Navigating Global Sustainability: Challenges and Opportunities for Uzbek Textile Clusters in Embracing Circular Economy Practices

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Abstract

This thesis investigates how Uzbek textile clusters can adapt to the growing global demand for sustainable and circular textile production, addressing the critical question of successfully integrating circular economy (CE) principles into their operations and export strategies. Utilizing a mixed-methods approach that combines quantitative analysis of industry data with qualitative interviews with cluster stakeholders, the research identifies key barriers and opportunities for adaptation. Notable findings highlight the need for enhanced collaboration among stakeholders and the establishment of comprehensive sustainability programs to improve workforce skills and resource efficiency. The thesis concludes by proposing a strategic framework designed to enhance sustainability and circularity within Uzbek textile clusters, offering actionable recommendations for producers, policymakers, and international collaborators.
Key words: Uzbekistan, textile industry, textile cotton clusters, sustainability, circular economy, transparency.

Table of Content

1. Introduction

Uzbekistan's cotton textile industry has a long history, integral to Central Asia's ancient trade routes (Worldbank.org, 2020), and for centuries, establishing the nation as a leading global cotton producer of cotton (Shahbandeh, 2023), which is showing significant economic and geopolitical influence (Asfaw, 2019). However, the Soviet era legacy included exploitative labor practices (Cotton campaign, 2022), environmental damage (notably the Aral Sea crisis), and unsustainable water use. Post-independence challenges persisted, including reliance on raw cotton exports and human rights concerns (Morawska, E. 2018) (Chang, 2019).

Since 2016, transformative reforms have modernized the industry, significantly advancing the development of vertically integrated cotton-textile clusters (OECD events, 2025). These clusters are adopting innovative technology (Worldbank, 2020) integrating the entire value chain, from cultivation to garment production, aiming to enhance efficiency, quality, and sustainability (Better Cotton in Uzbekistan,2024). Government initiatives have eradicated forced labor, prioritized environmental sustainability, and shifted production towards higher-value-added finished goods (Kim & Park, 2019). This has facilitated re-engagement with international markets, attracting foreign investment and establishing Uzbekistan as a modern textile hub committed to balancing economic progress with social and environmental responsibility (UNECE, 2022). Uzbekistan's young and dynamic population, with a median age of around 28 years (UNICEF Uzbekistan, 2020), is a significant asset for attracting investors (Daryo.uz, 2024).

Currently, Uzbekistan’s textile exports are primarily directed toward Russia, other CIS countries, and China (Appendix 1). However, there is growing interest in expanding exports to the European Union and other international markets. To facilitate this, the government has focused on strengthening trade relations, improving production standards, and partnering with global brands (ProQuest, 2022).

The nation has not yet fully embraced a circular economy approach, and there remains a significant gap in its commitment to resource reduction, reuse, and recycling (World Bank, 2024). While some awareness of sustainable practices exists, comprehensive strategies and implementation efforts are essential to build a truly sustainable future (World bank, 2020). This multifaceted value chain, deeply rooted in cotton, spans from cultivation to the production of ready-to-wear garments, playing a pivotal role in Uzbekistan's economy.

This study examines the urgent need for Uzbek textile clusters to adapt to the evolving trends of sustainability and circularity within the global textile industry. By analyzing current practices and exploring the implications of these trends, this research aims to identify critical challenges and pathways that Uzbek textile clusters can leverage to enhance their competitiveness, promote sustainable production, and secure ongoing market access. The findings will deepen our understanding of the factors influencing these clusters and will form the development of effective strategies for sustainable and competitive market engagement.

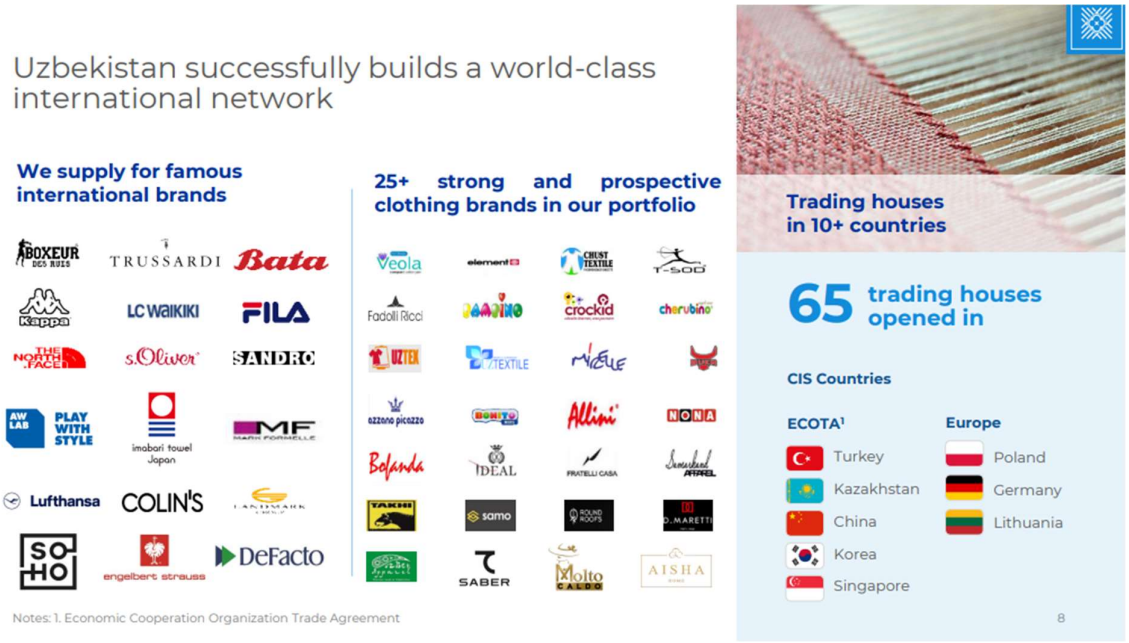

Figure 1, Source: Uzbekistan textile association (UTA)

1.1. Problem statement

Uzbekistan's textile industry, renowned for its high-quality cotton production, is currently at a critical turning point where it must transition from traditional linear production methods to a more sustainable circular economy (World bank, 2020). This shift is essential not only for tackling environmental challenges like waste and resource depletion but also for enhancing the industry's competitiveness in the global market. The ongoing war in Ukraine has disrupted Uzbekistan's primary export market, with Russia, a major importer of Uzbek cotton goods, now seeking cheaper alternatives (GET, 2022). This situation underscores the urgent need for Uzbekistan to diversify its export markets.

Despite the potential for growth, Uzbekistan's textile clusters face significant challenges. Many clusters are characterized by a lack of comprehensive frameworks for sustainable practices, limited access to innovative technologies, inadequate training for workers, and insufficient waste management systems (World bank, 2024). Furthermore, the absence of strong partnerships and collaboration within both local and international contexts hinders effective implementation of circular economy principles (UNECE, 2022). Addressing these barriers is crucial not just for ensuring the sustainability of the textile sector but also for unlocking new avenues for economic growth and trade.

1.2. Research Questions/Objectives:

- **How can Uzbek textile clusters effectively adapt to the evolving trends and demands of sustainability and circularity in the global textile industry?**
- **Sub-Question 1:** What are the key barriers and opportunities that these clusters face in this transition?
- **Sub-Question 2:** How can circular economy principles be integrated into the production and export strategies of Uzbek textile clusters to enhance their sustainability and circularity?

1.3. Scope and Limitations

1.3.1. Scope

This study focuses on the transition to a circular economy in Uzbekistan's cotton-producing textile clusters, specifically examining the stages up to the sewing process. It explores current practices, barriers and opportunities for adopting circular economy principles, and the readiness of these clusters to meet requirements, such as product traceability and sustainability standards.

1.3.2. Limitations

The research is limited to a four-month period, restricting the depth of data collection and analysis.

Uzbekistan's complex textile industry makes consistent data collection challenging due to its diverse and fragmented nature. With numerous clusters, interviews could only be conducted with a few representatives, as many were occupied during the peak cotton harvesting season or chose not to participate. The study focuses solely on cotton-producing clusters, excluding other segments of the textile value chain that do not involve cotton.

These limitations may affect the generalizability of the findings, but the study provides valuable insights for improving the understanding of sustainability in Uzbekistan cotton textile clusters and the needed steps for future improvement.

1.4. Why this research matters for Uzbekistan and its Textile sector

Transitioning to a circular economy can enhance the competitiveness of Uzbekistan's textile sector by reducing costs and increasing efficiency (Switch-Asia, 2023). It can also open up new markets and opportunities for sustainable products. Implementing circular economy practices can significantly reduce the environmental footprint of the textile industry, including reducing waste, conserving resources, and minimizing pollution, which is crucial for sustainable development (World bank, 2020). A circular economy can create new job opportunities and improve working conditions in the textile sector, contributing to the overall well-being of communities by promoting sustainable practices and reducing the negative impacts of traditional production methods. By adopting circular economy principles, Uzbekistan can position itself as a leader in sustainable textile production, enhancing its reputation on the global stage and attracting investment from international markets.

2. Literature review

The literature review provides valuable empirical insights by illustrating the current landscape of sustainability and circularity within Uzbek textile clusters and identifying gaps in both academic and grey literature. It includes a range of sources, such as academic articles that offer theoretical frameworks and empirical evidence, grey literature like governmental documents that provide policy context and industry regulations, and websites of textile clusters that showcase current practices and innovations. By integrating these diverse sources, the literature review enriches the understanding of the current state of the industry and lays the groundwork for actionable recommendations for enhancing sustainability efforts in Uzbek textile clusters.

2.1. Uzbekistan's Textile Industry Transformation: A Cluster-Driven Approach

Uzbekistan's remarkable transformation of its cotton and textile industry is largely due to the strategic implementation of over 140 production clusters (World bank, 2020). This cluster-based

approach marks a fundamental shift, moving the sector beyond raw cotton exports towards a vertically integrated system encompassing all production stages, from field to finished garment (GIZ, 2024). This transformation, facilitated by the establishment of these clusters, has positioned Uzbekistan as a major player in the global spinning industry, significantly contributing to rural development and industrialization (GIZ, 2024). The shift from raw cotton exports to a vertically integrated system represents a significant structural change, enabling the processing of 100% of its 1.1 million tons of cotton into yarn, employing over 510,000 people across 1.03 million hectares *(UNECE, 2022).* This commitment to value-added production has established Uzbekistan as a significant player in the global spinning industry (GIZ, 2024).

2.2 Cluster Development and Structure: A Government-Led Initiative

Uzbekistan's cotton-textile clusters originated from a government-led initiative (Figure 2). Private textile companies submitted investment proposals, which underwent review and approval through government resolutions. These resolutions designated specific geographic areas and privatized existing ginneries, creating vertically integrated private enterprises (World bank 2020). Clusters are geographically defined, some clusters utilize contract farming with independent farmers, while others engage in direct farming, leasing land for cultivation (World bank 2020). Although the government initially drove cluster formation (a top-down approach), recent policy adjustments aim to reduce state control, empowering clusters and farmers to operate more independently in the marketplace (World bank, 2020). The government still retains influence through mechanisms such as setting minimum prices, regulating credit access, and overseeing cluster performance (World bank,2020). A non-governmental Association of clusters supports clusters, advocating for their interests and resolving disputes (Norma.uz, 2020). The Actor map of cluster is presented on Figure 2.

The country has also made significant strides in modernizing agricultural practices, adopting high-yield cotton varieties, embracing organic cotton production, and investing in water-saving technologies (GIZ, 2024). These improvements, alongside substantial investments in processing and manufacturing equipment, have led to significant export growth, exceeding $3 billion in 2020 and projected at $7 billion by 2025 (Asia Pacific journal of marketing & management review, 2024).

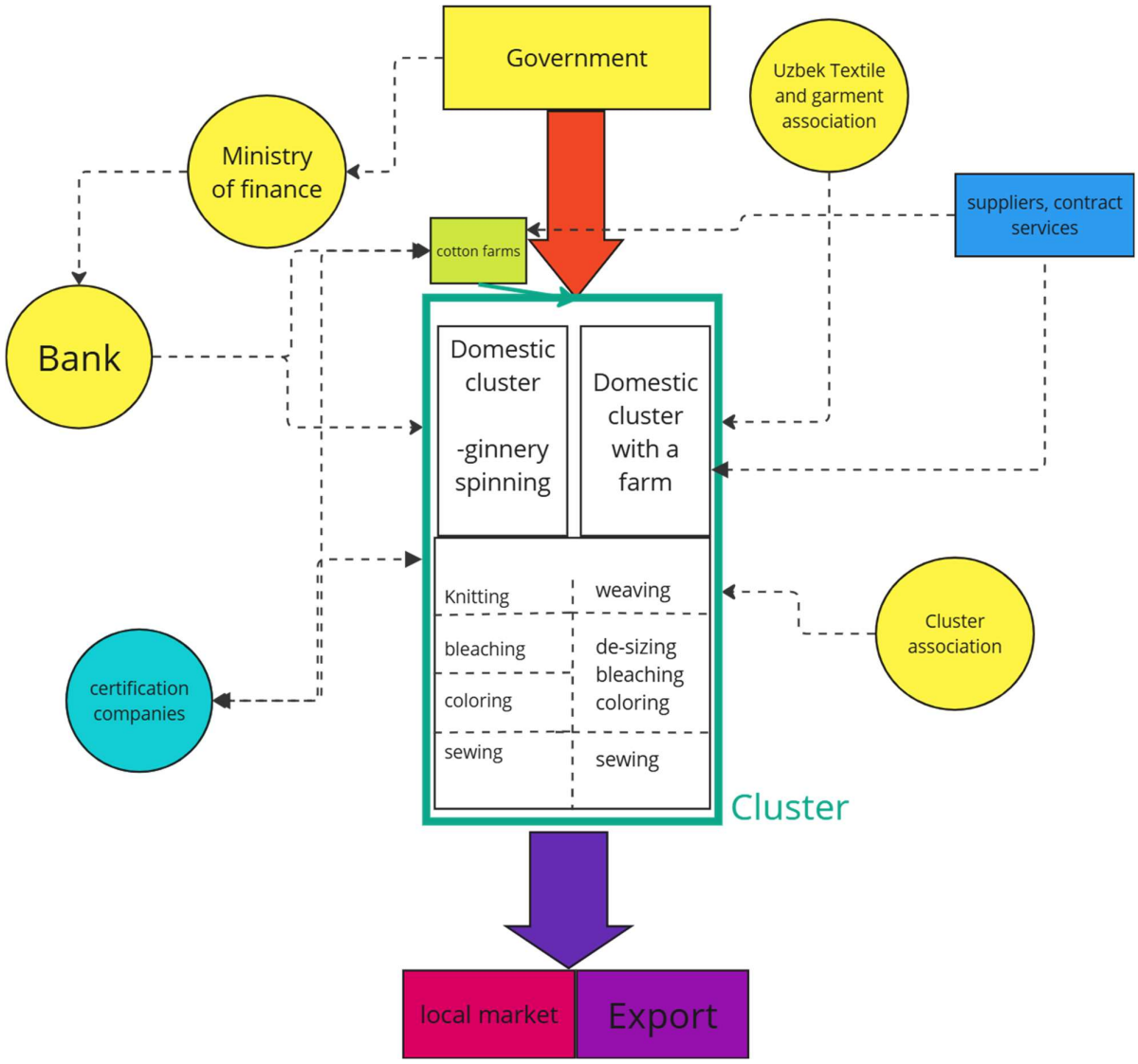

Figure 2, Cluster, Actor map

2.3 Vertical Integration, Production Capacity, and Global Market Integration

Uzbekistan's textile clusters exhibit vertical integration, spanning cotton cultivation to garment manufacturing. Individual clusters specialize in specific stages, from yarn production to finished textiles and garments, creating a diverse and dynamic industry (Uzts.uz, n.d.). This vertical integration enhances transparency and traceability, crucial for meeting international standards for sustainability and ethical production (GIZ, 2024). The industry boasts significant production capacity: all cotton grown is processed into yarn (3.9 million spindles, 932,000 tons of yarn in 2023) (USDA, 2024), woven and knitted fabrics (1.364 million m² woven, 370,000 tons knitted)

(GIZ, 2024), and finished garments, with the latter's export share growing from 17% to 40% of total textile exports (2018-2022).(Appendix1).

Modernization efforts involve the implementation of cutting-edge technologies from the latest generation (RB Asia, 2021). Uzbek clusters have integrated successfully into global supply chains (Prezident.uz, 2023), producing clothing for international brands like ZARA, Waikiki, and Baldessarini (Figure1). This success is fueled by Uzbekistan's young and dynamic workforce (UNICEF, 2020), combined with generations of expertise in cotton cultivation, ensuring adaptability and innovation.

The elimination of forced and child labor, coupled with deeper processing of raw materials (World bank, 2020), has further enhanced efficiency and competitiveness. These improvements have also translated into significant export growth, geographic expansion of markets, job creation in rural areas, and overall increases in employment and income for the population (Djurabaev, 2023).

2.4 Uzbekistan's Journey Towards a Sustainable Textile Industry

2.4.1 Government reforms and international integration.

Since 2017, the Government of Uzbekistan (GoU) has committed to implementing a comprehensive range of reforms across various sectors, focusing on enhancing public services, improving governance, and promoting investment to stimulate economic growth (strategy.uz, 2022). The recent reforms and sustainability initiatives showcase its ambition to become a competitive and responsible global market player (World Bank Group, 2022). The EU's granting of GSP+ status in 2021 recognized Uzbekistan's progress in labor, governance, judicial, and business reforms (European Commission, 2021). This preferential trade status reduced tariffs on 66% of EU tariff lines to zero, boosting duty-free exports from 2,400 to 6,200 products, including textiles, apparel, carpets, and footwear. These changes enhance market access, foster international partnerships, and align Uzbekistan with global labor, environmental, and governance standards. To support compliance, the government covers up to 100% of ESG certification costs (GIZ, 2024), capped at $15,000, and provides incentives like tax reductions for water-efficient investments and subsidies for laser-leveling technologies.

2.4.2. Sustainability Initiatives in the Textile Sector

Sustainability is at the core of Uzbekistan's policies, guided by its 2019–2030 green economy strategy (Adilova, M., 2020). The plan targets energy efficiency, renewable energy expansion, improved water and waste management, climate change adaptation, and restoring ecosystems.

As of 2019, drip irrigation was implemented across 9,000 hectares of cotton fields, with a greater emphasis on improving seed quality and expanding organic cotton cultivation. By 2023, approximately 7,000 hectares are dedicated to organic cotton cultivation, while the Better Cotton Initiative's principles are being implemented on over 35,000 hectares (USDA, 2020).

The textile industry is transforming to meet sustainability and circular economy goals. Partnerships with organizations like UNECE and GIZ have led to significant initiatives, such as UNECE's "Sustainability Pledge," which emphasizes blockchain technology for traceability and independent testing for sustainable materials (UNECE, 2022). GIZ's "Sustainability and Value Added in the Cotton Economy" project has tackled forced labor issues and environmental harm while promoting sustainable practices, resulting in a 10% increase in farmer incomes and the creation of 1,500 new jobs (GIZ, 2020). Additionally, SWITCH-Asia supports Uzbekistan in promoting sustainable consumption and production as part of its economic diversification and modernization efforts (Switch-Asia, n.d.).

2.4.3. Labor rights and social sustainability.

Uzbekistan's textile and apparel industries are increasingly working to meet international sustainability standards. While progress has been made in eliminating systemic child and forced labor, ongoing monitoring and enforcement are crucial (UNECE, 2022). Further efforts are needed to increase awareness and support the implementation of international labor standards within cotton clusters, as local producers struggle to understand and comply with new legal frameworks and audit requirements (Leon, 2024). The persistence of forced and child labor in some clusters (Uzbekforum.org, 2022), coupled with a significant shortage of skilled labor due to worker migration to higher-paying CIS nations (Tleuken et al., 2022), hinders the transition to a socially responsible textile industry. Addressing these labor rights violations is essential for building an ethical sector that meets global standards.

2.4.4. Certification, standards, and the cluster model.

Uzbekistan's textile industry is progressing toward greater sustainability. While organic cotton cultivation has reached 7,000 hectares and over 35,000 hectares adhere to Better Cotton Principles and Criteria, a considerable gap exists: only 4% of Uzbek cotton currently holds BCI certification (United Nations, n.d.).

Moreover, the vertically integrated textile clusters in Uzbekistan hold the potential for enhanced transparency and traceability within the supply chain (GIZ, 2024). However, concerns remain about their overall impact; critics argue that this structure can function as a de facto monopoly, with private companies controlling essential resources and limiting farmers' bargaining power (Synovitz & Bobojon, 2021). In response to these issues, a January 2023 decree from the

government liberalized cotton prices, enabling more equitable negotiations between farmers and clusters (GIZ, 2024), and the President's announcement in October 2023 allowed farmers to contract with any cluster in their region.

2.5. Navigating Challenges for Sustainable Development

This chapter examines the industry's efforts toward ethical labor practices, environmental responsibility, and technological advancement. It highlights the challenges of implementing sustainable practices, enhancing supply chain transparency, and fostering socio-economic equity. To achieve environmental sustainability, Uzbekistan's textile industry must adopt several key practices, including significantly reducing water usage and chemical inputs, soil regeneration (USDA.gov, 2020), and renewable energy implementation (Daryo.uz, 2024). Prioritizing recycled content and designing for durability are crucial for minimizing environmental impact and promoting a circular economy (Wang, 2019; World Bank Group, 2024).

While initiatives like the UNECE cotton blockchain pilot project show promise, broader adoption is necessary for effectiveness. Lastly, Uzbekistan's heavy dependence on water-intensive cotton production presents a significant obstacle to achieving a fully circular economy (World bank group, 2020).

The complex shift to a circular economy encounters challenges stemming from institutional frameworks, cultural norms, technological limitations, and market dynamics (Chen et al., 2021). Cultural barriers arise from low interest and limited awareness among consumers and businesses about circular economy principles, largely due to market immaturity and insufficient government initiatives to promote the concept (Tleuken et al., 2022).

Looking ahead, there will be a greater focus on improving the quality of services and addressing various challenges across sectors to achieve sustainable development and enhance competitiveness. Ongoing investment in renewable energy (Daryo.uz, 2024), coupled with sustainable industrial practices, signifies Uzbekistan’s commitment to reducing its environmental footprint and building a resilient, sustainable future in its textile sector.

2.6. Overview of regulations and standards for textile.

To successfully export globally, Uzbekistan must ensure compliance with a variety of regulations. For instance, the European Union has established a complex framework of regulations and standards governing textile imports, aimed at protecting consumers, the

environment, and promoting fair competition. These regulations encompass various aspects of textile products, including the materials used, labeling, and safety requirements. Below is an overview of key regulations connected to sustainability:

- *General Product Safety Directive (GPSD (European commission, 2002).* This overarching directive sets out basic safety requirements for all products placed on the EU market, including textiles. Products must not endanger consumers' health or safety. Specific risks covered under GPSD for textiles include flammability, chemical hazards (e.g., harmful dyes), and mechanical hazards (e.g., sharp edges, loose parts).
- *REACH* (*Registration, Evaluation, Authorisation and Restriction of Chemicals)* (European commission, (n.d) This regulation restricts or bans certain hazardous substances in textiles, requiring manufacturers to register their use and demonstrate their safe handling. This is a key piece of legislation, covering a wide range of chemicals that might be found in textiles, including dyes, finishes, and other additives.
- *The EU Strategy for Sustainable and Circular Textiles (European commission, 2023)* is a comprehensive policy framework aimed at transforming the textile sector. It focuses on promoting sustainability, circularity, and reducing the environmental impact of textile production and consumption.
- *The Ecodesign for Sustainable Products Regulation (ESPR) (European commission, 2024)* seeks to make products sold in the EU significantly more sustainable by improving their circularity, energy efficiency, recyclability, and durability. Key initiatives within this framework include the *Digital Product Passport (DPP)* (European commission, 2024b) for improved product transparency and the Sustainable Product Initiative (SPI) for lifecycle sustainability improvements across all products, including textiles.
- *Waste framework directive* (European commission, n.d.) aims to reduce textile waste through improved recycling, reuse, and prevention of waste generation. While not directly impacting imports, it influences the overall sustainability goals within the EU that indirectly affect the desirability of certain imported products.
- *Restrictions on Hazardous Substances (RoHS*) (European commission, 2021). Though primarily focused on electronic and electrical equipment, certain aspects of RoHS can indirectly impact textiles if they contain electronic components or materials subject to RoHS restrictions.
- *Textile products (Labelling) regulation (*European commission, 2022) This regulation mandates specific information on textile labels, such as fiber composition, care instructions, and the manufacturer's name and address. The country of origin must be clearly indicated.

2.7. International standards existing in Uzbekistan for sustainability in textiles.

Uzbekistan's textile clusters are increasingly focusing on sustainable practices and meeting international standards, leading to the achievement of several important certifications (Asia pacific journal of marketing & management review, 2024). These certifications help enhance the credibility of Uzbek textiles in the global market, particularly in the EU, by demonstrating a commitment to quality, sustainability, and ethical production. The following are key certifications that have been achieved in Uzbekistan's textile clusters:

- *Global GAP (Good Agricultural Practice)* (Global G.A.P, n.d.) is an international standard ensuring agricultural product safety and compliance with quality and technical requirements, covering the entire production cycle. Certification is voluntary and differs from national standards by evaluating the whole production process, not just the final product.
- *Organic certification* (ams.usda.gov, n.d.) confirms adherence to organic standards in food cultivation, production, packaging, and transportation.
- *OEKO-TEX® STANDARD 100* (oeko-tex.com, n.d.) certifies textile products free from harmful substances. It involves testing over 100 criteria, including prohibited and potentially hazardous substances. The certificate is valid for 12 months, with a repeat evaluation for extensions.
- *WRAP (Worldwide Responsible Accredited Production)* (*Wrap Compliance,* 2024) certification indicates ethical business practices, including following labor laws and banning forced and child labor practices, fair compensation, health and safety standards, and the right to collective bargaining.
- *BSCI (Business Social Compliance Initiative)* (Amfori.org. (n.d.). is a non-profit initiative by the Foreign Trade Association (FTA) aimed at improving supplier performance through social responsibility monitoring in global trade. It focuses on continuous improvement of suppliers' social practices, promoting best practices aligned with global standards like the UN Universal Declaration of Human Rights and ILO conventions.
- *GOTS (Global Organic Textile Standard)* (*Gots, n.d.*) ensures the organic certification of textile products from raw material collection to production and labeling. It covers textiles made from at least 70% certified organic fibers, including yarn, fabric, clothing, and home textiles.

- *SEDEX (Supplier Ethical Data Exchange)* (Sedex. 2024) is a non-profit organization that promotes ethical business practices in global supply chains by sharing audit reports and encouraging improvements. Founded in 2001, it aims to reduce the audit burden for suppliers.
- *The CE marking (Conformité Européenne)* (European commission, 2022) certifies that a product meets EU safety standards, indicating it is safe for humans and the environment, but does not guarantee product quality. It is required for certain product categories such as medical equipment, toys, construction materials, and machinery.
- *BCI (Better Cotton Initiative) (*Better Cotton, 2024) is the biggest global sustainable cotton program, working to eliminate the negative environmental and social impacts of cotton production through collaboration with stakeholders.

3. Methodology

3.1. Research Strategy

The research paper employed a variety of methods, including desk research, unstructured and semi-structured interviews, and document analysis (encompassing sustainability reports, government publications, and company websites) to gather in-depth data on Uzbekistan's textile cluster's approach to the circular economy.

This study utilizes a mixed-methods framework with an interpretive research strategy that emphasizes understanding social phenomena from the viewpoints of the individuals involved. Specifically, it aims to investigate the perceptions, experiences, and challenges faced by stakeholders within the Uzbek textile cluster as they adapt to the changing demands of the global market.

Incorporating both inductive and deductive reasoning, the research identifies patterns and themes collected data, such as interview transcripts and secondary data analysis through inductive reasoning. In contrast, deductive reasoning guides the interpretation and analysis of this data by applying established theoretical frameworks, including circular economy theory, cluster theory, and RBL theory.

Although not strictly a case study, the research incorporates elements of an explorative case study approach by examining the experiences of various stakeholders across different Uzbek textile clusters. This facilitates a deeper understanding of the diverse challenges and

opportunities within the industry. The study holds both exploratory and descriptive elements; it explores the perceptions, experiences, and challenges faced by Uzbek textile clusters in adapting to global sustainability trends. Additionally, it describes the current state of the Uzbek textile industry, focusing on production processes, resource consumption, environmental impacts, and market access strategies.

Desk research is integral to this study, with governmental websites providing authoritative insights into relevant policies and regulations impacting the textile sector. Company websites and sustainability reports are vital for assessing how textile clusters collectively tackle sustainability challenges and implement industry's best practices. The review of academic articles contributes rigorous analysis and established theoretical frameworks to support research objectives, while grey literature, such as reports from industry associations and NGOs, offers practical insights into real-world challenges and practices within textile clusters.

By combining qualitative and quantitative data, incorporating theoretical frameworks, and employing an interpretive approach, this research aims to provide a comprehensive understanding of the challenges and opportunities facing Uzbek textile clusters in navigating global sustainability trends. Such insights will ultimately guide the development of effective strategies for sustainable and competitive market engagement, serving as a foundation for future research and policymaking in the sector.

3.2. Research Design

The research design is illustrated in figure 3 below.

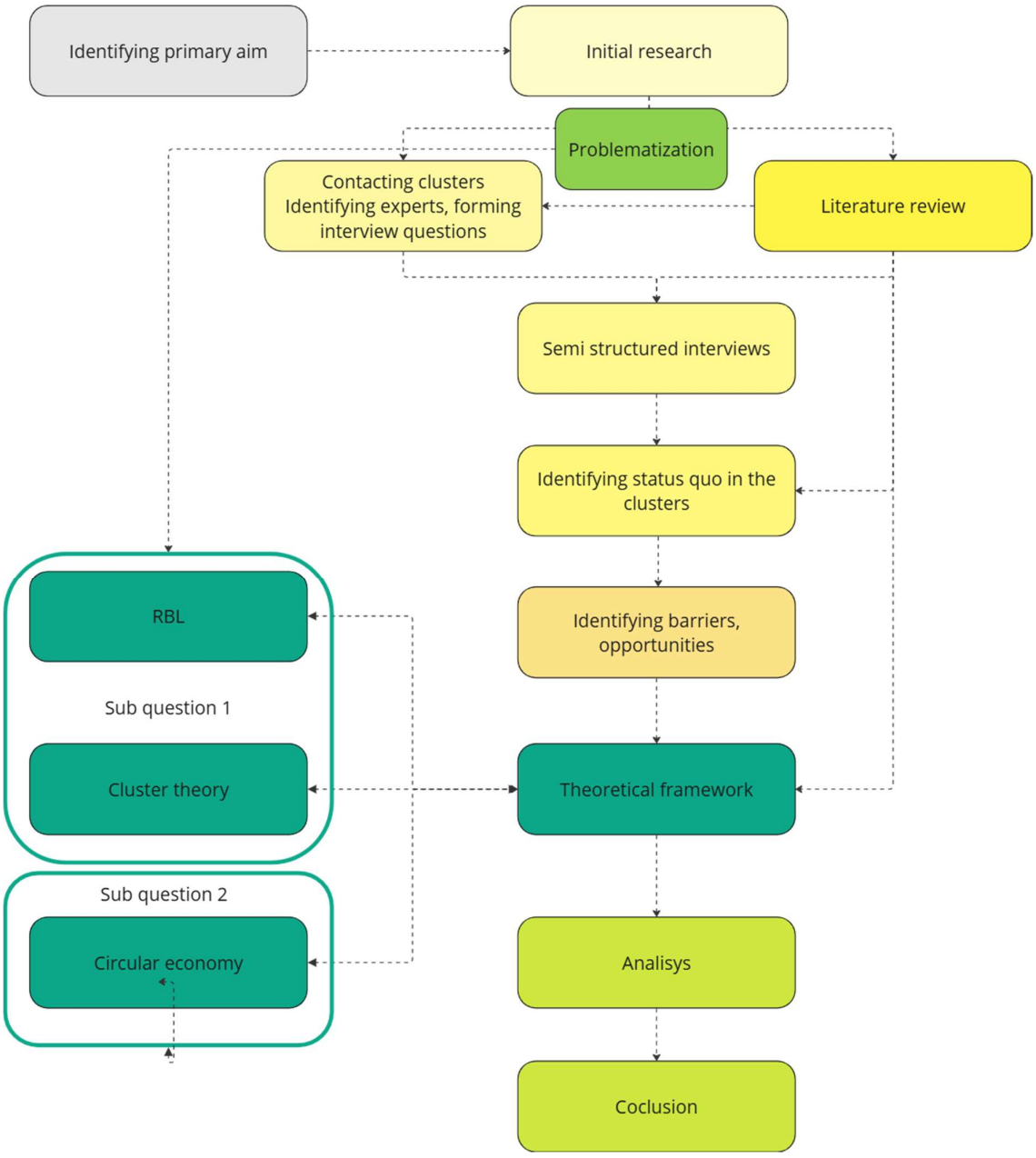

Figure 3, Research diagram

3.3 Data collection methods

3.3.1 Desk research

Extensive desk research was made to gather information from sustainability reports, government publications, and academic articles that inform the context and background of the study. This research utilized specific keywords from selected years between 2017 and the present, focusing on topics such as "textile clusters Uzbekistan", "cotton industry Uzbekistan", "sustainability in Uzbekistan textile," "sustainable practices in Uzbek textile clusters," and "circular economy in the textile industry of Uzbekistan." This approach aimed to collect relevant information and insights into the evolving landscape of Uzbekistan's textile industry, particularly concerning sustainability, circular economy practices, and the regulatory framework affecting the industry.

3.3.2 Semi-Structured Interviews (Figure 4)

The study conducted several interviews in fall 2024 within the period of 2 months with representatives from clusters, 10 clusters were contacted and only 3 of them answered. The aim of semi-structured interviews with textile clusters was to gain insights into their operational practices, including data management, material tracking, and waste processing, while assessing sustainability efforts like renewable energy use and efficient irrigation. The interviews sought to identify export challenges, opportunities for growth, and compliance with international standards. Additionally, they explored training programs for sustainable development and the level of collaboration between clusters on sustainability issues, ultimately gathering qualitative data on the textile industry's landscape regarding sustainability and operational efficiency. Additionally, by reaching out to international organizations in Uzbekistan and consulting with the international advisor to the Uzbekistan Textile and Garment Association, valuable insights were gained into the situation of textile clusters from both internal and external perspectives. This approach illuminated the clusters' operational challenges, regulatory environment, and growth opportunities, as well as their perception and support from international stakeholders. From this point of view, the focus on textile clusters often emphasizes sustainability, quality standards, and innovation, with stakeholders evaluating adherence to environmental regulations, the use of eco-friendly materials, and efficient production and waste management practices, which are increasingly important in the global market.

The interview with the representative of the public sector, provided valuable insights into the regulatory framework and official representation of textile clusters, highlighting the association's influence on industry standards, compliance with international regulations, and promotion of sustainable practices.

Additionally, were interviewed a representative from a certification company that provides certifications to textile clusters, a consultant specializing in strategy and production optimization who offered valuable insights into the textile clusters, as well as two PhD researchers—one working with farmers and the other in the textile industry.

The specific companies and names involved in the study were not shown, but they were selected to represent a diverse range of industry and contexts to enrich the findings and applicability of the framework.

This method facilitated in-depth discussions, allowing for both structured questions and open-ended responses that provided rich qualitative data on current practices, challenges, and insights regarding sustainability and market entry.

Figure 4, The interviews

4. Theoretical frameworks

The research also utilizes relevant theories, such as Circular economy theory (ellenmacarthurfoundation.org), the Resource-Based View (RBV) (Barney, 1991) and Cluster Theory (Penrose, 2009), to analyze the findings and provide a theoretical basis for understanding the competitive dynamics and resource utilization within the Uzbek textile sector.

4.1. Circular economy theory

The concept of circular economy is closely associated with Ellen MacArthur, who promotes sustainability through the Ellen MacArthur Foundation (Ellenmacarthurfoundation.org, n.d.). The Circular Economy (CE) is a regenerative economic model that seeks to minimize waste and optimize the use of resources by maximizing the lifespan of products, materials, and resources within the economy (UNEP, 2023), a departure from the linear "take-make-dispose" model, while the circular economy prioritizes three core principles:
Reduce: Cutting down on resource consumption and waste generation during production, encouraging the use of fewer raw materials and energy.
Reuse: Extending the lifecycle of products and materials by reusing them in their original form or through remanufacturing, thus avoiding premature disposal.
Recycle: Processing and transforming waste materials back into usable resources to create new products, thereby reducing the need for virgin raw materials.

However, the circular economy concept has evolved to encompass additional principles, such as regeneration, which focuses on restoring and improving natural systems(Ellen Macarthur foundation). The principle of regenerating nature promotes practices that shift from extraction to regeneration, focusing on restoring soil and ecosystems instead of depleting them. By enhancing biodiversity and improving soil health, these practices work with natural processes to ensure sustainable and resilient ecosystems.
The primary goals of a circular economy are sustainability and resource efficiency, focusing on minimizing environmental impact and conserving natural resources (Ellen MacArthur foundation). For the textile industry, adopting a circular economy model is particularly important

due to the sector's significant environmental footprint, characterized by excessive waste, water usage, and reliance on non-renewable resources (Chen et al., 2021). By embracing circular practices, such as designing for durability, recycling textiles, using sustainable fibers and regenerating soil, the textile industry can dramatically reduce its negative impact, promote responsible consumption, and create more sustainable production cycles (Chen et al., 2021).
The e-mobility case study, described in the article by J. Konezhko et al, 2019, while focused on a different sector, provides valuable lessons directly applicable to developing circular textile clusters in Uzbekistan. The challenges encountered as aligning diverse stakeholder interests (e.g., balancing the needs of cotton farmers, manufacturers, and recyclers), managing the complexity of a multi-actor system, and securing early customer commitment for new, sustainable products—are mirrored in the textile industry. The study's conclusion emphasizes that strong governance structures, clearly defined business models, and effective communication are paramount for success. Furthermore, the identified principles of collaboration, experimentation, and platformization are directly transferable: fostering collaboration across the entire textile supply chain, experimenting with pilot projects focused on sustainable practices (e.g., recycling, innovative materials), and establishing digital platforms to connect stakeholders and improve transparency are crucial steps towards building a thriving circular textile ecosystem in Uzbekistan. The case study’s findings underscore the necessity of a holistic approach that goes beyond simply focusing on geographical proximity.

4.1.1. Application of Circular Economy (CE) in global textile supply chains

The Circularity Gap Report, Textiles highlights critical issues within the global textile industry concerning circular economy principles *(*Circularity Gap Reporting Initiative, 2024).
The industry exhibits a shockingly low circularity rate of just 0.3%, indicating that only a tiny fraction of materials used in production comes from recycled sources. Furthermore, over 99% of materials are sourced from virgin inputs, predominantly synthetic fibers derived from fossil fuels, making the dependence on finite resources a significant concern. The environmental impact of the industry is substantial, affecting various categories such as material footprint, water scarcity, climate change, biodiversity loss, and human health, with conventional cotton production exacerbating issues of water scarcity and eutrophication due to fertilizer runoff. Socially, the industry employs around 140 million individuals worldwide, with many laboring under hazardous conditions and receiving low wages, compounded by a large segment of the workforce in informal employment, leading to considerable economic inequities. Additionally, the industry faces overproduction challenges, producing billions of garments annually, with up to 30% remaining unsold, thus contributing to massive waste and resource depletion driven by

the fast fashion model. Transitioning to sustainable practices poses significant challenges, as systemic changes are necessary yet often hindered by cost barriers and limited access to technology. A lack of digital data availability and transparency further complicates efforts to benchmark circularity and environmental impacts. In summary, the report paints a picture of an industry that is overly reliant on unsustainable practices, impacting both the environment and labor conditions, while highlighting that collaboration among stakeholders such as governments, businesses, and financial institutions, is crucial to address these challenges, reduce consumption, improve social conditions, and adopt cleaner production methods.

4.2. Resource-Based View theory.

The Resource-Based View (RBV) (Penrose, 2009) provides a valuable framework for understanding how Uzbek textile clusters can leverage their unique resources and local knowledge to adapt to the growing demands for sustainability and circularity in the global textile industry.

Penrose's groundwork, primarily in her book "The Theory of the Growth of the Firm," established the conceptual foundation for Resource-Based Theory (RBT). Her key contribution was viewing the firm not as a simple, static entity but as a complex bundle of interconnected resources, physical assets, human capital, organizational knowledge, and access to opportunities. She argued that a firm's growth and strategic behavior stemmed from the effective management and deployment of these diverse resources and their inherent productive potential. This perspective challenged earlier economic models that treated firms more abstractly. While not explicitly formulating the VRIO/VRIS framework, her work provided the fundamental understanding of the firm as a collection of resources which forms the basis for later developments in RBT.

While Penrose's work laid the groundwork, Barney's refinement of Resource-Based Theory (RBT) (Barney, 1991) shifted the focus from simply describing the effective management of firm resources to explicitly explaining how those resources generate *sustained* competitive advantage. Penrose focused more on the growth of the firm through resource allocation, while Barney emphasized the conditions VRIN under which resources lead to a competitive advantage that is difficult for competitors to replicate.

4.2.1. Resources

Resources encompass the assets, abilities, organizational procedures, information, and understanding that an organization holds. They can be categorized into:

Tangible resources are physical assets such as machinery, buildings, and equipment.
Intangible resources are non-physical assets including brand reputation, intellectual property, and human capital (skills and expertise of employees).
Capabilities is the ability of a firm to use its resources effectively to achieve desired outcomes.

4.2.2. Competitive advantage

A competitive advantage occurs when a firm performs better than its rivals due to its unique resources and capabilities. This could manifest in higher profitability, market share, or quality of products/services.

4.2.3. VRIN Framework:

For a resource to contribute to competitive advantage, it should meet the following criteria:
Valuable resources must enable the firm to exploit opportunities or neutralize threats in the environment.
Rare resources must not be widely possessed by competitors, making them unique to the firm.
Inimitable resources should be difficult for competitors to imitate or replicate, often due to unique historical circumstances, social complexities, or specific processes.
Non-substitutable resources mean there should be no equivalent resources that can provide the same benefits, ensuring that competitors cannot easily find alternatives.

4.3. Clusters Theory

The cluster theory is applied to Uzbekistan's textile sector because it emphasizes the importance of geographic concentration and interconnectedness among businesses to foster innovation, enhance productivity, and improve competitive advantage, which are critical for the country's efforts to modernize its textile industry and integrate into global markets.
In a “Principles of economics” Marshal describes cluster is a “geographic concentration of specialized industries”(Marshall, 1890).
Michael Porter argues that in today's global economy, competitive success relies on interconnected clusters of businesses and organizations rather than mere access to global resources (Porter, 1998). These clusters enhance innovation and productivity through local competition, shared knowledge, and collaboration.
Porter emphasizes the need for public-private cooperation to establish infrastructure and education, prioritizing productivity for sustainable competitive advantage. While globalization has increased resource accessibility, local contexts remain crucial, as proximity fosters

collaboration and specialized knowledge. Government policies that enhance education, infrastructure, and competition play a vital role in developing these clusters.
Moreover, addressing issues like environmental policy and economic inequality requires focusing on productivity improvements and expanding opportunities rather than just redistributing resources. Ultimately, clusters drive productivity and innovation by fostering collaboration and creating competitive environments for continuous improvement.
Insights from studies on industrial clusters, such as Yamawaki's examination of Japan's industrial structure, which emphasizes the role of leading firms, pooled labor markets, and public research facilities (Yamawaki, 2002), provide valuable perspectives. Similarly, Menzel and Fornahl's models of cluster dynamics emphasize the significance of technological heterogeneity and localized learning (Menzel & Fornahl, 2010).
In the article (Babadjanov& Petrick, 2023) the authors find a significant disconnect between the theoretical concept of clusters in industrial policy literature and their implementation in Uzbekistan. Clusters in Uzbekistan are largely single, vertically integrated firms, not networks of interconnected enterprises.
Together, these studies provide a comprehensive understanding of the mechanisms driving cluster development and the essential components that contribute to their success, offering valuable lessons for regions seeking to leverage clustering as a strategy for economic growth and competitiveness.

5. Analysis

5.1. Data analysis strategies

The research employed a mixed-methods approach, integrating qualitative and quantitative data analysis to address two sub questions. For the first sub question, examining Porter's Cluster theory and the Resource-Based View (RBV), quantitative data on cluster resources (e.g., firm numbers, technology access, infrastructure quality, capital availability) was gathered from desk research (sources such as government statistics, industry reports, and potentially company data if publicly accessible). This quantitative data was complemented by thematically analyzed qualitative interview data on perceived barriers and opportunities. This allowed for a comparison between the theoretical framework and the empirical reality of cluster development in the Uzbek textile industry.

The second research sub question, focusing on Circular economy integration, also utilized desk research alongside thematically coded interview data. The desk research provided quantitative data on aspects such as material flows, waste generation, energy consumption, and relevant environmental impact indicators sourced from industry reports and government databases. This quantitative data, combined with the qualitative interview data exploring sustainable practices, CE principle adoption, and regulatory compliance, provided a more comprehensive understanding of circular economy implementation within the Uzbek textile clusters.
Both research sub questions utilized a triangulation strategy, combining qualitative insights with quantitative context from desk research. Thematic analysis of interview transcripts was central, identifying patterns and challenges related to cluster development and circular economy implementation.

5.2. Analysis 1: Resource identification (RBV theory) and utilization and Porters cluster theory for Uzbekistan textile clusters.

Combining resource-based view (RBV) and cluster theory for the research sub-question, "*What are the key barriers and opportunities for Uzbekistan textile clusters to adapt to the evolving sustainability and circularity trends and demands of the global textile industry?"* offers a comprehensive understanding by examining both the collective dynamics within clusters and the strategic resources that individual firms can harness. Additionally, it emphasizes the importance of dynamic capabilities critical for responding to global market changes, allowing for the development of nuanced strategic recommendations for stakeholders.

- **Resource-Based View (RBV)**: Focuses on the internal resources and capabilities of a firm that can lead to competitive advantage. Resources that are valuable, rare, inimitable, and non-substitutable (VRIN criteria) drive a firm's success.
- **Porter's Cluster Theory**: Emphasizes the benefits that firms gain from being geographically clustered, including access to specialized suppliers, a skilled labor pool, and the potential for innovation through collaboration and competition within the cluster.

5.2.1. Tangible resources Resource-Based View (RBV)

- **Geographic concentration as a resource.** Geographic concentration is a vital resource for Uzbek textile clusters, enhancing competitiveness and operational efficiency. Clustering enables firms to access specialized suppliers, reducing transportation costs and lead times. Additionally, it fosters collaboration and knowledge sharing, driving innovation and

resilience. This interconnected environment allows clusters to respond quickly to market changes, strengthening their strategic positioning in the global market.

- **Geographic position as a resource.** Uzbekistan's central location offers a significant advantage in terms of reduced transportation times and the potential to avoid reliance on air and sea freight comparing to competitors.
- **Natural resources.** Uzbekistan is known for producing high-quality cotton, which is generally longer and stronger than that from other countries like China, India, and Pakistan(RB Asia, 2020) This superior quality can reduce the amount of textile waste generated during production, as higher-quality fibers typically lead to more durable and long-lasting products(Kim &Park, 2019).
- **Machinery.** Uzbekistan's textile clusters boast modern equipment capable of high-quality, efficient production. However, its capacity utilization lags significantly behind competitors like Bangladesh, Pakistan, and India (Interview with GIZ and advisor)

  "The crucial point is the productivity. And the productivity in Uzbekistan is low. You have the modern lines and on the most modern line, in comparison to Bangladesh with old machines, bad machines, but the Bangladesh´s productivity is three times higher"
- **Access to solar energy as a resource.** For Uzbekistan's textile clusters, abundant sunshine provides readily available solar energy, a valuable resource that can be leveraged to reduce energy costs and enhance sustainability.
- **Financial resources** are essential for investing in sustainable practices. Clusters with greater financial resources can better support the acquisition of new equipment and training. However, according to the interviews (Expert 4) the interest rates for bank loans are quite high.

  "...financing through loans is tough given the high interest rates. The allocation of funds posed problems as it wasn't efficient".

  According to Expert 9, local businesses are generally hesitant to invest in their operations, often waiting for external investors or loans, which are currently are likely stopped by the president:

  "The mentality is here to use borrowed money, and the owners of the companies do not invest so much by themselves".

  The decline in Russian demand for Uzbek textiles due to the ongoing conflict (Expert 7) has created significant challenges for an industry that has historically relied on Russia as a primary export market. As Russia increasingly turns to cheaper suppliers like Bangladesh, India (Expert 9), many Uzbek clusters are experiencing decreased orders and revenue

shortfalls (Expert 7). This situation places additional pressure on numerous small and medium-sized businesses that depend on consistent demand (Expert 7) and leads to reduced investment in innovation, thereby hindering growth and progress within the Uzbek textile sector.

At the same time, it created an urgent need for Uzbekistan to diversify its export markets.

- **Digital platform for data storage.** The adoption of a tailored digital platform for data storage is an essential organizational resource for Uzbek textile clusters, serving as a dynamic hub that enhances collaboration, communication, and management processes among all stakeholders. Such platforms streamline operations, improve transparency, and support innovation in sustainable practices, allowing clusters to respond more effectively to market demands and align their strategies with sustainability trends. As highlighted in interviews with (Expert1, Expert 10) many clusters lack the necessary platform to facilitate effective information exchange, which negatively impacts data flow and storage. This deficiency in robust data management can hinder collaboration, leading to inefficiencies and potential inaccuracies in information sharing.

"But still, the organizational structure, has to be changed. Especially in the sales department, which is corresponds with EU clients in the end. And as a rule, these departments are not aware that is going on in the other department of cluster, for example. "Expert 10"

5.2.2. Intangible resources

- **Human resources and knowledge.** Uzbekistan's textile industry benefits from a constantly growing and youthful population (Tadayonfard, 2024), which fosters adaptability and a willingness to learn, driving innovation within the sector. The country boasts a rich tradition in cotton cultivation, renowned for its high-quality cotton fiber, supported by a skilled textile workforce. This workforce is a vital asset, but gaps in advanced training related to sustainability and innovative practices remain barriers to fully leveraging this resource.

  The cluster model offers significant opportunities for enhancing Uzbekistan's economic performance and promoting sustainable development. Rather than shifting towards the production of man-made fibers, as suggested by GIZ (GIZ, 2024), it is crucial to capitalize on the existing strengths in cotton production. Plans to establish six chemical technology clusters by 2026 further underscore this focus (Tojiev, 2022); however, the increasing critique of synthetic fibers due to their environmental impact highlights the sustainability challenges associated with this transition. While substantial literature supports the development of synthetic fibers, many countries have already advanced in this market

(FHASAL, 2023), often requiring large investments in technology and infrastructure (GIZ, 2023).

Moreover, blending cotton with synthetic fibers like polyester or elastane complicates the recycling of post-consumer textile waste (GIZ, 2023), as the labor-intensive process of separating different fiber types presents significant challenges (Textile exchange,2024). Instead of solely focusing on synthetic fibers, Uzbekistan should build upon its legacy of high-quality sustainable cotton production.

To address skill gaps and improve operational efficiency, the textile clusters are increasingly investing in international expertise from countries such as India and Bangladesh (interview with GIZ). This involves bringing in specialists to train local personnel in advanced machinery, which necessitates a significant commitment of time and resources.

- **Brand reputation and sustainability.**

  Uzbekistan's textile industry, while boasting a strong heritage in cotton cultivation and production, faces challenges in sustainability and brand recognition, hindering its competitiveness. Developing brands that highlight organic and recycled cotton, leveraging the country's Silk Road history and cultural heritage (particularly cities like Samarkand, which has seen a tourism boom (Intellinews.com, 2024), can create a strong market position. A brand reputation emphasizing sustainability, recyclability, and durability would also incentivize Uzbek textile clusters to adopt sustainable practices (Yu et al., 2023).

  "Clusters need a create their own brand- this is the most important, we have everything for it- vertical clusters, newest equipment, people, who knows textile production" Expert 7.

  "The complexities of international regulations, however, require specialized knowledge and resources that many Uzbek textile clusters lack, according to interview findings", Expert 9.

  "So, European buyer comes to the factory first before buying a big amount of whatever. And they do an audit and they would tell their head office passed or failed. So, once we come, we didn't agree and we never come back again to Uzbekistan, right? If it's not changed, I'm not going to do any business with Uzbekistan", Expert 9.

  According to the interviews with representatives from the clusters, only a small number have taken steps toward implementing recycled content and recycling practices.

  Many Uzbek clusters did not achieve the certification levels required by the EU (Appendix1) and this lack of compliance hinders their ability to establish a strong reputation in the EU market and creates a major obstacle to increased European exports and the full realization of the benefits afforded by GSP+ status (Expert 9):

"So, you have the legal framework, GSP+, which is good for the beneficiary of exports, but companies cannot export because they are not ready"

There is a shortage of specialists with a sustainability-focused mindset, (interview, Expert 7) and existing educational programs are insufficient as seen from interview with expert 10. This limits the knowledge and skills needed to implement sustainable practices and understand circular economy concepts (Expert 9).

"But you see, you may have a certified company, social standards and environmental standards being implemented, but then maybe the highly legal companies coming to Tashkent or to other places here and they see that factories located in a residential area. Maybe the line, the machines are too close to each other. Maybe the electricity box where all the cables and switches are in is open. Maybe you have an inflammable liquid gas in the cylinder beside something which is inflammable. There are no emergency exits on certified standards. So, this is what the European buyer would not accept" Expert 9.

- **Management and innovation capabilities**

  Effective management is crucial for coordinating the adoption of sustainability. However, the novelty of cluster system and the absence of international examples result in misguided management in some clusters (Expert 4)

  "In other textile companies, funds were better invested. Here, mismanagement led to the owner selling us out to the bank" Expert 4.

  Skilled managers who grasp the operational needs and strategic importance of innovations can drive the acceptance of new technologies. However, as noted in interviews (Expert 6,9) organizational issues and ineffective leadership and old-fashioned mindset present significant barriers. Frequent reorganizations can exacerbate misaligned priorities and lead to poor decision-making, hindering the long-term goals of the textile clusters, following from interviews (Expert 6):

  "if the government gets involved in private businesses, setting up rules and fixing prices, the whole thing will crash – and that's exactly what's happening".

  "The clusters were supposed to support them(farmers), but when things fell apart, the farmers were left holding the bag. And even when the cotton is harvested, the local authorities step in and claim it for the state, which totally messes with market prices. This whole situation – government interference, price fixing – has destroyed the cluster system."

  The elimination of ministries responsible for garment, cotton and leather industries, coupled with the absence of strong labor unions, as revealed in interviews (Expert 6) leaves textile cluster workers in a vulnerable position, undermining social sustainability in the industry:

"The ministry of Light industry, The ministry of Leather industry, The ministry of Cotton Industry etc.– they were abolished, they've all been rolled into the Chamber of Commerce. No one is accountable anymore!" Expert 6

Regulatory inconsistencies and complex governance structures further disrupt stability and growth within these clusters (Lopes et al., 2023). Corruption adds to the challenges, as favoritism and bribery affect resource allocation, licensing, and access to incentives, resulting in inefficiencies and distorted competition (Uzbekforum, 2024).

Following by interviews (Experts 9,10), clusters favor large orders, which conflict with the demand patterns of European companies that typically place smaller orders; this mismatch restricts their access to the European market and hinders their productivity potential, thus, a change in management mindset and a different focus are necessary to address this mismatch.

"that the management of most companies will not accept these guidelines, which the main buyers from Europe would give them, so the European buyers will not invest" Expert 9

"Uzbekistan, I think, with the clusters, sometimes makes a wrong strategic decision, with too much order, and too little consumption. So, what we experience in many clusters is that they are not fully utilized" Expert 10

This situation exemplifies interdependent constraints: the clusters' inability to meet European standards due to insufficient compliance discourages European engagement, while the lack of European engagement hinders the development of the necessary compliance mechanisms within the clusters.

"So 30 people prepared for an audit, nine or 10 decided to go through the audit, which costs a lot of money (...)And one year later, I think only two kept the certification. And the other seven said, like, hey (...)we don't have any clients in Europe. Why should we continue paying for it? If we are not making any use of it?" Expert 10

Following by interview with expert 10, currently, Uzbek clusters primarily export to Russia and China, markets with less stringent compliance requirements than the EU:

"And while they can still survive with these orders from Russia and the USSR, we often do not see any more interest in exporting to the European market. So, basically, it means why put all this money into quality standards of safety and preservation, if you can also, for lower input, export to the countries of the USSR, or continue the status quo."

However, the same interview reveals that some clusters already have European clients due to their consistent fulfillment of obligations, professional work ethic, and adaptability to client demands*:*

"…there are clusters that already have European clients, because they fulfill their obligations, work professionally, are ready to adapt to the order." Expert 10

Interviewee emphasize the nascent stage of Uzbek clusters, highlighting their considerable potential for growth and success:

"Practically, they only started five years ago. And in those five years, we had two years of pandemic, and one year of like shock after the war on Ukraine. So like, this is really just a very, very short period of time. And I think in the next couple of years, this can still develop. I mean (....) due to the reforms, certain market mechanisms are starting to work." Expert 10

Following by interview with expert 9, to succeed in the European market, the industry should consider a dual-track approach: one focused on less-demanding markets (Russia and China), and another dedicated to meeting EU compliance standards for higher-value exports – a strategy successfully employed by Bangladesh years ago:

"…you have all the opportunities, but you have to make sure that you separate compliance and non-compliance companies, that you are getting ready for the compliance markets. So, the machinery which are not used, you have to separate for the compliance markets to build up new companies" Expert 9

Clusters that promote a culture of innovation are better positioned to achieve compliance with EU regulations (Textile ETP, 2024). In an interview with Expert 5, he highlighted several factors influencing the preference for traditional methods among farmers, including concerns over labor quality and a hesitance to invest in new technologies.

"*There are many different reasons. Some of them care about people who want to earn money by picking cotton; some think the quality of hand-picked cotton is better. Some, of course, do not want or cannot spend money on machinery" Expert 5*

For instance, in many clusters, cotton is still picked by hand (Youtube.com, 2022). Farmers often hesitate to invest in new equipment for multiple reasons such as

Farmers resist investing in new equipment due to factors like an outdated mindset (Interview with Expert 5).

"the problem is in outdated mindset and a fear of changing something- so they stick to their old practices" Expert 5

Access to innovative technologies for recycling, waste management, and sustainable production methods can create a unique capability that supports the transition to a circular economy in Uzbek clusters. Several textile clusters have already started recycling of short

fibers by adding them into their production. According to the interview with Expert 7, people in Uzbekistan tend to utilize all available waste, although it often goes undocumented. For instance, textile scraps from the sewing process are repurposed by other companies to create wallpaper.

"In Uzbekistan we have no waste from cotton, everything is being used." Expert 7.

- **Collaborative networks.** Collaboration with vocational training centers and universities is vital for building a talent pipeline in Uzbekistan's textile clusters, particularly in cotton production. Various programs support sustainable practices by empowering value-chain actors to adopt innovative solutions and enhance productivity (Agrichallenge, 2024). However, despite these training initiatives, significant gaps remain in advanced skills and knowledge related to sustainability. This limits the workforce's ability to leverage innovations effectively. Notably, even an international company responsible for sustainability in Uzbekistan could not answer questions about digital product passports, highlighting a significant knowledge deficit (Expert 10). To maximize competitive advantage, Uzbek textile clusters should prioritize ongoing training focused on sustainability and innovation. Engagement with international organizations like UNECE, ILO, GIZ, and the World Bank is crucial for promoting sustainable practices. Additionally, the study from Ghana (Asare-Kyire et al., 2019) underlines collaboration among textile clusters is essential for sharing experiences and driving innovation.
- **Software/platforms as resources**

  The lack of software for data management and exchange within organizations serves as a significant barrier to achieving traceability and transparency in Uzbekistan's textile clusters. Currently, not all clusters are equipped with the necessary software to facilitate effective information sharing (Interview with UTA).

  While the availability of up-to-date technology and digital infrastructure is essential, Uzbekistan's clusters must still address gaps in hardware and software that are critical for maintaining traceability. Although clusters operate as vertically integrated systems, characterized by transparency in their processes and fostering better coordination and efficiency, there is currently no specific program tailored to meet their unique needs for data exchange. Many clusters rely on specialized software such as SAP, Uzpahta (Expert 1, 2) or similar systems, However, in some clusters, there is a lack of any data platform, resulting in management processes being conducted manually (Expert 1).

5.2.3. VRIN framework analyses

The VRIN framework, which stands for Valuable, Rare, Inimitable, and Non-substitutable, provides a structured approach to assess the competitive advantages of resources within organizations. In the context of Uzbek textile clusters, this analysis aims to identify and evaluate the unique resources and capabilities that contribute to their competitive positioning in the global market.

5.2.3.1. Valuable

- **High-Quality Cotton**: Access to superior-quality cotton that is longer and stronger than that produced in many other countries allows for the production of durable textiles, providing value through reduced waste and higher customer satisfaction.
- **Skilled workforce**: The existence of a skilled in textiles workforce contributes to efficient production processes and high-quality outputs, with ongoing training enhancing this resource's value.
- **Geographic concentration**: The clustering of textile firms improves access to suppliers, shared infrastructure, and collaboration, increasing operational efficiency.
- **Geographic position**: Uzbekistan’s central location offers a significant advantage in terms of reduced transportation times and the potential to avoid reliance on air and sea freight.
- **Heritage of the silk road**: Uzbekistan’s historical position along the Silk Road lends cultural value to its textile products, enhancing their global appeal.
- **New equipment**: The introduction of modern machinery enhances productivity, improves quality, and supports sustainable practices. By streamlining processes and increasing manufacturing efficiency, new equipment contributes significantly to the overall value proposition of the clusters.

5.2.3.2. Rare

- **Unique climate for cotton production**: Uzbekistan’s climatic conditions enable the production of high-quality cotton that may not be easily replicated elsewhere, adding to its competitiveness.
- **Legacy of expertise**: The historical context and cultural knowledge surrounding cotton cultivation and textile production provide a unique standing in the global textile market.
- **Silk road influence**: The historical significance of the Silk Road contributes to the rarity of Uzbekistan's textile products, drawing buyers interested in authentic, culturally rich items.
- **Availability of cutting-edge machinery**: If the clusters successfully invest in advanced textile machinery that is not widely available to competitors, this can create a rare resource advantage.

5.2.3.3. Inimitable

- **Heritage and culture**: The long-standing tradition of cotton farming and textile production in Uzbekistan creates embedded cultural expertise that is difficult to replicate quickly.
- **Cultural significance of silk road products**: The association of Uzbek textiles with the Silk Road creates a unique narrative tied to the region's history and identity that cannot be easily duplicated.
- **Integration of new equipment**: The specific configurations and integration of new machinery within the existing production processes are tailored to the clusters. This unique setup can be challenging for competitors to replicate without considerable time and investment.
- **Geographic position**: Uzbekistan's central location offers a significant advantage in terms of reduced transportation times and the potential to avoid reliance on air and sea freight.

5.2.3.4. Non-substitutable

- **Integrated value chain**: The complete vertical integration of the cotton-to-textile production process creates a unique operational framework that is not easily substituted. This control over the entire value chain enhances quality and responsiveness to market demands.
- **Brand identity and silk road legacy**: Building a strong brand around sustainable practices tied to high-quality Uzbek cotton and the Silk Road heritage creates a distinctive identity that is difficult for competitors to substitute.
- **Transparency and traceability**: The combination of vertical integration and modern equipment enhances transparency and traceability, vital in today's market where sustainability and ethical practices are crucial. This level of visual oversight is not easily replicable by competitors.

5.2.4. Barriers as resource limitations in the context of RBV

In the Resource-Based View (RBV), barriers faced by Uzbek textile clusters are limitations in resources and capabilities that impede sustainable competitive advantage, affecting their adaptability to market demands and effective sustainability strategies.

- **Limited financial resources.**

  Uzbek textile firms are often reluctant to invest their own capital in modernization, relying heavily on external financing. This financial constraint prevents access to advanced technologies necessary for improving productivity and quality, ultimately hindering innovation and competitiveness in the global market.

- **Skill gaps and workforce limitations.**

  While the workforce has a strong foundation in cotton cultivation and textile production,

there are notable skill gaps in sustainability practices and advanced manufacturing technologies. These deficiencies restrict firms from optimizing processes, resulting in lower productivity and quality compared to better-trained competitors.

- **Outdated management practices.**
  Many clusters struggle with outdated management practices that hinder innovation and resource utilization. Ineffective leadership often leads to poor decision-making and resistance to change, making it challenging to align with new sustainability standards and market expectations.
- **Lack of collaboration and networking.**
  Collaboration barriers among firms limit resource sharing and innovation potential. The lack of strong networks prevents firms from leveraging collective resources and knowledge, diminishing opportunities for synergies that enhance innovation and sustainability practices valued in global markets.
- **Regulatory and compliance challenges.**
  Uzbek textile clusters encounter difficulties in meeting international standards and regulations, particularly regarding sustainability and environmental impact. Many firms lack the required certifications to access markets like the European Union, which limits growth opportunities and reflects operational and strategic alignment issues.
- **Dependence on Specific Markets:**
  A historical reliance on markets such as Russia for textile exports has created vulnerabilities. As market dynamics change and demand from traditional partners decreases, this dependency constrains growth opportunities and highlights the need for resource diversification crucial to maintaining competitive advantage.

5.2.1. Porter’s theory analysis

Michael Porter's cluster theory emphasizes the competitive advantages that arise from geographically concentrated networks of interconnected firms, suppliers, and supporting institutions. Uzbekistan's textile clusters model this concept to a significant extent, displaying a degree of vertical integration, as followed from interview with experts.

Porter's theory highlights the need for firms to adapt their strategies to global competition and changing demand conditions. However, Uzbek clusters, historically reliant on the Russian market, struggle to diversify their export bases and face challenges like mismatched order sizes with international customers. As follows from interviews, many European brands are hesitant to seek new sourcing countries due to economic constraints that complicate production changes, leading to decreased interest:

"This is just the economic situation; it costs a lot of money and effort to start production in a new country" Expert 10

Additionally, communication issues and specific product requirements hinder Uzbekistan's competitiveness, as brands often look for materials combining cotton and synthetic fibers, as well as diverse designs—preferences that Uzbekistan currently cannot match compared to countries like Turkey and Bangladesh:

"many brands are looking for a mix of cotton, also, also manmade fibres, different designs, (....) I would say the offer that Uzbekistan has right now, is nowhere near other production countries like Turkey, Bangladesh" Expert 10

Innovation is a cornerstone of cluster development, requiring significant investment in R&D and technology for ongoing adaptability in Porter's framework. Yet, many Uzbek clusters face considerable hurdles in embracing innovative practices due to outdated methodologies and restricted R&D investment, which hinder their modernization efforts. Furthermore, while Porter advocates for collaboration among firms, suppliers, and research institutions to foster a knowledge base conducive to innovation and competitiveness, many Uzbek clusters primarily focus on cotton production and operate independently, relying heavily on traditional practices (interview with cluster representatives).

Successful clusters, according to Porter, benefit from access to skilled labor, advanced infrastructure, and supportive government policies. However, Uzbek clusters often lack these essential support systems, facing challenges such as limited financial access (Expert 4), shifting regulations, and inadequate educational programs (Experts 4,5,9). Consequently, despite the potential benefits outlined in Porter's theory, Uzbek textile clusters encounter significant obstacles in adapting and innovating effectively.

5.2.1.1. Main barriers from analysis 1.

- **Limited financial resources.** Many Uzbek textile firms rely heavily on external financing and are hesitant to invest their own capital in modernization, which inhibits access to advanced technologies, hinders innovation, and compromises competitiveness.
- **Skill gaps and workforce limitations.** Although the workforce has a strong background in cotton production, there are significant skill gaps in sustainability practices and advanced manufacturing technologies, leading to lower productivity and quality compared to competitors.
- **Outdated management practices.** Clusters often operate with outdated management structures that stymie innovation and efficient resource utilization. Poor leadership can result in resistance to change, affecting the ability to meet new sustainability standards.

- **Lack of collaboration and networking.** Barriers to collaboration limit resource sharing and innovation potential. The absence of strong networks inhibits firms from leveraging collective resources, leading to missed opportunities for synergy.
- **Regulatory and compliance challenges.** Uzbek textile clusters struggle to meet international standards, particularly regarding sustainability and environmental impact. The lack of necessary certifications limits access to lucrative markets like the European Union.
- **Dependence on specific markets.** A historical reliance on the Russian market creates vulnerabilities, especially as demand decreases. This dependence constrains growth opportunities and highlights the need for diversifying export markets.

5.2.1.2. Strategies for analysis 1:

- **Enhancing financial investment.** Encourage local firms to invest in their operations by providing incentives, developing strong business cases for modernization, and fostering an investment-friendly environment that attracts external funding.
- **Targeted skill development programs.** Implement training initiatives focused on sustainability practices and advanced manufacturing technologies. Engaging international expertise for training local personnel can bridge existing skill gaps.
- **Adopting modern management practices.** Foster effective leadership that embraces innovation and change. Management training programs should focus on strategic decision-making aligned with sustainability goals.
- **Facilitating collaboration networks.** Create platforms to enhance collaboration among textile firms, suppliers, and research institutions, enabling resource sharing and joint innovation initiatives to address collective challenges.
- **Regulatory compliance support.** Provide guidance and resources to help clusters meet international standards and certifications, facilitating access to new markets and enhancing competitiveness.
- **Market diversification strategies.** Develop strategies to reduce reliance on traditional markets, such as Russia, by exploring opportunities on the global market, which will enhance resilience among changing demand dynamics.

5.2.1.3. Conclusion of analysis 1

Uzbek textile clusters face significant barriers to entering EU market, rooted in financial constraints, skill gaps, outdated management practices, a lack of collaboration, regulatory challenges, and an over-reliance on specific export markets. However, there are promising strategies to enhance sustainability and competitiveness. By increasing financial investments, fostering targeted skill development, modernizing management practices, building collaborative

networks, supporting regulatory compliance, and diversifying markets, Uzbek textile clusters can better adapt to the evolving demands of the global textile industry. This multifaceted approach not only addresses existing challenges but also positions the industry to leverage its strengths, enabling a more sustainable and competitive future in the international market.

5.3. Analysis 2, Circular Economy theory

To address Sub Question 2: *How can the principles of a circular economy (reduce, reuse, recycle, regenerate) be integrated into the production and export strategies of Uzbek textile clusters to enhance their appeal to the EU market?* We will focus on principles reduce, reuse, recycle, and regenerate and employ circular ecosystem innovation strategies such as platformization, collaboration, and experimentation.

The principles of a circular economy—reduce, reuse, and recycle—offer a sustainable framework that can significantly enhance the production and export strategies of Uzbek textile clusters. By adopting these principles, clusters can align with the growing demand for sustainability in the EU market and improve their competitiveness and resource efficiency.

5.3.1. Reduce

- **Minimizing resource consumption.** Uzbek textile clusters can focus more on reducing material inputs, water consumption, and energy usage during production processes. Water is a critical resource in cotton cultivation and textile manufacturing, and inefficient use can lead to significant environmental and economic challenges. Some clusters have already installed drip irrigation systems, as reported in various articles and interviews (Expert 1,2, 3, 4, 6, 10), to optimize water usage in cotton farming, conserving this vital resource. Additionally, implementing proper soil treatment practices can prevent degradation and avoid the abuse of land resources, ensuring long-term sustainability (Kalro.org, 2024).
- **Incorporation of renewable energy.** Uzbekistan has significant potential for solar energy generation due to its sunny climate. Several solar power plants are in various stages of development, with plans for large-scale solar farms to generate clean energy (AJTMR, 2022). Many clusters are actively installing solar panels, as follows from interviews, supported by government subsidies (Inogamdjanov, 2023), which significantly reduce energy costs and reliance on fossil fuels for production processes.

  The country also has promising wind energy potential, particularly in regions like the deserts of the Karakalpakstan and Navoi areas. Wind farm projects are underway to harness this renewable energy source (AJTMR, 2022).

- **Design for longevity.** Designing products for durability is critical for a circular economy, as high-quality textiles lead to longer-lasting garments (Mesa et al., 2022). By implementing rigorous quality control measures during production, clusters can ensure that their products meet high durability standards. Some testing laboratories have already been successfully established in Tashkent (UzDaily, 2017). This approach reduces the need for frequent replacements and aligns with the European Union's increasing preference for sustainably produced, durable goods has significant implications for industries looking to enter or expand in the EU market, such as e.g. Ecodesign Directive (European commission, 2023).
- **Product lifecycle thinking.** Adopting a lifecycle approach in design can further enhance sustainability (Low et al., 2013). Clusters should implement lifecycle assessments (LCA) to evaluate environmental impacts throughout the product's lifespan, allowing for informed decisions that reduce waste and improve sustainability.

5.3.2. Reuse

- **Second-hand options.** Offering second-hand options or resale platforms for pre-owned textiles domestically can enhance the lifecycle of products and appeal to eco-conscious consumers. This not only provides a cost-effective alternative for customers but also promotes a culture of reuse, aligning with circular economy principles.
- **Innovative upcycling.** Uzbek textile clusters can explore upcycling opportunities, whereby old textiles are transformed into new products. This creative reuse can attract environmentally conscious consumers domestically and in the EU market and enhance product differentiation.

5.3.3. Recycle

- **Implementing recycling program.** Clusters should establish systems for collecting and recycling textile waste generated during production. Following insights gathered from interviews, some clusters are already recycling short fiber waste into their products, demonstrating a commitment to circular practices.

5.3.4. Regenerate

Regeneration focuses on restoring and renewing natural systems. Uzbek textile clusters can adopt agricultural practices that improve soil health, such as crop rotation and organic farming techniques, which not only enhance cotton quality but also contribute to the overall health of the ecosystem. According to interviews with experts, only a few clusters are currently implementing these sustainable practices (Expert 6).

Exploring the use of regenerated fibers, such as recycled cotton or other sustainable materials, can help reduce the environmental impact of textile production. This shift would align with circular economy principles and meet the growing demand for eco-friendly products in the global market.

Encouraging community participation in regenerative practices can strengthen local ecosystems and cultivate a culture of sustainability in Uzbekistan's textile clusters. Given that the concept of circular economy strategies is relatively new in the region (Expert 8), educational programs targeted at farmers and workers are essential for raising awareness about regenerative agriculture practices (Expert 5). This focus on education will enhance the overall sustainability of the textile cluster and support their journey toward adopting these innovative practices.

5.3.5. Fostering collaborations

- **Building collaborative networks.** Fostering collaborations within and between clusters is essential for sharing knowledge, resources, and best practices. By establishing networks that connect different stakeholders, including farmers, manufacturers, technology providers, and research institutions, clusters can enhance their collective capacity to innovate and transition towards circular practices.
- **Partnerships with international organizations.** Collaborating with international organizations that promote sustainability can provide Uzbek textile clusters with valuable insights, resources, and technical assistance. However, following interviews with international experts (Expert 9, 10), it has been noted that the educational support provided by these organizations is currently insufficient. More tailored training programs that directly address the specific needs of textile clusters are necessary to elevate their sustainability efforts.

5.3.6. Collaboration, experimentation, and platformization principles applied to Uzbekistan textile clusters.

Applying the principles of circular ecosystem innovation to Uzbek textile clusters requires a multifaceted approach focusing on collaboration, experimentation, and platformization, while acknowledging the unique context of Uzbekistan.

- **Collaboration.** Uzbek textile clusters should develop a more strategic approach to selecting partners, considering not only technological capabilities but also shared values and cultural fit to foster trust and sustained collaboration. This could involve collaborations with EU companies specializing in sustainable textile technologies and circular economy solutions. Engaging with organizations beyond the textile sector, such as designers, recyclers, and retailers, would introduce fresh perspectives and enhance innovation capabilities. Supporting local artisans and cooperatives specializing in upcycling or textile waste management could be a good strategy. Expert 7's interview revealed that Uzbek textile clusters currently lack collaboration with companies that utilize textile waste as a raw material.
  Building trust and securing commitments from all stakeholders (farmers, ginners, processors, exporters, etc.) is crucial for Uzbekistan's clusters. According to interview findings (Expert 5), there are significant problems between farmers and clusters in Uzbekistan. To solve these problems, transparent and fair contracts, equitable profit-sharing, and open communication are essential.
- **Experimentation.** Developing a value proposition that goes beyond raw cotton exports is essential. This could involve creating high-value-added products (e.g., organic cotton clothing, recycled textiles) and targeting niche markets with sustainability credentials.
  Since European markets favor smaller companies for their easier implementation of sustainability requirements as follows from interview with Expert 10, large Uzbek textile clusters should leverage their underutilized capacity to conduct experimental production runs focused on meeting these requirements. This should involve incorporating experimentation processes into their operations:
  "And many companies are not looking for the fast fashion, Inditex scales. And especially for them, the smaller companies that produce ready made garments (...)are more attractive. And it's also much easier to implement certain sustainability requirements with them." Expert 10
  Uzbek clusters should explore ways to repurpose textile waste into new products (e.g., insulation, upholstery), thereby maximizing resource utilization and reducing environmental impact. Currently, based on interviews, the usage and practices related to textile waste in Uzbekistan are undocumented:
  "Clusters are just selling it, and afterwards it is not traceable, it goes to handicraft production, but all waste is used" Expert 7.
  Pilot projects with selected partners and technologies should test new approaches on a smaller scale before wider implementation. This process should include engaging global

consumers in the design and development, prototyping, and feedback collection to ensure market viability.

- **Platformization.** A user-friendly, open digital platform connecting all actors in Uzbekistan's textile value chain is crucial for facilitating collaboration, resource sharing, and knowledge exchange among stakeholders. Interview data indicates a low level of digitalization within Uzbek textile clusters (Expert 1).

6. Discussion

Ihe findings of this research highlight critical challenges and opportunities for Uzbek textile clusters as they seek to align with global sustainability standards and circular economy principles. The barriers identified—including financial constraints, skill gaps, and outdated management practices—are indicative of broader systemic issues within the industry. Addressing these challenges is not merely about meeting compliance standards; it requires a fundamental rethink of how the textile production process is structured and managed.

One of the most significant factors influencing the ability of Uzbek textile clusters to achieve sustainability is the pressing need for financial investment. Many clusters operate on limited budgets, which restricts their capacity to modernize practices and adopt new technologies. The integration of renewable energy sources, such as solar and wind power, as highlighted in the findings, represents a pivotal step towards reducing operational costs and dependence on fossil fuels. Investments in renewable energy not only mitigate environmental impact but also enhance long-term economic viability. This dual focus aligns with the principles of the circular economy, emphasizing both resource efficiency and ecological responsibility.

Skill gaps among the workforce further complicate this transition. The research indicates a pressing need for targeted educational initiatives aimed at equipping workers with the skills necessary for sustainable practices. Collaboration with international organizations can play a vital role in this regard, as they can provide expertise and resources to develop training programs tailored to the specific needs of the Uzbek textile sector. Moreover, fostering a culture of continuous learning and adaptability will be essential for workers to navigate the evolving landscape of sustainable production.

The integration of circular economy principles, particularly the strategies of reduce, reuse, recycle, and regenerate, serves as a practical framework for enhancing the sustainability of Uzbek textile clusters. The findings suggest that implementing practices such as upcycling and recycling textile waste not only extends product lifecycles but also fosters a commitment to environmental stewardship. There is a growing consumer market demanding products that align with circular economy values, and Uzbek clusters are well-positioned to meet this demand by leveraging their unique cultural and material resources.

It is important to acknowledge that the reforms in Uzbekistan have been ongoing for six years, which, while significant, is not an extended period in the context of industrial transformation. The Uzbek textile clusters are unique in the world, employing a top-down approach. The journey toward compliance with sustainability standards will take time, as systemic changes and reconfiguration of industry practices cannot be realized overnight. Furthermore, Uzbekistan's rich cultural traditions and iconic fabrics, such as ikat and adras, present an opportunity for developing a global brand. By preserving these heritage textiles and using sustainable practices, they can create a strong international identity that enhances the appeal of Uzbek textiles in global markets. The evolution of these clusters into sustainable entities reflects the complexity and gradual progress associated with such ambitious undertakings.
Collaboration emerges as a cornerstone of success in this endeavor. The research emphasizes the importance of building networks among stakeholders, including farmers, manufacturers, and international partners. Collaborative efforts can facilitate knowledge sharing, drive innovation, and enhance the overall capacity to implement sustainable practices. Successful models of collaboration within and between clusters can lead to collective advancements in resource management and process optimization, fostering resilience in the face of market fluctuations.

Finally, the discussion reveals that platformization and experimentation are critical components in transitioning towards a more interconnected textile ecosystem. Developing a digital platform to facilitate resource sharing and information exchange could empower stakeholders and streamline operations. Engaging in experimental projects allows clusters to test new ideas and materials in a controlled setting, ultimately leading to more informed decisions and innovative solutions that align with sustainability objectives.

Conclusion

Uzbek textile clusters face significant barriers to achieving compliance with sustainability in the global market, rooted in financial constraints, skill gaps, outdated management practices, a lack of collaboration, regulatory challenges, and an over-reliance on specific export markets. However, there are promising strategies to enhance sustainability and competitiveness. By increasing financial investments, fostering targeted skill development, modernizing management practices, building collaborative networks, supporting regulatory compliance, and diversifying markets, Uzbek textile clusters can better adapt to the evolving demands of the global textile industry. This multifaceted approach not only addresses existing challenges but also positions the industry to leverage its strengths, enabling a more sustainable and competitive future.

In this context, integrating the principles of a circular economy—reduce, reuse, recycle, and regenerate—into the production and export strategies of Uzbek textile clusters presents a viable pathway to enhance their compliance with sustainability standards. By focusing on strategies such as minimizing resource consumption, utilizing renewable energy sources, and designing products for longevity, clusters can effectively align their operations with the growing demand for sustainable practices.

Implementing innovative approaches like upcycling and establishing systems for recycling textile waste will not only prolong the lifecycle of products but also demonstrate a commitment to environmental stewardship. Additionally, adopting regenerative agricultural practices can improve soil health and reduce the ecological footprint of textile production, which is essential in today's environmentally conscious market.

Fostering collaborations and building networks among stakeholders—from farmers to manufacturers—will further enhance the capacity of Uzbek textile clusters to innovate and share best practices. Engaging with international organizations will provide valuable resources and insights to promote sustainability, highlighting the importance of tailored educational initiatives to raise awareness and capabilities within the local workforce.

Lastly, embracing principles of collaboration, experimentation, and platformization is crucial for establishing an interconnected textile ecosystem. Developing a user-friendly digital platform can facilitate resource sharing and knowledge exchange, paving the way for a more cohesive and

resilient industry. By harnessing these circular economy strategies, Uzbek textile clusters can overcome existing barriers and position themselves as competitive players in the global market, effectively meeting the evolving demands for sustainability and compliance.

7. Reflection

In conclusion, the pathways to sustainability and compliance for Uzbek textile clusters are multifaceted. By addressing systemic barriers and embracing circular economy principles, there is a significant opportunity to enhance competitiveness and resilience in the global market. This master's thesis contributes a comprehensive framework for integrating these principles into the operations of Uzbek textile clusters, demonstrating how Sustainable Design Engineering (SDE) can enhance sustainability practices while fostering resource efficiency. Key strategies such as reducing, reusing, recycling, and regenerating provide valuable insights into SDE, particularly within emerging markets.

The findings underscore the critical role of SDE professionals in facilitating the transition to sustainable practices within industries facing complex challenges. Equipped with skills to analyze systems and promote innovation, SDEs are well-positioned to address sustainability issues. In the context of Uzbek textile clusters, they can navigate the intricate structures of evolving organizations and implement effective circular economy strategies.

However, this thesis has limitations, including a four-month writing timeframe that constrained depth of analysis and data collection, along with the inability to conduct in-person research in Uzbekistan. While the Resource-Based View (RBV) was chosen for analysis, alternative theories could have provided broader perspectives on systemic factors influencing sustainability. The scalability of these findings suggests they can inform sustainability practices in other emerging markets with similar complexities. This research has the potential to inspire further dialogue within SDE regarding the integration of circular economy principles in challenging contexts.

Ultimately, this thesis provides valuable insights into sustainable practices in the Uzbek textile sector. Despite its limitations, the reflections on theoretical frameworks and industry complexities set a foundation for future research, emphasizing the ongoing role of SDEs in addressing sustainability challenges. The journey to a sustainable future continues, with SDEs essential in leading transformative change across industries and communities.

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