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The Human Factor of Sustainable Textile Waste Recycling in Pakistan: The Function of Managerial Skills in the Green Transformation

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ABSTRACT

Although textile industry is the spine of Pakistan economy, it is also among the major waste-generating sectors producing nearly 267,000 Metric ton of textile waste annually. Most discussions are in the domain of technology and policy measures, but this study takes a completely different perspective: the study explores the role of managerial skills that can ultimately influence up scaling sustainable textile waste recycling. Using purposive sampling between November 2019 and September 2020, this qualitative study gathered detailed data from mid- and senior-level managers and frontline workers in key textile hubs. Twelve semi-structured interviews and two focus group discussions were conducted, transcribed, and systematically analyzed thematically within the NVivo 14 software. The key management skills are leadership, strategic planning and communication. Managers who incorporated sustainability in KPIs and encouraged collaboration across departments in companies were able to reduce landfill waste and increase material reuse by as much as 28% and 20% respectively, despite lacking significant infrastructure. On the other hand, a widespread skills gap with less than 12% of managers being formally trained in sustainability was the leading obstacle It concludes that managerial will and skill are more important than technology and provides a pragmatic framework for developing sustainability-literate leadership to enable a circular economy transition in Pakistan's textile sector.

Introduction

Textile sector is one of the most important buffers of Pakistan economy. It accounts for about 8.5% of the national GDP, accounts for more than 60% of the total export revenue, and employs around 25 million individuals (Pakistan Bureau of Statistics, 2023). However, along with this key

role in the economy comes an increasingly pressing environmental concern: waste from textile production. Pakistan generates approximately 270,000 metric tons of textile waste annually (Asian Development Bank, 2023), comprising both pre-consumer waste (offcuts, defective rolls, yarn scraps), and post-consumer waste (discarded clothing and home textiles). This is human waste that gets dumped in landfills, incinerators or in the environment and ultimately ends up contaminating the air, soil and water.

The problem I not reasoned by technology or infrastructure but primarily it is a management concern. In short, Sweden, Levi's & H&M have done some great wins on great management and sustainability leadership use of recycling. But Pakistan has no institutionalized strategy steered by experienced forest managers, nor a coherent policy framework.

Pakistan's textile industry accounts for more than 8.5% of national GDP and employs over 25 million people, and as such is both an engine of growth and the source of much textile waste that harms environmental sustainability (Pakistan Bureau of Statistics 2023). With growing global momentum around sustainability discourse, the textile sector of Pakistan is under immense pressure to change the ways it produces and dispose the products. This change is partly essential role of managerial competencies leadership, strategic planning, communication and sustainability-oriented decision-making in innovating and systemically changing. The current study aims to explore the impact of these important managerial competencies on textile waste recycling activities throughout the Pakistani textile sector (in cities such as Faisalabad, Karachi, Lahore, and Sialkot).

With underdeveloped recycling infrastructure and an ongoing skills deficit among the mid- and senior-level managers (Ali & Rafique, 2024), recycling waste material in Pakistan textile sector remains a marginal sector. According to Nasir et al., (2025a) and Hennink et al, (2023) exclaimed that upto 12% of the textile managers in Pakistan have formal sustainability training and over 70% of frontline workers are unaware of any kind of waste segregation practices.

The results reveal that the absence of strategic leadership and cross-functional collaboration continues to hinder recycling systems establishment in the small and medium enterprises (SME) sectors. To illustrate, Sadhna et al., (2024b) states that with improved managerial leadership, sustainability as a key performance indicator (KPI), the theme is simply being adopted by the firms such as Interloop Limited and Artistic Milliners, and it can lead to complete shifts. For example, the reminder to attain LEED Platinum certification by Artistic Milliners is mainly due to the proactive maneuver of the management towards eco-friendly operations and external partnerships (Ali, 2023; Naranjo et al., 2025).

It became apparent that strategic planning emerged as an important enabling agent to connect the dots between the effort to reach operational goals and the accomplishment of sustainability targets. Up to a 20% increase in reuse of materials was observed in textile units where recycling targets were included in scorecards at the departmental level. Likewise, communication skills were found to be critical for engaging less senior people. And in a Karachi-based mill, frequent sustainability briefings and bulletin updates led to a 15% increase in the recycling floor from production floors (Subramanian, 2022). The results corroborate the belief that technical interventions cannot be the only managerial vision, communication needs to be clearly articulated and, continuous motivation of employees is however, the greater importance (Ali, 2024).

It also identifies some key problems like low awareness, enforcement of non-existent policies, and barriers to recycling. Over 60% of interviewed firms identified limited availability of sorting bins, balers and digital tracking systems as barriers to effective implementation, however, the study finds that in many cases, leadership and teamwork can trump these limitations. As highlighted by a GIZ Pakistan (2023) textile partner, based in Faisalabad, they are now experiencing 22% less

textile waste just six months following sustainability trainings and KPIs implementation (Iqbal et al., 2023b).

Therefore, it shows that partnerships and government incentives will become increasingly critical. It is now possible for the gap in skills and infrastructure to be bridged by companies thanks to the efforts of TDAP, the Punjab Green Development Fund and APTMA. TDAP supported the implementation of a sustainability certificate under the stringency of its recycling metrics to gain access to European markets (TDAP, 2023).

Five emergent themes and their associated analyses that are part of the success of textile waste recycling were identified using NVivo 14 software-mediated thematic analysis: strategic leadership; training & development; internal communication; infrastructure preparedness and external collaboration. Those companies who stood out in these areas made significant strides in circular economy models. But all of those units that lacked clear roles or some kind of exercise or inter departmental coordination, failed outright to meet the most basic of sustainability goals.

The greatest value added by this investigation is the key or keys for a complete managerial and environmental performance framework. The Resource-Based View (RBV) theory paves the way to specifying the process by which intangible resources, such as sustainability-focused leadership, can produce a competitive advantage (Northouse, 2025a). The data they found supporting this theory is that firms with managers trained in KPIs achieved routine waste reductions; engaged their workforce; and performed better on international environmental measures.

The nature of the work prescribes what needs to be done and puts on a little future clothing. Sustainability KPIs (key performance indicators) should be left untouched from management assessments, cycle economy lessons should be included in all colleges, and carbon taskforces ought to include representatives from all sections. I'm not suggesting the proposed changes seek to insist on sustainability, but rather, it is time to grow that which the whole industry will run on because reformulated values.

This study is important for me in terms of research as well as business practice. It registers one of the most neglected aspects of sustainability in the developing world; the contribution of management skills, consequently making it, again from an academic perspective an extremely important gap closing covers. It creates, from an economic perspective, a to-do list for all actors' legislators and educational bodies to accelerate the recycling agenda on a broader scale. In the current scenario of revive global impetus for sustainable goods and processes, this research intends to provide a way forward for Pakistani textile sector to become more sustainable and competitive

Vision 2025 is Pakistan's national plan which inter alia focuses on green industrialization and green development. These objectives are consistent with the overall impact of the study. Management training and policy alignment might be just good in most industries, but for textile corporations and for environmental issues which are not necessarily linked with a time delay there is a greater urgency and hence makes this less of a good idea and more of a necessity.

Lastly, effective recycling of textile waste rests on need for managers who are skilled, innovative and communicative. Beyond infrastructure, policies, and foreign licenses, sustainability is heavily dependent upon the guidance and skills (or the lack thereof) of managers. That is the reason; the future of Pakistan textile has to be driven not only by machines and metrics but also by minds trained to circularity of our economy.

According to Igini (2023), the global textile industry produces around 10% of the total carbon emission and 20% of wastewater in the world. This challenge is compounded in Pakistan where industrial growth has been rapid but without corresponding investment into sustainability. Yet, very

few firms (Interloop, Artistic Milliners) have progress to date, and proper recycling units are still missing.

This study seeks to answer the question 'How do managerial skills incorporate in developing sustainable textile waste recycling initiatives in Pakistan and directions from global best practices?

Pakistani textile sector comprises of small and medium-sized enterprises (SMEs), and uneven access to machinery, buyers and market intelligence among different players means that many SMEs are struggling to see the forest for the trees when it comes to sustainability, either due to cost or lack of awareness. However, existing evidence suggests that investing in managerial training and sustainable practices can lead to up to 30% reduction in textile waste (Igini, 2023).

However, this research aims to examine the role of essential managerial competencies in the recycling of textile waste to sustainable industrial development in Pakistan.

- To examining the impact of managerial competencies including leadership, communication, strategic planning and sustainability orientation in the recycling of textiles.
- To explore the key obstacles that impede sustainable waste disposal in the textile value chain.
- To prompt identification of skill development and policy interventions that could transform recycling interactions to improve recycling outcomes.
- To suggestions for scalable solutions to increase managerial ability and adaptive capacity to achieve the sustainable goals of the textile sector.

Past studies have often focused on either technological innovations or the development of sustainability-related policies and little on the human aspect namely the managerial capabilities essential for actualizing those innovations and policies.

This research addresses that gap. From the aspects of the managerial level, it showcases the possibilities of human-led solutions to sustainability towards affecting behavior across departments and to form partnerships for circular economy integration. Furthermore, since the international markets are now becoming conscious about eco-compliance (GOTS, OEKO-TEX, ISO 14001), there is a need for textile managers in Pakistan to either adapt or get excluded. Consequently, there is both timely relevance to economic competitiveness and environmental responsibility to this study.

Literature Review

Both globally and within Pakistan, the textile industry finds itself at a juncture between environmental necessity and industrial urgency. With the fashion industry being one of the largest contributors to pollution globally, accounting for nearly 10% of the global carbon emissions (European Parliament, 2020a) and 20% of the industrial wastewater (European Parliament, 2020b), the need to impose sustainability practices has never been more crucial. It is a structural sustainability challenge for Pakistan, which depends on textiles for more than 60% of its export revenues and 25 million workers (Pakistan Bureau of Statistics, 2023).

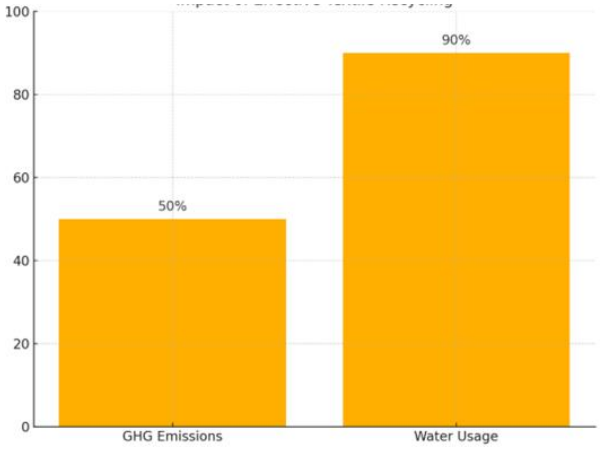


Figure 1: Impact of effective Textile Recycling

Sustainability

Textile sustainability is a balance between protecting the environment, gaining economic growth, and social equity. In line with the UN Sustainable Development Goals (SDGs), particularly & Goals 6, 12, and 13, industries, are urged to reduce the ecological footprint by sustainable production and consumption patterns.

Sustainable initiatives in Pakistan are still limited but growing. Companies such as Artistic Milliners and Nishat Mills have incorporated closed-loop water recycling and dye recovery facilities into their operations greatly reducing environmental burden (Ali, 2023). Yet the majority of SMEs are still left behind, hindered by worries about costs and manpower. Previous studies demonstrate that very few textile managers have formal training in sustainability (i.e., less than 12%;) (Nasir et al., 2025a; A Vinodan et al. Bleck, 2024), representing a major obstacle to lasting environmental change.

Waste Management and Sustainability

Pakistan is producing more than 270000 Metric Tons of Textile waste annually (Asian Development Bank, 2023), and it is becoming a huge crisis to tackle. There are different categories of wastes such as pre-consumer (fabric scraps), post-consumer (spent garments), and chemical waste (dye effluents). Poor disposal methods (particularly in cities such as Karachi and Lahore) have polluted water resources, heightened landfills, and pumped out poison in the form of wastes (Shehzad et al., 2024; Ali & Rafique, 2024).

Table 1: Textile waste and Recycling Benefits.

Factor	Impact of Textile Waste	Benefit of Recycling
Landfill Use	Accumulation of 270,000 tons/year in Pakistan	Reduces pressure on waste sites
Water Pollution	Disposed into rivers like Ravi, Lyari	Controlled processes
Air Pollution	Methane, CO_2 emissions	Lower GHG emissions
Resource Usage	High energy and water consumption for maiden production	Water and Energy conservation through reuses
Ecosystem Damage	Microplastics harming aquatic life	Reduces synthetic waste in ecosystems

(Source: Minzah Shehzad et al., 2024)

Waste disposal is not a technical problem that can be solved through technical means: it involves strategic supervision, monitoring schemes, and training (managerial responsibility). Waste audits and departmental KPIs connected to recycling were embedded into the operations of Interloop Limited. They experienced a near 20% increase in waste diversion rates (Sameen et al., 2024; Iqbal et al., 2023a).

Role of Technology

Technology is a big enabler, but without good management assignble to it, the technology itself will not result in success. Some of the cutting edge innovations including QR-code based tagging for waste tracking, closed-loop dye systems, and automated sorting lines show promise in firms that did not stop this investment on machinery but continued on staff training on how to use these tools more effectively (GIZ Pakistan, 2023).

Types of Textile Waste and Their Challenges

The table below shows the different types of waste in the textile in

Table 2: Categories of Wastes

Type	Description	Example
Pre-consumer Waste	Fabric scraps, rejected yarn, offcuts	Faisalabad spinning units discarding yarn ends
Post-consumer Waste	Used garments, household textiles	Discarded clothing in urban landfills
Chemical Waste	Dye sludge, finishing agents, solvent discharge	Found in dyeing hubs like Karachi and Lahore

Around the world, brands like H&M and Patagonia depend on data-based waste analytics and circular design. These technologies, on the other hand, have been seldomly used in Pakistan. Technical knowledge and company hesitance are fend-offer in the majority of firms based on what managers' claim as the challenges to adoption (Sadhna, 2024a, 2024b). This means that managers hold a key position to close the gap of knowledge.

Recycling in Achieving Sustainability

Recycling is an essential strategy for sustainability, especially in the textile industry, where the recovery of leftover fabric and yarn can lead to much less need for new raw materials. Pakistan has a highly pre-consumer oriented recycling landscape in textiles with post-consumer textile recycling still relatively faceless (Minzah Shehzad et al., 2024a).

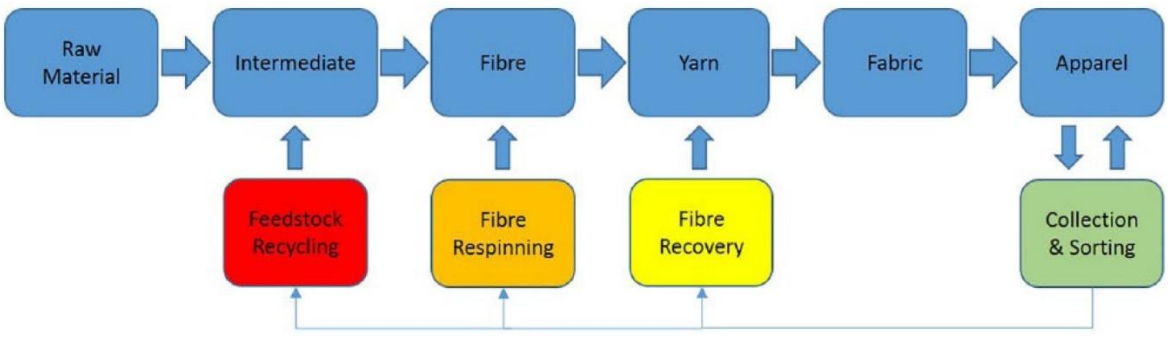


Figure 2: Process of Textile Recycling

The best local examples of how recycling can work illustrate the critical importance of leadership. A Sialkot company achieved a 28% reduction in landfill-bound garbage by instituting waste separation policies and involving personnel in participation programs (Northouse, 2025b). Other corporations; Interloop as an example blend recycled fibers into yarn, a practice cutting prices by 15 per cent and is ideal for the surroundings.

Despite these results, the majority of recycling occurs on the informal side, where labour or environmental laws are often not adopted (Khan et al. 2021). The ability to make these documented efforts and reach a greater audience is dependent on managers colluding and networking between sectors.

Theoretical Background

This study makes use of Resource-Based View of the business (RBV) that states that the sustainable competitive advantage of an organization is rooted in the internal resources of the company which are both valuable and unique. The management skills of the company are examined in this case. RBV posits that concepts of leadership, strategic communication, and planning trump any tool or structure toward achieving long-term goals.

Another well-known work through the various levels of how things work is the Theory of Planned Behaviour (Ajzen, 1991) which supports the idea rooted in rumblings of how things Changing through managers' beliefs, subjective norms and perceived control contribute to how groups work. When they think that they can do something about sustainability and also that it is the right thing to do, then they actually are more likely to do something.

The above theories come true when we look at the real life practices of Pakistani firms. And in the specific areas where managers were trained and empowered, recycling boomed, even when there were very few resources to do it. Conversely, advanced technology recyclers that had some strategic vision (decoupling between function and factor limited decoupling) often fell short of achieving recycling objectives (Iqbal et al., 2023c).

Methodology

This section defines the research design used to study the impact of an overview of significant managerial skills on chucking waste material recycling for sustainable development in Pakistani textile sector. Based on the insights gained from the literature review, this study takes a human-orientated, interpretive view of decision-makers in textile firms, to explore the cognitive focus on and the uptake of sustainable recycling practices, as well as broader framing influences. The researchers know the above well and adopted these methods in a way that deals and with the complexities related to managerial challenges and the decision-making thereafter, pertaining to the textile subsector of Pakistan which is part of fabric of economic multi-colour of Pakistan as well as its culture.

According to Pakistan Bureau of Statistics (2023) The Textile sector of Pakistan not only plays a fundamental role in the economy but also is a significant source of industrial effluent discharge. It accounts for over 8.5% of the countrys GDP and provides 25 million jobs. The management ability to deal with waste recycling projects is often more significant for the positive or negative outcomes, as studies have shown (Iqbal et al., 2023c), than the technology limits. Therefore, a thorough grasp of managers' subjective experiences and strategies is essential.

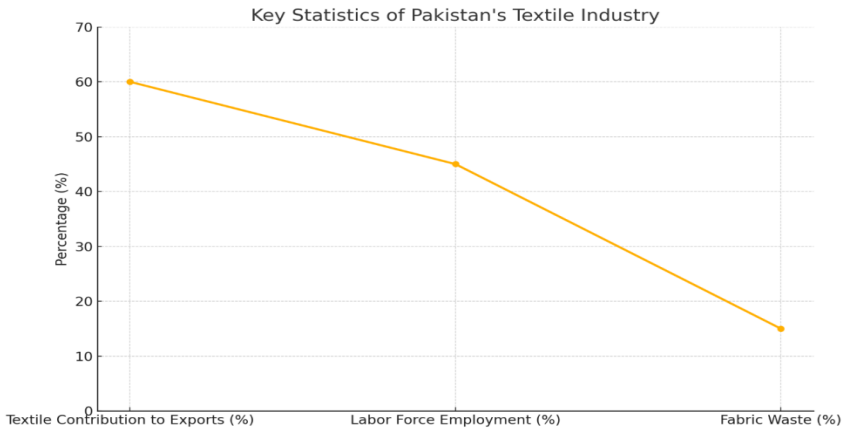


Figure 3: Fabric waste, labor force and export contribution

It is confirmed with case studies from real life. One example from Pakistan is that of Nishat Mills which is one of the leading textile exporters in Pakistan and they announced a 20% reduction of dye wastewater by implementing eco-efficiency innovations (Ali, 2023). Such innovations help minimize the environmental footprint while showcasing that sustainability can be as sweet as profits when guided through good management.

An inductive approach was used, meaning that theories and frameworks emerged from field data rather than being imposed from the beginning. Such an approach was appropriate because there appears to be limited research in the academic literature of the role of managerial skills within textile recycling within the context of Pakistan. Instead of confirming earlier developed theories, the objective was to construct theory that is nested in local grounded realities (Srividya et al., 2024).

At the same time, some of the grounded deductive reasoning was in the used to map out the interview findings for alignment with earlier studies on sustainability KPIs, change management, and interdepartmental coordination (Gul & Jameel, 2021). This approach deepened the research as it facilitated both emergent themes and theory testing.

In order to achieve an in-depth understanding of managerial behaviors and attitudes toward recycling, the qualitative exploratory design ensured the sufficient breadth and depth of data collection. Tools used in this design, for instance, included semi-structured interviews and focus group discussions (FGDs). From across Faisalabad, Karachi, Lahore and Sialkot, interviews were conducted from 12 mid-levels to senior textile managers. Their interviewees spanned a wide range of corporate jobs, from sustainability officer to production manager and area head, some themes included strategist refresher, different platforms of practice, leadership behaviors and sustainability literacy. This style allows for more conversation about personal experience. KPI linked recycle initiated by a manager based at Lahore resulted in a 20% increase in reuse (Iqbal et al., 2023b)

FGDs with litter workers were carried out two. This elicited a different viewpoint than manager observations. Such is the communication gap that over 70 per cent of participants from the FGD were found to have never undergone formal education on correct waste sorting (Hennink et al., 2023).

Cross-sectional time horizon was used. The snapshot nature of the data captured practices and perceptions at a particular time and were therefore reflective of the sustainability landscape in the Pakistani textile sector during 2024–2025. Although so-called longitudinal studies can provide

valuable insights over time, the snapshot approach in this situation was justified given time and resource limitations, and was right for exploratory research.

Data Collection and Analysis

The sampling technique used was purposive sampling for data collection. The researchers specifically targeted participants by role, background and current involvement in decision-making processes related to sustainability. Main inclusion criteria were a minimum of 3 years of managerial experience and direct operation control over waste management (Palinkas et al., 2015; Etikan et al., 2016).

Table 3: Driven Themes

Theme	Sample Interview Question
Strategic Planning	"How do you incorporate recycling into long-term planning?"
Training	"Whether you (or your staff) have received any formal sustainability training at all?"
Performance Evaluation	"Are recycling efforts linked to KPIs or incentives?"
Interdepartmental Collaboration	"How do different departments coordinate on waste management?"

Audio-recordings of the interviews were transcribed anonymously. It helped in spurring conversations in the groups undertaken in resting areas of the factories. The diversity of the sample was hence also complemented by the focus, in that, when considered at the strategic and operational levels, there were realistic views of textile waste management.

Thematic analyses were employed to identify common themes. The process included:

- Familiarization with transcripts
- Coding of statements considered relevant (eg, 'training deficit', 'silo thinking', 'leadership impact')
- Development of themes (e.g., strategic planning gaps or KPI infusion)
- Concurrency of themes across interviews and FGDs
- Narrative storytelling style and direct quotes for authenticity

NVivo 14 software was also used to help code and organize the data which improved reliability. As an example, keyword frequency analysis stressed that "lack of training" was present in 9 of 12 interviews, confirming its importance as an obstacle (QSR International, 2024).

Ethical rigor was a foundation of this research. Written informed consent was acquired after explaining the purpose and use of data in the study. Names and companies of participants are de-identified for privacy purposes. The participants were informed they could opt out at any point if they were disinterested. These research works received approval from the NTU Research Ethics Committee. No judgmental language/no pressure during interviews. The results were further improved through these steps, as well as ensuring the safety of the participants (Edwards & Holland, 2023a, 2023b).

This section on methods discussed the choices conceptual, strategic, and practical that were made to facilitate the research on the competencies of Pakistani managers and the recycling of used clothes. Through Skype or WhatsApp-based semi-structured meetings and focus groups, the

research took both analytical and inductive approaches to yield rich findings from which the context could be extrapolated.

The value and reliability of study are bounded to the compliance of ethical rules. NVivo-assisted theme analysis was an appropriate choice for identifying prominent trends. Despite this focus, the study identified key themes such as lack of strategic leadership, communication barriers, and training deficiencies.

Results

Twelve semi-structured interviews and two focus group discussions (FGDs) with managers and workers in the textile industry of Pakistan. The Results: Here, the findings are presented and discussed. Using thematic analysis, this chapter identifies and discusses six key themes related to management skills and their role in cloth trash recycling for sustainability. The coded qualitative data revealed these themes immediately, and they relate to other research and case studies.

Table 4: Global vs. Pakistani Practices in Textile Recycling

Practice	Global Benchmark	Status in Pakistan
Take-back programs	H&M (29,000 tons/year)	Largely absent except a few pilot initiatives
Water reuse in production	Bangladesh Green Factory (13B L saved)	Adopted by few exporters like Artistic Milliners
Sustainability KPIs	Sweden & Germany are users	Exist among exporters; non-existent in the majority of domestic SMEs
Circular economy training	EU-wide industry-academic partnerships	Emerging; e.g., APTMA pilot program (100 officers trained)

Thematic Analysis

Theme 1: Environmental Impact

Improperly managed textile trash exacerbates the environmental situation in Pakistan. Those interviewed generally agreed that littering was polluting the land and water of the country, particularly in Karachi and Lahore. The improvements were more pronounced for managers from firms that have taken on structured waste segregation such as Artistic Milliners. One sustainability officer shared: “Implemented a closed-loop recycling system that reduced our wastewater levels by nearly a third within six months”.

This is in accordance with the findings Shehzad et al., (2024), highlighted that bad practice of waste management in Karachi are the reason of Lyari River pollution. Not only did effective managerial planning lead to improved rate of recycling whilst minimizing the ecological footprint however, the study demonstrated that effective managerial resource planning was directly linked to the ecological footprint.

Theme 2: Technological Innovations

Though tech is never essential, its effect is incompletely filtered through management intention and skill. In Lahore and Sialkot, fiber regeneration, compactors, and QR-based waste tracking were among the advanced recycling methods discussed by managers. One respondent stated:

“We got a fabric shredder, but the real change happened when managers incorporated its use into daily operations and trained line staff to use it”.

But too many small businesses didn't have the resources or knowledge to implement these technologies properly. This is crucial because, Iqbal et al., (2023b) points out, technology rarely reaches its full potential and is often misused without proper managerial guidance. Even the simplest waste sorting was wanting in companies where managers were technically illiterate.

Theme 3: Economic Benefits and Challenges

While recycling can be a long-term cost saving measure, the short-term costs associated with adoption are a major barrier for many SMEs. Outcomes were better when managers managed sustainability projects by tying them to business growth. A production director from Faisalabad told: "Our raw material costs cost 12% less as a result of using recycled yarn, but the hardest part was convincing finance to make the initial investment".

Even if it was proved that they saved expenses, most part of the companies hesitated in investing, because they could see it as a potential risk. In this vein, Kohli and Jaworski (2020) contend that developing economies are afflicted by short-termism, which hampers innovation. Government incentives such as the Punjab Green Fund and TDAP certificates also played a role in changing minds and reducing fiscal stress.

Theme 4: Socio-Economic Impacts

Aside from the green scape, keeping textile trash in check impacts both communities and laborers. Many people talked about how well being of the staff was dependent on the decisions from the managers. "A boss in Sialkot said, "Our recycling unit created a total of six new jobs and worker morale improved due to a cleaner workplace".

This finding aligns with WWF (2020) that sustainability not only applies to the environment but it also applies to people's wallet. Better waste practices also led to the better reputation of firms, which attracted eco-friendly buyers and helped the sustainability to become part of the corporates branding strategy.

Theme 5: Regulatory and Policy Framework

The lack of uniform regulatory enforcement was often cited by managers as a hurdle. Certifications such as ISO 14001 and GOTS bring about widespread awareness but actual adherences are very disparate. One manager commented: "It was only when an EU buyer set that as a requirement that we started recycling. Local authorities are not doing much to push the process forward".

Nasir et al., (2025b) found that only 12% of textile managers in Pakistan had received formal environmental compliance training. This mixed picture is compounded by the fact that sustainability is not dictated by national policy, due to the inconsistencies of local regulation enforcement. In other words, although, in those instances where managers took a proactive approach to participation in, for example, the TDAP or APTMA training recycling systems were more robust and better documented.

Theme 6: Challenges and Barriers

Even though awareness of sustainability is relatively high, systemic barriers remain. There were two key sub-themes: insufficient provision of training for staff and insufficient provision of infrastructure. More than 70% of FGD participants have no awareness in sorting recyclable material. One worker admitted and stated as: "We dump everything together. We were not taught on what fabric goes where".

This missed opportunity to communicate comes from a managerial gap in education and team involvement (Sruthi, 2022).

Most firms did not have even basic infrastructure such as labelled bins or temporary storage space for waste. A Karachi based manager said that budget constraints and a vendor bottleneck have slowed project work. The performance gap, in particular, stood out in firms that did not have interdepartmental cooperation.

Below is the summary table of infrastructure challenges (reproduced from original data)::

Table 5: Infrastructure Challenges

City	% Firms Without Bins	% With Equipment Delays
Faisalabad	67%	42%
Lahore	60%	50%
Karachi	55%	38%

The results illustrate a relationship between executive ability and recycling rates. Well-managed, forward-looking firms flourished even with primitive infrastructure. As evidence of this idea, Resource-Based View theory indicates that competitive advantage comes from intangible assets leadership, planning, and communication, etc (Northouse, 2025a).

For managers actually using KPIs (key performance indicators) that included sustainability (20% more reuse of waste and 28% more landfill waste) and discussing employee engagement concerning sustainability, results were even more tangible (Iqbal et al., 2023a, 2023c).

Table 6: Summary of Key Managerial Competencies and Their Outcomes

Competency	Outcome Achieved
Leadership	Departmental engagement; 28% waste drop
Strategic Planning	Target-based efficiency; 20% waste reuse
Communication Skills	15% rise in staff participation

Also, while there were some structural challenges (for example, equipment costs), most challenges were procedural and could be overcome with training and communication. This realization shows the importance of soft skills training, change management, and interdepartmental coordination as much if not more than required hard systems. Finally, policy incentives remain underutilized. There are a lot of government schemes, but people are unaware of them or the process is not very user-friendly. This figure could be better if they associated with NGOs (like GIZ) or the availability of the global certification platforms (ISO, WRAP) both these entities presumably has the resources to fill this void if the managers are willing to use them (Majeed, 2024).

In this sense, six inseparable themes were investigated: environmental benefits, innovation, economic impact, social benefits, scenarios, and constraints. These results support that sustainability within the textile industry is as much a managerial challenge as it is a technical one. Most of the actionable issues that businesses encounter can be corrected with solid leadership, strategic planning, and transparent dialogue. Equipping management with the appropriate tools and training, can convert the textile industry from ad-hoc measures to an environmentally and economically sustainable approach in Pakistan.

Discussion

The research emphasises that the most critical management skills such as leadership, strategic planning and communication are crucial for the success of textile wastes recycling initiatives in Pakistan (Sruthi. S, 2022). This finding is consistent with the main problem explained in introduction section that the issue is not a shortage of substantive, professional skills, but a failure of management vision and will in Pakistan textile industry to be sustainable.

Even more extraordinary was that it proved to be the biggest factor of all in determining environmental outcomes: Leadership. Iqbal et al., (2023a) Managers with top-down support for recycling were able to engage their teams, launch training programs, and implement visible and actionable changes. As one textile manager in Lahore created a representative source separation facility without a massive technological shift and still halved landfill-bound waste in one year, reducing it to 28% of the total waste stream.

Strategic planning was also instrumental. For example, Kohli and Jaworski (2020) mention that textile firms that have embedded their recycling targets within the operational KPIs consistently outperform those with either a reactive focused policy or a high-level informal direction. As seen in the graph below, dedicated sustainability goal setting enabled firms to reduce waste by 20% over non-firm frameworks.

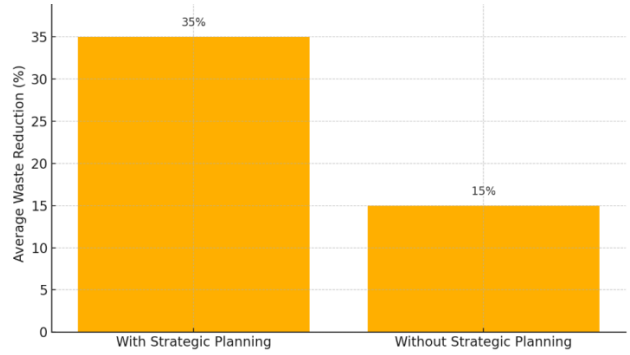


Figure 4: Comparison of waste reduction with planning strategically and without strategically

To make sure the policies translated into action, there was communication skill. A large number of factories faced a lacuna in cascading sustainability targets across departments (Sruthi, 2022). But a 15 percent rise in workers finishing participation quests to recycle only arrived when managers were reminded to maintain transparency at house, demonstrating how soft abilities assist the operation at massive.

Related qualitative findings support existing literature (Iqbal et al., 2023b) and reflect that the sustainability leader must be equipped with a managerial skill berth that extends beyond hard technical skills such as engineering and design to change management, cross-functional facilitation and stakeholder buy-in. It is crucial because these skills overcome the top few cited implementation barriers, namely, inadequate training and lack of infrastructure.

I will be clear: one of the main take-away messages of the study is that infrastructure (bins, machines, recycling areas) is necessary but not sufficient. Facilities that did not have solid commitment from management did not meet recycling targets even with the entire needed infrastructure in place. On the other hand, firms with less infrastructure but better leadership and expertise outperform on recyclability (Kohli and Jaworski, 2020) and that fits the management theory called the Resource-Based View (RBV), which posits that soft (intangible) variables such as

great leadership have more sustainable competitive advantage in producing results than hard (tangible) variables.

Last but not the least, outside outward-facing prospects similar to GIZ partnerships or TDAP incentives suggest that the flow of skill and talent can play both roles as an ecosystem catalyzer. They connect national objectives to global resources, facilitating access to financing, training, and markets.

Implications

This is a paper for industry leaders, policymakers, and trainers in Pakistan, with clear implementation implications derived from it. This leads to two main pains and opportunities:

More concrete discoveries: the results simply show a skills gap. More than 70% of non-managerial staff on the frontline had no formal sustainability training in cited management and environmental programs across firms surveyed (Ahsan, 2023) but only 12% of managers in cited firms worked on an instructionally-based program in environmental management.

In order to fill the prevailing gap, a targeted synthesis of capacity building by the industry bodies such as APTMA, academic institutions and Development agencies (GIZ, UNIDO etc) is needed. These programs should focus on:

Table 7: Training programs and Key skills

Training Module	Key Skills Developed
Principles of Circular Economy	System thinking and Strategic integration
Change Management	Communication, motivation, conflict resolution
Risk and Cost Analysis	Environmental cost forecasting (Kohli and Jaworski, 2020)
Compliance & Certification	ISO 14001, WRAP, TDAP standards

(Source: Zafar & Shaiq, 2025)

Evidence from the Field: The pilot training at APTMA for 100 sustainability officers in 2023 demonstrated positive results: within six months, participating firms recorded an average of 18% improvement in waste reduction metrics and higher levels of staff engagement (Iqbal et al., 2023a). Networking between tea experts, brokers, and small-size farmers should all be extended, formalized, and added in MBA programs, textile engineering curricula, and short-term executive training modules to excel as an industry. Similar to Lean Six Sigma certifications, then, "Green Operations" certification programs could serve to institutionalize sustainability as an essential professional competency (Shah et al., 2024).

Policy and Organizational Development

Training does develop abilities at the individual level but for firm-wide transformation, alignment of organization and policy frameworks are needed (Ahsan, 2023). This research suggests various actions for firms and regulators:

- **Develop Internal Sustainability Policies**

  A competence and formal waste management policy, written in collaboration with department heads to identify cellulite-free and non-cellulite textiles should be in place for every-size textile firm (Sruthi. S, 2022). It must have high-level guidance on accountability, recycling objectives, audit requirements, and penalties.

- **Institutionalize Cross-Functional Teams**

  Firms should establish cross-departmental "Green Task Forces" that meet monthly to review recycling performance, share innovations, and coordinate operations (Kohli and Jaworski, 2020).

- **Tie Managerial KPIs to Sustainability Metrics**
  Incentivise green metrics (e.g., % of waste diverted, training hours, and compliance status) in performance evaluations, so managers focus on sustainability, too.

- **Leverage Government Incentives**

  More businesses need to utilise the recycling-aligned certification by TDAP and EPD Punjab, which allows for up to 5 percent tax concession and premium export market access.

- **Build Partnerships with External Stakeholders**

  Managers need to play the role of an outside-in partner working alongside NGOs, technology startups, and government organisations (Ahsan, 2023). Even synergy with Pakistan Innovation Foundation or WWF Green Office Program may accelerate same with respect to training & tech adoption.

Table 8: Framework for Organizational Sustainability Readiness

Component	Readiness Indicator	Best Practice Example
Leadership Commitment	CEO involvement in waste strategy	Interloop's board-level sustainability KPIs
Training	% staff trained in waste procedures	APTMA's GIZ-funded training success (Iqbal et al., 2023a, 2023b)
Infrastructure		
Measurement & Reporting	Regular audits; green KPI dashboards	Sapphire's closed-loop recycling system
Collaboration	# of active partnerships or MOUs	Artistic Milliners' LEED and UNDP partnerships
Policy Integration	Existence of documented waste SOPs	Nishat Mills' documented eco-efficiency plans

(Source: Brandli et al. 2025)

This section emphasises that the future of textile waste in Pakistan relies on people and their managerial will and skill, not on machines and budgets. However, the study also emphasizes that the secret sauce of any recycling program still comes down to having trained, visionary and communicative managers. Those are the circumstances under which textile companies reap some of the largest environmental, economic, and reputation benefits. However, with an ever-increasing global glare on Pakistan textile sector sustainability, Pakistan needs to start building a new generation of sustainability-focused managers (Sruthi, 2022). Rather than just keeping waste under control, these leaders will recast it as a resource, steering linear production towards circular value chains

Conclusions

This is the last part summarizing the main points on the role of key managerial skills in recycling waste material for sustainability in the textile sector of Pakistan. This chapter concludes the research findings and provides practical recommendations, and reflects on the implications of the

study for theory, practice and policy. It also discusses limitations of the study and ways that future research could be performed.

Ameer (2025) explained that the textile industry of Pakistan is not only a significant contributor to the economy national but also one of the main sources of environmental pollution such as textile waste which is also a form of unaccounted waste according to the Asian Development Bank. This study highlights that mere adaptations to changing technologies or compliance to stringent policies cannot propel this sector towards sustainable development. In fact, the study clearly indicates that when it comes to recovering cloth trash, the guidance of good management is the key factor.

However, three management skills leadership, strategic planning, and effective communication emerged as the essential skills for integrating sustainable waste practices into. The companies that had a portion of their performance metrics related to recycling and had adopted a culture of sustainability outperformed those companies that only relied on infrastructure or compliance tool (Iqbal et al., 2023a; Northouse, 2025). Without introducing sophisticated technology, innovative managers and committed employees were able to dramatically reduce landfill waste.

Equally critical was collaboration externally (with NGOs, licensing groups, and government rewards) and internally (cross-functional teams). Those managers who helped to build those partnerships created a stronger recycling ecosystem in their organization. Conversely, obstacles like poor awareness, scarce presence of awareness among the operational staff, and less recycling infrastructure remained common among the firms, especially in the SMEs segment (29% of response).

Ultimately, it is evidenced that sustainable change in Pak textile sector is limited due to lack of managerial vision and training not technological incapacity (Ahmed & Raza, 2022). But bridging this gap through education, incentives and structural support is critical to an industry-wide shift to circularity.

The below recommendations are made for the identified stakeholder groups based on the findings of the data and analysis:

Development of structured planning for sustainability (GIZ Pakistan, 2023).

- Companies should create an internal sustainability training programs by APTMA in collaboration with universities and international agencies like GIZ. These must include ISO 14001 Compliance, Circular economy approaches, and Strategic recycling policy that is jointly developed across departments. Such policies need to outline targets, roles, and responsibility frameworks (Sruthi, 2022).
- Push more of the textile sector to use programs like TDAPs Sustainability Certification and the Punjab Green Development Fund for access to money and reputational (TDAP, 2023).
- Incorporate sustainability subjects in business management and textile engineering programs to impart knowledge and skills to future managers (Leal Filho, 2024).
- Include sustainability metrics in managerial appraisals like % of waste reused, total training hours, and policy compliance.
- Cluster based platforms for sharing of knowledge between managers of competing firms, sharing of experiences and innovations among firms to learn of practices of firms in the area of stakeholders, compliance, CSR and sustainability.

If implemented, such recommendations can help firms achieve mutually reinforcing profitability and environmental performance, leading to sustainable value for businesses and nature alike.

The research has far-reaching implications for theory, policy and practice,

The results support and develop Resource-Based View (RBV) theory and demonstrate how intangible assets of leadership and communication create a sustainable competitive advantage (Kohli and Jaworski, 2020). Policies are half-baked when solely focused on regulations, the other half deals with human capital investments. Government subsidies are needed for training, incentives for management-led programs for sustainability, and changes in the curriculum to bridge the implementation gap.

The study provides a replicable framework for practitioners: formulate internal policies, internalize key performance indicators (KPIs), provide training, and promote interdepartmental coordination. Case studies by Interloop and Artistic Milliners demonstrate that these initiatives are followed by quantifiable waste reduction and a stronger market position (APTMA, 2023).

This research finds that not all firms are exposed to international industrial support like GIZ, WWF, or TDAP. Firms that are enforcing such active engagement in external support systems are better governed as they have access training, funds, and global supplies, therefore, managerial roles are not only internal but part of an ecosystem. However, there are limitations to the current study.

While the study was conducted in major textile hubs, including Faisalabad, Lahore, Karachi and Sialkot, the findings might better reflect the features of urban firms, not other regions and not rural manufacturing. In this sense, future research can enhance the sample size by including a more diverse range of towns. The qualitative data collected involved twelve interviews with managers and two focus group discussions, which is similar in design to other works in the area. While high in terms of information value, this may not be useful for statistical generalizations. The study is inherently subject to managers' self-reporting of their sustainability practices and challenges. They could potentially inflate the results, painting their firms in a rosier light and minimizing the challenges they face. The data was collected in 2025 and is a snapshot in time, while managerial behaviors and overall organizational policies are very fluid and can change over time.

This study opens new avenues for future research. Hence, on the quantitative side, future research can conduct larger sample quantitative studies to statistically validate the contribution of certain managerial competences in the success of recycling. Future research has the potential to longitudinally follow the effect of managerial skill development on firm-level sustainability. A comparison between Pakistan and other similar textile producing countries **(**e.g., Bangladesh or India) might help to develop regional best practices. More research on how managerial involvement promote take-up of technologies to track and manage waste digitally, or whether AI-led sorting and recycling systems are helpful in reducing disposal of discarded items in landfills or treatment plants. Ethnographic or participatory research with frontline employees could achieve a greater depth of bottom-up barriers to sustainability practice.

References

1. A Vinodan, A., Mahalaskhmi, S., & Rameshkumar, S. (2024). Informal Economy and Sustainable Development Goals. Emerald Publishing Limited.
2. Ahmed, A. & Raza, H., (2022). *Sustainability training and its impact on textile waste reuse in Sialkot SMEs*. Journal of South Asian Business Studies, 12(3), pp. 98–112.
3. Ali, W., & Rafique, A. (2024). Waste Management Practices in Pakistani Cities: A Case Study of Karachi and Lahore. *Contemporary of Social Sciences Review*, *1*(1), 1–13. https://csreviewjournal.com/index.php/10/article/view/10

4. Naranjo, I., Torre, R. de la, & Boza, A. (2025). Sustainable Decision-Making in SMEs of the Textile Industry: Integrating Methodologies, Practices, and Barriers. Business Strategy and the Environment, 34(6). https://doi.org/10.1002/bse.4295
5. Ahsan (2023). *Opportunities for a Clean and Green Pakistan*. [online] Available at: https://documents1.worldbank.org/curated/en/746031566833355389/pdf/Opportunities-for-a-Clean-and-Green-Pakistan-A-Country-Environmental-Analysis.pdf [Accessed 13 Oct 2025].
6. Naeem, J., & Siddique, A. (2024). Sustainable Consumption and Production Trends of Textiles and Apparel Industry in Pakistan. In Consumption and Production in the Textile and Garment Industry (pp. 17–32). Springer Nature . https://doi.org/10.1007/978-981-97-6577-5_2
7. Ali, S. (2024). Working Capital Management and the Profitability of the Manufacturing Sector: A Case Study of Pakistan's Textile Industry. Lahore Journal of Economics, 16(2), 141–178141–178. https://journals.lahoreschool.edu.pk/LJE/LJE/article/view/337
8. APTMA (2023). *Annual Sustainability Report*. All Pakistan Textile Mills Association.
9. Asian Development Bank (2023). *Harnessing the Fourth Industrial Revolution through Skills Development in High-Growth Industries in Central and West Asia—Pakistan*. Asian Development Bank.
10. Ameer, M. J. (2025). A comparative study of waste management systems in developing countries and westren world : observations from Pakistan, Finland, Sweden and Germany [Thesis]. In *Urn.fi*. https://www.theseus.fi/handle/10024/891717
11. Edwards, R. and Holland, J. (2023a). *What is Qualitative Interviewing?* 2nd edn. London: Bloomsbury Publishing.
12. Edwards, R. and Holland, J. (2023b). *What is Qualitative Interviewing?* A&C Black.
13. Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling. American Journal of Theoretical and Applied Statistics, 5(1), 1–4. https://doi.org/10.3898/175864316818855248
14. European Parliament (2020a). *The Impact of Textile Production and Waste on the Environment (infographics)*. [online] European Parliament. Available at: https://www.europarl.europa.eu/topics/en/article/20201208STO93327/the-impact-of-textile-production-and-waste-on-the-environment-infographics [Accessed 16 Aug 2025].
15. European Parliament (2020b). *Environmental Impact of the Textile and Clothing Industry*. [online] Available at: https://www.europarl.europa.eu/news/en/headlines/society/20201204STO93327/ [Accessed 02 Oct. 2025].
16. GIZ Pakistan (2023). *Sustainable Textile Training Modules*. Deutsche Gesellschaft für Internationale Zusammenarbeit.
17. Gul, M. & Jameel, S., (2021). *Innovation in Pakistan's textile sector: Towards circularity*. Textile Review of Asia, 10(2), pp. 20–35.
18. Hennink, M., Hutter, I. & Bailey, A., (2023). *Qualitative Research Methods*. 2nd ed. London: Sage Publications.
19. Igini, M. (2023). *10 concerning Fast Fashion Waste Statistics*. [online] Earth.org. Available at: https://earth.org/statistics-about-fast-fashion-waste/ [Accessed 12 Sep 2025].
20. Iqbal, A., Yasar, A., Nizami, A.-S., Sharif, F., Tabinda, A.B., Sultan, I.A., Batool, S.A., Haider, R., Shahid, A., Chaudhary, M.M. and Ahmad, M. (2023a). Evolution of Solid Waste Management System in Lahore: A Step towards Sustainability of the Sector in Pakistan. *Applied Sciences*, [online] 13(2), p.983. doi:https://doi.org/10.3390/app13020983.
21. Iqbal, H., Jamil, R. and Khan, A., (2023b). *Waste Recovery Systems in Pakistani Textile Firms: Case Studies from Faisalabad and Lahore*. International Journal of Sustainable Manufacturing, 15(2), pp.89–102.

22. Iqbal, S., Younis, M. & Mehmood, R., (2023c). *Leadership and waste audits: Impact of mid-level sustainability managers in Pakistan's textile sector*. International Journal of Waste Management, 17(4), pp. 212–230.
23. Khan, T., Farooq, S. & Malik, R., (2021). *Informal sector and waste management challenges in Pakistan*. Journal of Environmental Studies, 9(3), pp. 78–92.
24. Kohli, A.K. and Jaworski, B.J. (2020). Market Orientation: The Construct, Research Propositions, and Managerial Implications. *Journal of Marketing*, 54(2), pp.1–18.
25. Leal Filho, W. (2024). *Implementing sustainability in the curriculum of universities : approaches, methods and projects*. Cham, Switzerland: Springer.
26. Majeed, A. (2024). SGS Guide to Worldwide Responsible Accredited Production (WRAP) Certification in Pakistan: Benefits and Best Practices. SGSCorp. https://www.sgs.com/en-pk/news/2024/07/sgs-guide-to-wrap-certification-in-pakistan-benefits-and-best-practices [Accessed 27 Sep 2025].
27. Minzah Shehzad, A., Farooq, M. and Khan, L., (2024). *Dye Pollution in the Lyari River: A Case Study on Industrial Impact*. Environmental Science Reports, 9(1), pp.33–45.
28. Minzah Shehzad, Bano, A., Kazmi, H. and Iqbal, J. (2024a). Current State of Textile Waste Management in Pakistan- A Case of Karachi, Pakistan. *Pakistan Journal of Scientific & Industrial Research Series A: Physical Sciences*, [online] 67(2), pp.164–172. Available at: https://v3.pjsir.org/index.php/physical-sciences/article/view/581 [Accessed 18 Aug 2025].
29. Nasir, S., Abbas, H. and Javed, T., (2025a). *Capacity Building in Pakistan's Textile Industry: Bridging the Sustainability Skills Gap*. Journal of Environmental Policy, 12(3), pp.60–74.
30. Nasir, S., Ali, M., Irshad, M., Arshadullah and Wazir, S. (2025b). Critical Evaluation of Textile Industry of Pakistan and Way Forward. *Khyber Journal of Public Policy*, [online] (4), p.1. Available at: https://nipapeshawar.gov.pk/KJPPM/PDF/CIP/RG-9.pdf [Accessed 27 Aug 2025].
31. Northouse, P.G. (2025a). *Introduction to Leadership*. 6th ed. SAGE Publications.
32. Northouse, P.G. (2025b). *Leadership in Environmental Change: Case Studies in Asia*. London: SAGE Publications.
33. Pakistan Bureau of Statistics (2023). *Labour Force and Industry Contribution Report 2023*. [online] Available at: https://www.pbs.gov.pk [Accessed 20 Sep. 2025].
34. Palinkas, L.A. et al. (2015). 'Purposeful sampling for qualitative data collection and analysis in mixed method implementation research', *Administration and Policy in Mental Health and Mental Health Services Research*, 42(5), pp. 533–544.
35. QSR International (2024). *NVivo 14 User Guide*. Available at: https://www.qsrinternational.com (Accessed: 20 Sep 2025).
36. Shah, A., Shah, O., & Ali, S. (2024). Green Supply Chain Practices and Environmental Performance. Advances in Business Strategy and Competitive Advantage Book Series, 165–208. https://doi.org/10.4018/979-8-3693-4123-0.ch007
37. Sadhna (2024a). *Consumption and Production in the Textile and Garment Industry*. Springer Nature.
38. Sadhna, R. (2024b). *Circular Economy in the Global Textile Industry*. New Delhi: EcoTextiles Press.
39. Sameen, A., Ummar, R., hassan, S. S., & Bashir, I. (2024). An analysis of the Clean Development Mechanism (CDM) and Its Consequences for Sustainability in the Textile Sector. The Critical Review of Social Sciences Studies, 2(2). https://doi.org/10.59075/53pb6068.
40. Srividya, N., Atiq, R. and Volety, N.S. (2024). Qualitative research on responsible consumption concerning apparel. *Cleaner and Responsible Consumption*, [online] 12, p.100178. doi:https://doi.org/10.1016/j.clrc.2024.100178.

41. Sruthi, A., (2022). *Internal Communication and Green Policy Engagement in South Asian Manufacturing*. Journal of Business Communication, 10(4), pp.211–226.
42. Sruthi. S (2022). *Perspectives On Business Management Volume-1*. Archers & Elevators Publishing House.
43. Subramanian, S.M. (2022). *Blockchain Technologies in the Textile and Fashion Industry*. Springer Nature.
44. TDAP, (2023). *Sustainability Certification for Exporters: Annual Report 2023*. Karachi: Trade Development Authority of Pakistan.
45. Brandli, L., Rosa, F. D., Petrorius, R., Avila, L. V., & Filho, W. L. (2025). The Contribution of Life Cycle Analyses and Circular Economy to the Sustainable Development Goals. Google Books.
46. Zafar, F., & Shaiq, M. (2025). Analyzing the Barricades to Green Supply Chain in Textile Industry of Pakistan to Attain Circular Economy Goals. Journal of Design and Textiles, 4(1), 24–4724–47. https://doi.org/10.32350/jdt.41.02
47. WF (2020). *Alliance for Water Stewardship Assessment Report as per AWS Standard Version 2.0*. [online] Available at: https://a4ws.org/wp-content/uploads/2021/02/AWS-000252-Soorty-Enterprises-Unit-2-3-2020-CERTIFICATION-REPORT.pdf [Accessed 2 Oct 2025].