items should be packaged in plant able materials.
- Manufacturers should provide alternatives to plastic that are compostable and biodegradable since their final products will not affect the climate
- Throughout the supply chain, over packaging must be avoided.
- Work with manufacturers who employ eco-friendly procedures.

f) Climate Change policy

- A general policy to promote positive climate change should be implemented
- To conserve the climate, new government policies need to be implemented and pushed.
- Each should improve their climate adaptation.

g) Mitigation strategies

- Industries should adopt energy-saving techniques by utilizing renewable energy sources.
- Quick emission reductions can be achieved by switching power plants and automobiles to less carbon-intensive fuels.
- To protect the environment, industrial pollutants and vehicle emissions should be appropriately absorbed and filtered.

H) Eco Friendly Products

- To save environment, industries should use sustainable copying and printing of paper
- Introducing excellent quality diaries and calendars which has no negative impact on surroundings
- Ecologically sound notepads and notebooks should be made available.

- All trade should be required to use reusable envelopes
- Ecologically responsible business cards should be adopted.
- Use should be made of sustainable folders.
- Promoting sustainable pencils is important.

Chapter 6

6 Conclusion and Recommendations

"Fit-for-the-future" Climate-resilient industries require innovative technology and methodologies in Pakistan. These steps should be taken to make industry environmentally friendly

1. **Sustainable energy solutions**

Energy that is affordable, dependable, and sustainable is a necessary precondition for long-term economic prosperity. To secure access to contemporary energy sources, business should take a multifaceted approach to providing sustainable energy solutions, while also taking actions to minimize energy-related gHg emissions from industry. This strategy involves increases in energy efficiency, renewable energy solutions, and the development and transmission of low-emission technology. Industry should respond to the demands of a diverse range of stakeholders by examining the country's context, priorities, industrial structure, and stage of development.

2. **Industrial energy efficiency**

Internationally Industrial energy efficiency programs are built on more than three decades of experience in industrial energy efficiency measures and regulations. These programs recognize the potential in decreasing energy intensity in industry and its contribution to boost industry competitiveness. The application of managerial tools based on the ISO 50001 energy Management Standard and/or pertinent national standards is combined with the deployment of low emission technology, the principles of product quality, sustainability, and cost-effectiveness. The strategy encourages long-term investment to support the growth of an energy-efficient firm and incorporates energy-efficient measures into the company's everyday operations.

3. **Renewable energy for productive use**

Renewable energy sources give developing nations the chance to adopt a low-emission route supported by innovative, perceptive, and regionally applicable energy solutions. The growth

of the renewable energy industry lessens reliance on imported energy, generates employment, and slows climate change.

Renewable energy should be considered by industry to boost their competitiveness and cost-effectiveness; small and medium-sized firms should be encouraged to adopt renewable energy in industrial applications. Additionally, it encourages the creation of creative business plans to advance the field of renewable energy and seeks to improve access to electricity, particularly in rural regions, through mini grids**.**

4. Multiple benefits of sustainable energy solutions

Multiple advantages of sustainable development are provided by sustainable energy solutions, including poverty reduction, better food, and energy security, improved public health and gender equality, reduced pollution, improved biodiversity, and cost savings that promote competitiveness. Industry should work to leverage these numerous advantages and help countries and the world at large accomplish their development goals.

5. Montreal protocol and GHG emission reductions

Ozone-depleting compounds, such as chlorofluorocarbons (CFCs) and hydro chlorofluorocarbons (HCFCs), are powerful greenhouse gases with hundreds or thousands of times the potential of global warming carbon dioxide (CO2). Preventing the release of ODS into the atmosphere helps repair the ozone layer and has a considerable influence on climate change mitigation.

ODS are employed in various industrial industries, including refrigeration and air conditioning, foam manufacture and solvent usage, medicinal inhalers, and agriculture. CFCs were phased out under the Montreal Protocol in 2010, and HCFCs are presently on a phase-out plan that will result in their total removal by 2040. UNIDO, together with the Protocol's other implementing bodies, assists these sectors in developing countries in their efforts to phase out harmful compounds.

In 2014, UNIDO was named the best Montreal Protocol implementation agency between 2001 and 2015. UNIDO's successful execution of over 1,340 Montreal Protocol projects to limit the use of CFCs, HCFCs, and HFCs (hydro fluorocarbons) has resulted in a reduction in yearly greenhouse gas emissions of about 340 million tCO2eq.

While it has been proved that these compounds can be entirely replaced globally, the overall potential of the Montreal Protocol initiatives is restricted by the contribution of those gases to climate change, which now accounts for 2% of total global gHg emissions.

6. Climate resilient industry

The urgency of shifting to industries that are climate resilient has been demonstrated by the climate agenda. A comprehensive strategy that recognizes the interdependence of mitigation and adaptation strategies and considers their potential trade-offs for industries that can withstand climate change, internationally, is crucial.

Experience has demonstrated that treating a point of impact or source of gHg emissions separately can frequently only shift the load or danger to another site. This frequently has a negative impact on the more vulnerable areas, which have fewer resources or less ability to handle issues, adding to the stress already placed on ecosystems or economies. For instance, several developed nations have made progress in recent years in reducing the environmental effects of their rising resource use. Technology developments and "exporting" the more resource- and pollution-intensive processes to other countries have both contributed to this. Simply said, in certain circumstances, consumption and pollution patterns have simply been relocated, frequently to emerging nations.

Climate is a universal public utility that transcends national boundaries. As a result, the world's material and resource movements must be considered, and the globe must be viewed as a single system. An avenue for addressing gHg emissions and sites of effect within the unbounded dynamics of our solar system is provided by the climate resilient industry.

Like how adaptation and mitigation are conceptually complimentary approaches to tackling the effects of climate change. By combining them, you may achieve cost-effectiveness and a range of advantages that you might not have otherwise. UNIDO adopts a comprehensive strategy to support the transition of industries in developing nations and economies toward a low-emission and climate-resilient future, building on its experience in environmental protection.

7. Green Industry for climate action

Through its two-pronged approach, the Internationally Green Industry Initiative situates sustainable industrial growth within the framework of new global sustainable and climate resilient development issues.

- Developing green businesses to provide high-quality environmental products and services, such as environmental consulting services, renewable energy, trash recycling, and resource recovery.
- Greening of industry to constantly enhance environmental performance of industry by utilizing resource-efficient and Cleaner Production (RECP) techniques and technology.

8. Building blocks for climate resilient industry

Industrialized nations must take use of this chance to transmit the greatest technology to developing nations to aid them and prevent them from being "locked-in" to socio-technical frameworks that do not promote industrial development that is climate resilient. Learning from industrialized nations and utilizing technology transfer foster creativity and makes major contributions to getting over obstacles in the way of the adoption of climate resilient industry solutions. Industry should engage closely with donor nations to deliver the greatest technology to emerging nations and transitional economies that are now accessible.

These building blocks cover three principal areas:

- Firstly, Utilizing the potential of clean technologies and encouraging technology transfer can aid in the development of an industry that is climate resilient. Most improvements in per capita income, according to empirical data, are the result of technological advancements. By empowering this information, socioeconomic performance and climatic resilience are improved.
- Secondly, fostering innovation and entrepreneurship offers a chance to create new opportunities for wealth development while protecting the environment. To encourage entrepreneurship and innovation in cleaner technologies and resource-efficient manufacturing, it assists small and medium-sized businesses (SMes) in finding commercial and finance possibilities given by climate action.
- Thirdly, fostering international collaboration strengthens collaboration for climate resilience. To encourage investment and carry out industrial best practices,

UNIDO also seeks to strengthen collaborations with both state and sub-national organizations, including cities, companies, and regional level networks. Diverse sources of knowledge and experience are essential for developing an industry that is climate resilient. As a result, multi-stakeholder collaborations are essential for bringing in funding and providing the knowledge and skills needed to implement climate-resilient solutions locally.

9. Technology transfer

Transferring and implementing environmentally friendly technology are necessary to reduce climatic consequences. The UNFCCC's Cancun accords reaffirmed how crucial it is to encourage and improve technology transfer to help developing nations tackle the climate crisis. In collaboration with various stakeholders, organizations like UNIDO encourage the development and transfer of these technologies.

Many industrial nations' traditional development strategies have negative environmental effects, making them an inadequate example for poorer nations to adopt. But now is a suitable time for emerging nations to start on the road toward reducing their emissions. One explanation is that these nations have not invested as much in the infrastructure that ties them to ecologically harmful technology.

Learning from industrialized nations and utilizing technology transfer foster creativity and makes major contributions to overcoming obstacles in the adoption of climate-resilient industry solutions. Industrialized nations must take use of this chance to transmit the greatest technology to developing nations to aid them and prevent them from being "locked-in" to socio-technical frameworks that do not promote industrial development that is climate resilient. The industry should engage closely with donor nations to deliver the greatest technology to emerging nations and transitional economies that are now accessible.

10. Fostering innovation for climate resilient entrepreneurship

Small and medium-sized businesses (SMes), which employ the bulk of the workforce in the private sector, account for a sizable portion of the global economy and global productive potential. The major obstacles to getting SMes involved in sustainable energy projects are their lack of financial resources, technical expertise, and incentives to get through roadblocks to implementing green technology. To overcome these obstacles and actively create innovative solutions for climate resilient industry, fostering innovation and entrepreneurship

may draw both individuals and SMEs. With its depth of knowledge and experience, Pakistani industry could profit from its ability to support SMEs with technical help and foster their creativity and entrepreneurship to address the climate crisis. UNIDO actively encourages the creation and application of creative financial.

11. Partnering for climate action

According to the IPCC Fifth Assessment Report, transformation alters a system's core characteristics in response to the climate and its consequences. To achieve the transition to accelerate climate action, various stakeholders must be included at all stages of the transformation. Like how UNIDO has created strategic relationships with a wide variety of stakeholders to facilitate research and information exchange and to eliminate obstacles to encourage action locally.

12. Non-state actors

To successfully implement climate-friendly industrial solutions, non-state actors, including corporations, cities, states, and regions, play a critical role. The groundswell of non-state action, as demonstrated, for instance, by UNIDO's work on Sustainable Cities, offers significant promise for energizing and speeding climate change mitigation and resilient development.

References

- Bunyagidj, Chaiyod; David Greason. "Promoting Cleaner Production in Thailand: Integrating Cleaner Production into ISO 14001 Environmental Management Systems." Industry and Environment. 19.3 (1996): 44-48.
- UNIDO. How to Improve the Economic and Environmental Performance of Industry in Ho Chi Minh City Vietnam: 1999: 4-7, 28-37?
- Aaheim HA, Aunan K, Seip HM. Climate change and local pollution effects—An integrated approach. Mitigation and Adaptation Strategies for Global Change 1999; 4:61–81.
- Aunan K, Fang J, Vennemo H, Oye K, Seip HM. Co-benefits of climate policy—lessons learned from a study in Shanxi, China. Energy Policy 2004;32(4):567–81.
- Cifuentes L, Borja-AburtoVH, Gouveia N, Thurston G, Lee Davis D. Climate change: Hidden health benefits of greenhouse gas mitigation. Science 2001; 293:1257–9.
- Ekins P. How large is a carbon tax justified by the secondary benefits of CO2 abatement? Resource and Energy Economics 1996; 18:161–87.
- Krewitt W, Heck T, Trukenmu ¨ller A, Friedrich R. Environmental damage cost from fossil electricity generation in Germany and Europe. Energy Policy 1999; 27:173–83.
- LeeDavis D et al. Short-term improvements in public health from global-climate policies on fossil-fuel combustion: an interim report. The Lancet 1997; 350:1341–9.
- Wang X, Smith KR. Secondary benefits of greenhouse gas control: Health impacts in China. Environmental Science and Technology 1999; 33:3056–61.
- Australian Manufacturing Council (AMC), (1993) The Environmental Challenge: Best Practice Environmental Regulation, AMC, Melbourne
- Australian Manufacturing Council (AMC), (1992) The Environmental Challenge: Best Practice Environmental Management, AMC, Melbourne
- Ayres, I & Braithwaite, J (1992) Responsive Regulation: Transcending the regulation deregulation debate, Oxford University Press, UK
- Bennett, M & James, P (1997) "Environment-Related Management Accounting: current practice and future trends" 17 Spring Greener Management International 32-51.
- Cairncross, F (1991) Costing the Earth: the challenge for governments, the opportunities for business, Harvard Business School Press, Boston, Massachusetts

- Christie, I; Rolfe, H; &Legard, R (1995) Cleaner production in Industry: Integrating business goals and environmental management, Policy Studies Institute, London
- Clinton, W J & Gore, A Jr (1995) Reinventing Environmental Regulation, Washington DC
- World Bank, 2006b. “Pakistan Strategic Country Environment Assessment”. Washington DC.
- World Bank, 2008, Environmental Health and Child Survival. Washington DC.
- Rodrik, D. (2004). Industrial Policy in the 21st Century. UNIDO
- Philip E. Auerswald and Ammar Malik, 2011, “Review of (LUMS) Industrial Policy: Its spatial Aspects and Cluster Development” Consultant report commissioned by the World Bank. Washington DC.
- ani Rodrik, Gene Grossman, Victor Norman Source (1995), “Getting Intervention Right: How Korea and Taiwan Grew Rich”, Economic Policy, Vol.10, No.20 (April 1995), pp 53-107.
- Fiorino, D J (1996) "Towards a New System of Environmental Regulation: the case for an industry sector approach" 26(2) Environmental Law 457-489
- Fischer, K & Schot, J (1993) Environmental Strategies for Industry: international perspectives on research needs and policy implications, Island Press, Washington DC
- Gardiner J; & Balch, G (1980) "Getting People to Protect Themselves: Information facilitation, regulatory and incentives strategies" in J Brigham & D Brown (Eds) Policy Implementation: Penalties or incentives, Sage Publications, Beverly Hills, USA
- Grabosky, P N (1995) "Regulation by Reward: On the use of incentives as regulatory instruments" 17(3) Law and Policy 256-280
- Gray, W B &Scholz, J T (1991) "Analyzing the equity and efficiency of OSHA enforcement" 3(3) Law and Policy 185
- Gunningham, N & Cornwell, A (1994) "Legislating the Right to Know" 11 Environmental and Planning Law Journal 274-288
- Gunningham, N (1995) "Issues and Options in Designing aNPI" in Minter Ellison (eds) Final Report to the Environment Protection Agency for the Development of Legislative Modelling for the National Pollutant Inventory and Associated Community Right to Know in Australia, Mingter Ellison, Melbourne
- Gunningham, N (1996) "From compliance to best practice in OHS" 9(3) Australian Journal of Labour Law 221-246.

- Hofman, H (1996) "Corporate Environmental Reporting: The next tool for environmental gains?" A paper presented at the 1996 Australian Academy of Science Fenner Conference on the Environment: Linking Environment and Economy Through Indicators and Accounting Systems, September/October, The University of New South Wales, Sydney.
- Holmes, J (1992) Managing into the 1990's - Manufacturing and the Environment: an executive guide, DTI, Department for Enterprise, London.
- Humphrey, H III (1994) "Public/private environmental auditing agreements: finding better ways to promote voluntary compliance", 3 Corporate Conduct Quarterly 1-4
- James, D (1993) Using Economic Instruments for Meeting Environmental Objectives: Australia's experience, Department of the Environment, Sport, and Territories, AGPS, Canberra
- Jasch, C (1993) Environmental Information Systems in Austria 13(2) Social and Environmental Accounting 7-9
- Johnston, N (1995) "Profit from Cleaner Production" in M D Rogers (ed) Business and the Environment, MacMillan, London, pp 203-217
- Jones, L R & Baldwin, J H (1994) Corporate Environmental Policy and Government Regulation, JAI Press, Greenwich, USA
- Lester, M (1996) "What Do Corporate Environmental Reporting?" A paper presented at the 1996 Australian Academy of Science Fenner Conference on the Environment: Linking Environment and Economy Through Indicators and Accounting Systems, September/October, The University of New South Wales, Sydney
- Miller, A S (1994) "The Origins and Current Directions of United States Environmental Law and Policy: an overview" in B Boer; R Fowler; & N Gunningham (Eds), Environmental Outlook: Law and Policy (1994), Federation Press, Sydney
- Mitchell, R (1994) Intentional Oil Pollution at Sea, MIT Press, Cambridge, Massachusetts
- Norberg-Bohn, V & Rossi, N (1996) "Motivations for pollution prevention technology innovation: the case of Kraft pulp and paper mills" A paper presented at the 5th International Research Conference of the Greening of Industry Network, Heidelberg, November.
- Organization for Economic Co-operation and Development (OECD), (1994a) Pollution Prevention and Control Group PRTR Guidance to Governments Doc, OECD, Paris

- Organization for Economic Co-operation and Development (OECD), (1995a) Technological Transformation for Sustainable Development, OECD, Paris
- Pollard, M (1996) "Western Mining Corporation Public Environmental Reporting" A paper presented at the 1996 Australian Academy of Science Fenner Conference on the Environment: Linking Environment and Economy Through Indicators and Accounting Systems, September/October, The University of New South Wales, Sydney.
- Peters, T J & Waterman R H (1982) In search of excellence, Harper & Row, New York
- Porter, M (1990) The Competitive Advantage of Nations, Macmillan Press, London.
- Porter, M (1991) "America's Green Strategy" Scientific American April
- Rae, M (1996) "Why Do Corporate Environmental Reporting? If You Don't, Your Company Will Die!" A paper presented at the 1996 Australian Academy of Science Fenner Conference on the Environment: Linking Environment and Economy Through Indicators and Accounting Systems, September/October, The University of New South Wales, Sydney.
- Romm, J J (1994) Lean and Clean Management: how to boost profits and productivity by reducing pollution, Kodansha America, New York
- Rosenberg, W G (1990) "The New Clean Air Act of 1990: Winds of Environmental Change" 35 (2) Business Horizons,35
- Saether, B & Amundsen, A (1996) "Cleaner Production Assessment in Norway: experiences and policy implications 5(3) Business Strategy and the Environment 178-187
- Schmidheiny, S (1992) Changing Course: a global business perspective on development and the environment, MIT Press, Cambridge, Massachusetts
- Stone, C (1989) "Choice of Target and Other Law Enforcement Variables" in M Friedland (Ed), Sanctions and Rewards in the Legal System, University of Toronto Press, Toronto
- Vogel, D (1986) National Styles of Regulation: Environmental Policy in Great Britain and the United States, Cornell University Press, Ithaca, New York.
- Wallace, A (1993) Eco-Heroes: Twelve Tales of Environmental Victory, Mercury House, San Francisco.

- Webb, K and Morrison, A (1996) Legal Aspects of Voluntary Codes: in the shadow of the law, Canadian Department of Consumer Affairs/Treasury Board of Canada, Ottawa
- Welford, R (1994) Cases in Environmental Management and Business Strategy, Pitman, UK
- Welford, R & Gouldson, A (1993) Environmental management and Business Strategy, Pitman, UK
- Womack, J P & Jones, D T (1994) "From Lean Production to the Lean Enterprise" March/April Harvard Business Review 93-103
- E. Alkaya, M. Böğürcü, F. Ulutas and G. N. Demirer, "Adaptation to Climate Change in Industry: Demonstration Projects for Water Saving Through Eco-Efficiency Approach," Proceedings of the 15th ESCP Conference Bregenz, Austria, 2012.
- N.U. Haq and H. Nasir, "Cleaner production technologies in de-sizing of cotton fabric," The Journal of Textile Institute, 103 (3), p304-310, 2012.
- Cleaner Production, Guide for Textile Industries, Beirut, 2010.
- E. Ozturk, H. Koseoglu, M. Karaboyaci, N. O. Yigit, U. Yetis and M. Kitis, "Sustainable textile production: cleaner production assessment/eco-efficiency analysis study in a textile mill," Journal of Cleaner Production, 138, Part 2, 1 December 2016, Pages 248-263.
- J. Fresner, "Starting continuous improvement with a cleaner production assessment in an Austrian textile mill," Journal of Cleaner Production, Volume 6, Issue 2, 1998, Pages 85-91.
- L. Dumitrescu, A. M. Mocioiu& E. Visileanu, "Cleaner production in Romanian textile industry: a case study", International Journal of Environmental Studies, Volume 65, 2008 - Issue 4, Pages 549-562.
- B. S. Kipkoech, "Effect of Organizational Factors on Adoption of Cleaner Production in Composite Textile Industries in Uasingishu County, Kenya," International Journal of Economics, Commerce and Management, Vol. IV, Issue1, January 2016, pp 265-279.
- M. Sirait, "Cleaner production options for reducing industrial waste: the case of batik industry in Malang, East Java-Indonesia," "IOP Conference Series: Earth and Environmental Science," 2018.
- O. Tong, S. Shao, Y. Zhang, Y. Chen, S. L. Liu, and S. S. Zhang, "An AHP-based water-conservation and waste-reduction indicator system for cleaner production of

textile-printing industry in China and technique integration," Clean Technologies and Environmental Policy, October 2012, Volume 14, Issue 5, pp 857–868.

- Abbasi, G.Y., Abbassi, B.E., 2004. Environmental assessment for paper and cardboard industry in Jordan — a cleaner production concept. J. Clean. Prod. 12, 321–326. doi:10.1016/S09596526(02)00047-1
- Avşar, E., Demirer, G.N., 2008. Cleaner production opportunity assessment study in SEKA Balikesir pulp and paper mill. J. Clean. Prod. 16, 422–431. doi: 10.1016/j.jclepro.2006.07.042
- Baas, L., 2007. To make zero-emission technologies and strategies a reality, the lessons learned of cleaner production dissemination must be known. J. Clean. Prod. 15, 1205–1216. doi: 10.1016/j.jclepro.2006.07.017
- Cagno, E., Trucco, P., Tardini, L., 2005. Cleaner production and profitability: analysis of 134 industrial pollution prevention (P2) project reports. J. Clean. Prod. 13, 593–605.
- Calia, R.C., Guerrini, F.M., de Castro, M., 2009. The impact of Six Sigma on the performance of a Pollution Prevention program. J. Clean. Prod. 17, 1303–1310.
- Daddi, T., De Giacomo, M., Dils, E., Polders, C., Lepe, G., Calvo, V., 2013. Transferring the Integrated Pollution Prevention and Control (IPPC) Approach and Best Available Techniques (BAT) Concepts to Egypt, Tunisia, and Morocco. Sustainability 5, 2944–2959.
- Danihelka, P., 2004. Subjective factors of Cleaner Production—parallel to risk perception? J. Clean. Prod. 12, 581–584.
- De Medeiros, J.F., Ribeiro, J.L.D., Cortimiglia, M.N., 2014. Success factors for environmentally sustainable product innovation: a systematic literature review. J. Clean. Prod. 65, 76–86. doi: 10.1016/j.jclepro.2013.08.035
- Deltas, G., Harrington, D.R., Khanna, M., 2013. Green management and the nature of pollution prevention innovation. Appl. Econ. 46, 465–482. doi:10.1080/00036846.2013.857004
- Dieleman, H., 2007. Cleaner production and innovation theory; social experiments as a new model to engage in cleaner production. Rev. Int. Contam. Ambient. 23.
- Dobes, V., 2013. New tool for promotion of energy management and cleaner production on no cure, no pay basis. J. Clean. Prod. 39, 255–264. doi: 10.1016/j.jclepro.2012.08.007

- Fresner, J., 1998. Cleaner production for effective environmental management. J. Clean. Prod. 6, 171–179.
- Fresner, J. et al., 2010. The theory of inventive problem solving (TRIZ) as an option generation tool within cleaner production projects. J. Clean. Pro.18, 128-136.
- Frijns, J., Van Vliet, B., 1999. Small-Scale Industry and Cleaner Production Strategies. World Dev. 27, 967–983. doi:10.1016/S0305-750X (99)00044-3
- Gale, R., 2006. Environmental management accounting as a reflexive modernization strategy in cleaner production. J. Clean. Prod. 14, 1228–1236.
- Galeazzo, A., Furlan, A., Vinelli, A., 2014. Understanding environmental-operations integration: The case of pollution prevention projects. Int. J. Prod. Econ. 153, 149–160.
- Galeazzo, A., Furlan, A., Vinelli, A., 2013. Lean and green in action: interdependencies and performance of pollution prevention projects. J. Clean. Prod. doi: 10.1016/j.jclepro.2013.10.015
- Gombault, M., Versteege, S., 1999. Cleaner production in SMEs through a partnership with (local) authorities: successes from the Netherlands. J. Clean. Prod. 7, 249–261. doi:10.1016/S09596526(99)00084-0
- Hillary, R., Thorsen, N., 1999. Regulatory and self-regulatory measures as routes to promote cleaner production. J. Clean. Prod. 7, 1–11. doi:10.1016/S0959-6526(98)00030-4
- Hossain, K.A., Khan, F.I., Hawboldt, K., 2008. Sustainable development of process facilities: state-of the-art review of pollution prevention frameworks. J. Hazard. Mater. 150, 4–20.
- Howgrave-Graham, A.; van Berkel, R. Assessment of cleaner production uptake: method development and trial with small businesses in Western Australia. J. Clean. Prod. 15,787-797.
- Huang, Y.; Luo, J.; Xia, B., 2013.Application of cleaner production as an important sustainable strategy in the ceramic tile plant–a case study in Guangzhou, China. J. Clean. Prod. 43, 113-121.
- Jia, L., Zhang, Y., Tao, L., Jing, H., Bao, S., 2013. A methodology for assessing cleaner production in the vanadium extraction industry. J. Clean. Prod. doi: 10.1016/j.jclepro.2013.05.016
- Khan, Z., 2008. Cleaner production: an economical option for ISO certification in developing countries. J. Clean. Prod. 16, 22–27. doi: 10.1016/j.jclepro.2006.06.007

- Khanna, M., Deltas, G., Harrington, D.R., 2009. Adoption of Pollution Prevention Techniques: The Role of Management Systems and Regulatory Pressures. Environ. Resour. Econ. 44, 85–106.
- Kubota, F.I., da Rosa, L.C., 2013. Identification and conception of cleaner production opportunities with the Theory of Inventive Problem Solving. J. Clean. Prod. 47, 199–210.
- Li, Z.; Zhang, Y.; Zhang, S., 2011. Status of and trends in development for cleaner production and the cleaner production audit in China. Environmental Forensics. 12, 301-304.
- Lober, D.J., 1998. Pollution prevention as corporate entrepreneurship. J. Organ. Chang. Manag. 11, 26–37.
- Lopes Silva, D.A., Delai, I., Soares de Castro, M.A., Ometto, A.R., 2013. Quality tools applied to Cleaner Production programs: a first approach toward a new methodology. J. Clean. Prod. 47, 174–187.
- Neto, A.S., Jabbour, C.J.C., 2010. Guidelines for improving the adoption of cleaner production in companies through attention to non-technical factors: A literature review. AFRICAN J. Bus. Manag. 4.
- Ochsner, M.; Chess, C.; Greenberg, M., 1995. Pollution prevention at the 3M corporation: Case study insights into organizational incentives, resources, and strategies. Waste Management. 15, 663672.
- Silvestre, B.S., Silva Neto, R. e, 2014. Are cleaner production innovations the solution for small mining operations in poor regions? The case of Padua in Brazil. J. Clean. Prod. doi: 10.1016/j.jclepro.2014.01.097
- Staniškis, J. K., 2011. Water saving in industry by cleaner production. In Water Purification and Management. 1-33. Springer Netherlands.
- Stone, L.J., 2006a. Limitations of cleaner production programs as organizational change agents I. Achieving commitment and on-going improvement. J. Clean. Prod. 14, 1–14. doi: 10.1016/j.jclepro.2004.12.008
- Stone, L.J., 2006b. Limitations of cleaner production programs as organizational change agents. II. Leadership, support, communication, involvement, and program design. J. Clean. Prod. 14, 15–30.
- Taylor, B., 2006. Encouraging industry to assess and implement cleaner production measures. J. Clean. Prod. 14, 601–609.

- Tseng, M.-L., Lin, Y.-H., Chiu, A.S.F., 2009. Fuzzy AHP-based study of cleaner production implementation in Taiwan PWB manufacturer. J. Clean. Prod. 17, 1249–1256. doi: 10.1016/j.jclepro.2009.03.022
- Vickers, I., Cordey-Hayes, M., 1999. Cleaner Production and Organizational Learning. Technology analysis & strategic management. 11, 75-94.
- Van Berkel, C.W.M., 1994. Comparative evaluation of cleaner production working methods. J. Clean. Prod. 2, 139–152.
- Van Hoof, B., 2014. Organizational learning in cleaner production among Mexican supply networks. J. Clean. Prod. 64, 115–124.
- Visvanathan, C., Kumar, S., 1999. Issues for better implementation of cleaner production in Asian small and medium industries. J. Clean. Prod. 7, 127–134. doi:10.1016/S0959-6526(98)00050-X
- Zhang, T.Z., 2000. Policy mechanisms to promote cleaner production in China. J. Environ. Sci. Heal. PART A-TOXIC/HAZARDOUS Subst. Environ. Eng. 35.
- Yi, Hosang et al. cleaner production option in a food (Kimchi) industry J. Clean. Prod. 9, 35-41.
- Dong S., Liu T., Zhang X., et al., 2015. Dyeing and printing industry economic operation analysis of China 2014. Textile Dyeing and Finishing Journal. 37(4), 1-5.
- Guo J., Ma F., Qu Y., et al., 2012. Systematical strategies for wastewater treatment and the generated wastes and greenhouse gases in China. Frontiers of Environmental Science & Engineering. 6(2), 271-279.
- Ranganathan K., Karunagaran K., Sharma D. C., 2007. Recycling of wastewaters of textile dyeing industries using advanced treatment technology and cost analysis—case studies. Resources, Conservation and Recycling. 50(3), 306-318.
- Lin B, Moubarak M, 2013. Decomposition analysis: change of carbon dioxide emissions in the Chinese textile industry. Renewable and Sustainable Energy Reviews. 26, 389-396.
- Avsar, E., Demirer, G.N., 2008. Cleaner production opportunity assessment study in SEKA Balikesir pulp and paper mill. J. Clean. Prod. 16, 422-43.
- Chandra, R., Sankhwar, M., 2011. Influence of lignin, pentachlorophenol, and heavy metal on antibiotic resistance of pathogenic bacteria isolated from pulp paper mill effluent contaminated river water. J. Environ. Biol. 32, 739-745.
- Kamali, M., Khodaparast, Z., 2015. Review of recent developments on pulp and paper mill wastewater treatment. Ecotoxicol. Environ. Saf. 114, 326-342.

- Kinnarinen, T., Golmaei, M., Jernstrom, E., Hakkinen, A., 2016. Separation, treatment, and utilization of inorganic residues of chemical pulp mills. J. Clean. Prod. 133, 953-964.
- Meyer, T., Edwards, E.A., 2014. Anaerobic digestion of pulp and paper mill wastewater and sludge. Water Res. 65, 321-349.
- Wen, Z.G., Di, J.H., Zhang, X.Y., 2016. Uncertainty analysis of primary water pollutant control in China's pulp and paper industry. J. Environ. Manag. 169, 67-77.
- Korosec K. Wastewater market within pulp, paper industry to hit $1.56bn, environmental & energy management news; 2013.
- Samreen R, Saadia SA, Asma I. 2006. Histopthological changes observed in heart and gizzard of quail chicks coturnix japonica administrated by the diverse levels of chrome shavings. Afr. J. Biotechnol 5:1765- 1769.
- Ramesh K, Thirumangi V. 2014. Impacts of tanneries on quality of ground water in Pallavaram, Chennai metropolitan city. IJERA. 4:63-70.
- Chowdhury FJ, InamulHaq SM, Aminul Islam M. 1996. Accumulation of various pollutants by some aquatic macrophytes found in the Bariganga River. Proceedings of the 25th Bangladesh Science conference.
- Kankaria S, Andukur A, Hemamailin CG, Kisishnveni M. 2011. Impact of tannery effluents on ground water and agriculture with a remedial measure. A case studies. International Conference on Chemical Biological and Environmental Science, Bangkok. 383-388
- Siddiqui A, Uroos A, Nadeem F. 2016. Sectoral competitiveness and value chain analysis: leather Gloves value chain analysis in Pakistan. Trade development authority of Pakistan.
- Ghafoor A, Zafar M. 2014. Determinants of leather exports from Pakistan: a time series analysis. Transactions on Edu. Soc. Sci. 5: 77-86.
- Garai J. 2014. The impacts of climate change on the livelihoods of coastal people in Bangladesh: a sociological study. In: Leal FW, Alves F, Caeiro S, Azeiteiro UM, editors. International perspectives on climate change: Latin America and beyond. Cham, Switzerland: Springer International Publishing Switzerland; p. 151–163.
- Azom MR, Mahmud K, Yahya SM, Sontu A, Himon SB. 2012. Environmental impact assessment of tanneries: a case study of Hazaribag in Bangladesh. Int J Environ Sci Dev. 3:152– 156.

- Biswas B, Hamada T. 2012. Relation between Hazaribag tannery industry development and Buriganga river pollution in Bangladesh. Int J Environ. 2:117–127.
- Gain P, Moral S. 2002. Leather industries, environmental pollution, and mitigation measures. Dhanmondi: Society for Environment and Human Development (SEHD)
- Sidhu, S., Kasti, N., Edwards, P., Dellinger, B., 2001. Hazardous air pollutants formation from reactions of raw meal organics in cement kilns. Chemosphere 42, 499–506.
- Isikli, B., Demir, T.A., Urer, S.M., Berber, A., Akar, T., Kalyoneu, C., 2003. Effects of chromium exposure from a cement factory. Environ. Res. 91, 113–118.
- Kalafatoglu, E., O¨rs, N., O¨ zdemir, S.S., Munlafalioglu, I., 2001. Trace element emissions from some cement plants in Turkey. Water Air Soil Pollut. 129, 91–100.
- Legator, M.S., Singleton, C.R., Morris, D.L., Philips, D.L., 1998. The health effects of living near cement kilns: a symptom survey of Midlothian, Texas. Toxicol. Ind. Health 14, 829–842.
- Alcock, R.E., Gemmill, R., Jones, K.C., 1999. Improvements to the UK PCDD/F and PCB atmospheric emission inventory following an emission measurement programme. Chemosphere 38, 759–770.
- Brzuzy, L.P., Hites, R.A., 1996. Estimating the atmospheric deposition of polychlorinated dibenzo-p-dioxins and dibenzofurans from soils. Environ. Sci. Technol. 30, 1797–1804.
- Yang, C.Y., Chang, C.C., Tsai, S.S., Chuang, H.Y., Ho, C.K., Wu, T.N., Sung, F.C., 2003. Preterm delivery among people living around Portland cement plants. Environ. Res. 92, 64–68.
- Malich, G.,Braun, M.,Loullis, P.,Winder, C.,1998.Comparison of regulations concerning hazardous substances from an international perspective. J. Hazard. Mater. 62, 143–159.
- Reniers, G.L.L., Ale, B.J.M., Dullaert, W., Foubert, B., 2006. Decision support systems for major accident prevention in the chemical process industry: a developers' survey. J. Loss Prev. Process Ind. 19, 604–620.
- Rathnayaka, S., Khan, F., Amyotte, P., 2011. SHIPP methodology: Predictive accident modeling approach. Part I:methodologyandmodel description. Process Saf. Environ. Prot. 89, 151–164.

- Nivolianitou, Z., Konstantinidi, M., Michalis, C., 2006. Statistical analysis of major accidents in petrochemical industry notified to the major accident reporting system (MARS). J. Hazard. Mater. 137, 1–7.
- Gomez, M.R., Casper, S., Smith, E.A., 2008. The CSB Incident Screening Database: Description, summary statistics and uses. J. Hazard. Mater., Papers Presented at the 2006 Annual Symposium of the Mary Kay O'Connor Process Safety Center 159, 119–129.
- Amine Dakkoune, Lamiae Vernières-Hassimi, SébastienLeveneur, Dimitri Lefebvre, Lionel Estel., 2018. Risk analysis of French chemical industry. Safety Science.105, 77-85.
- Croitoru, L., & Sarraf, M. (2010). *The cost of environmental degradation: case studies from the Middle East and North Africa*: The World Bank.
- Ittehad Chemicals Limited. from https://ittehadchemicals.com/about-us/mission-vision/
- Pollution Issues. (2017). Petroleum, from http://www.pollutionissues.com/Na-Ph/Petroleum.html
- The Wilderness Society. (2018). 7 WAYS OIL AND GAS DRILLING IS BAD FOR THE ENVIRONMENT, from https://www.wilderness.org/articles/article/7-ways-oil-and-gas-drilling-bad-environment
- Government of Pakistan. (2018). Textile Division Retrieved 18/11, 2018, from http://www.textile.gov.pk/
- Ogugbue, C. J., & Sawidis, T. (2011). Bioremediation and detoxification of synthetic wastewater containing triarylmethane dyes by Aeromonas hydrophila isolated from industrial effluent. *Biotechnology research international, 2011*.
- Nishat Linen. (2017). Annual Report, from http://www.nishatmillsltd.com/nishat/pdf/annual17.pdf
- Nishat Linen. (2018). Annual Report, from http://www.nishatmillsltd.com/nishat/pdf/annual18.pdf

Annex A

Interview Schedule

	What is the volume/weight of material used for producing organization primary products/service?
	From where is the organization getting its raw material?
	What is the %age of non-renewable and %age of renewable material out of total material being used?
	%Age of recycled material used for manufacturing product?
	ENERGY CONSUMPTION
	What type of energy and for what purpose is it used outside the manufacturing plants i.e., energy used in functions other than production process?
	Are there any initiatives to reduce energy consumption?
	What are those initiatives and when were those started?
	What percentage of energy is saved by those initiatives?
	What persuaded you to take initiatives for energy reduction?
	Did you get any help from any government/NGO for implementing energy saving measures?
	WATER CONSUMPTION
	How many gallons of water are used in the production process?
	What is the source of water?

	What measures have been taken to save water consumption?
	How much in percentage water consumption has been reduced?

	AIR EMISSIONS
	What type of emissions are there in manufacturing plants?
	NOX. SOX, ozone depleting substances?
	What is the amount of air emissions in kg/tons?
	What steps have been taken to reduce emissions?
	Did you get technical help from any government/ NGO for implementation of those measures?
	Wat hurtles did you face in implementing the emission control measures?
	How did you overcome those hurdles?
	How much did it cost you?
	Did you receive any competitive advantage in the market because of emission control measures?
	Did you get any incentives from the government for taking emission control measures?
	Do you think ISO helps in emission reduction?
	EFFLUENTS
	What is the total water discharge as effluents?
	Where is the water discharged?
	Are there any water treatment plants?

	SOLID WASTE
	How much solid waste is produced (kg/tons)?
	What is the composition of solid waste?
	How is solid waste stored on site?
	Who collects the waste?
	Is there recycling activity done?
	How much recycled waste is obtained (kg)?
	What is the use of recycled waste?
	How is waste disposed off?
	How is the waste transported to landfill sites?
	Who is responsible for dumping the waste?
	SPENDING ON ENVIRONMENT PROTECTION
	How much amount (percentage of budget) do the organizations spend on environmental protection measures?
	What type of activities are carried out for environmental protection?
	SCREENING OF SUPPLY CHAINS
	Do you screen your supply chains in terms of their environmental protection measures?
	What is the percentage of new suppliers that were screened using environmental criteria?
	If not, do you have plans to screen supply chains to ensure compliance with environmental protection measures?