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Entrepreneurship in Eco-Friendly Textilefibers: A Case Study of Lotus Silk

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ABSTRACT:
The textile industry, with its ancient roots and essential role in human life, has always been a fertile ground for entrepreneurship and innovation. The growing demand for clothing and textiles has driven the industry to diversify its products and expand its markets, creating new opportunities for skilled and motivated individuals. However, the industry faces significant challenges due to global warming, largely caused by the use of fossil fuels and synthetic fibers. These issues have led to increased scrutiny of the environmental impact of textile production, from raw fiber processing to packaging and storage. Synthetic fiber fabrics, in particular, contribute to soil degradation and release harmful chemicals into the environment. To promote an environmentally friendly lifestyle, various measures can be taken-one of which is choosing clothing made from sustainable and eco-friendly fabrics. This research focuses on the characteristics of lotus fibers as a sustainable resource for textile production and explores the entrepreneurial opportunities they present, using a regional case study. The study involved in-depth interviews with various textile companies, industry experts, academics, and local farmers to examine the components of entrepreneurship in the eco-friendly textile sector, specifically through the case of lotus silk. Our findings indicate that, given global concerns about climate change and the significant impact of the textile industry, focusing on the production of environmentally friendly fibers can provide a foundation for educating and supporting local farmers, identifying market needs, and finding suitable business partners. This approach can lead to the development of profitable and sustainable businesses in this field.

KEYWORDS: Entrepreneurship, Innovation, Lotus Fibers, Eco-Friendly Fibers, Environmentally Compatible Fibers, Lotus Silk**.**

I. INTRODUCTION

The textile industry is undergoing a significant transformation driven by the urgent need for sustainability and environmental responsibility. Traditional textile production is resource-intensive and environmentally damaging, contributing substantially to global carbon emissions, water pollution, and waste generation. In response, entrepreneurial ventures focusing on eco-friendly textile fibers are emerging as key players in reshaping the industry toward a more sustainable future. Green textile fiber entrepreneurship is a revolution in sustainable fashion that emphasizes the well-being of the earth while stimulating innovation and economic development. Lotus silk, which is derived from the stalks of the water lotus plant, is one model that demonstrates a luxury, environmentally friendly alternative to conventional textiles. This unique fabric is produced by a completely non-polluting, manual process that does not incorporate any toxic chemicals, electricity, or water, and thus it is one of the world's most sustainable fabrics (Sofia Vera, 2025). Apart from its green record, lotus silk possesses outstanding characteristics such as being hypoallergenic, breathable, and biodegradable, placing it among the finest materials in the green luxury industry (Ecosilky, 2025). The case of lotus silk entrepreneurship shows how ancient traditional

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Challenges and Future Directions

Despite encouraging progress, entrepreneurship in sustainable textile fibers is hampered by challenges such as availability of raw materials, scaling up new technologies, and consumer acceptance. Sustainable fibers are likely to require new supply chains and consumer education to take hold against entrenched synthetic fibers (Su, 2021). However, collaborative business models that connect farmers, designers, and brands are demonstrating success in filling these gaps through shared value creation and environmental stewardship (Fibershed, 2025). In the future, continued investment in biotechnology, material science, and interlocking networks will be critical to widening the scope of sustainable textile entrepreneurship. The embedding of carbon capture technologies, for example those examined by start-up firms such as Rubi Laboratories, and high-performance natural fibre materials, like those developed through Natural Fiber Welding, bring the hope that a future emerges where green textiles are able to meet environmental demands as well as performance demands (Textile Focus, 2024).

The Expression Problem

Entrepreneurship is a key driver of economic growth and development in many developing countries. Its importance is increasingly recognized, as it requires seriousness, perseverance, and the ability to seize opportunities. Kurdish entrepreneurs, for example, have demonstrated their capacity to identify and capitalize on opportunities, leading to success in various industries and contributing to the commercial advancement of society. Their initiative and creativity have enabled the creation of new organizations and businesses. When discussing entrepreneurship, various factors come into play, such as innovation, generating profit and employment, marketing strategies, customer satisfaction, and emerging economic trends like environmental sustainability (Kioumarsi et al., 2009; Kioumarsi et al., 2022).

Clothing Design and Production

Clothing design and production is one of the most popular and profitable sectors within the textile industry. Entrepreneurs with technical knowledge and skills in textile and fabric production have significant opportunities in this field. With proper investment, it is possible to produce high-quality textile products on a large scale. Given the vast global textile market, the import and export of fibers can be highly profitable skill and recent sustainability norms could be combined to deliver high-value products which not only catered to growing consumer needs for sustainable clothing but were also good for local communities and ecosystems (Smith, 2025).

Innovation and Sustainable Fiber Development

Green business leaders are spearheading the innovation of sustainable fibers produced from renewable, biodegradable, and low-impact sources. Examples include organic cotton, hemp, bamboo, and novel biofabricated ones such as algae, microbes, and farm waste. For instance, businesses like Algiknit produce yarn from kelp, a fast-growing seaweed that uses minimal land and water and which offers a biodegradable alternative to man-made fibers (Scispot, 2025). Similarly, companies like Modern Synthesis produce bio-fabrics using microbial weaving technology from microbial cellulose, which are lightweight, durable, and biodegradable fabric (Scispot, 2025). Other innovative developments include Mango Materials' conversion of methane into biodegradable bio-polyesters, addressing both greenhouse gas and microplastic pollution problems, and Spiber's Brewed Protein™, spider silk mimicry made from renewable biomass sources (Scispot, 2025). These innovations suggest the entrepreneurial drive towards integrating biotechnology into fabric-making, reducing dependency on petroleum inputs and reducing environmental footprints.

Entrepreneurial Opportunities and Market Dynamics

Sustainable textile business is not merely environmentally motivated but economically promising as well. The sector offers opportunities for startups to invent new materials and production processes using recycled, organic, or biodegradable raw materials and upcycling old materials into a new one (Textile Mentor, 2025). This motivates new business models around circularity and the optimized use of materials. Businesses such as Bolt Threads and PANGAIA are the best examples of entrepreneurship being combined with material science and sustainability goals. Bolt Threads' development of spider silk-inspired yarns and mycelium leathers, and PANGAIA's use of seaweed fiber and biodegradable packaging, are market-ready solutions attractive to eco-conscious consumers (Textile Focus, 2024). Additionally, initiatives like the New York Textile Lab and the Climate Beneficial Fiber Partnership show how entrepreneurial action can synthesize small-scale agriculture, fair sourcing, and open supply chains to create regenerative textile systems (Fibershed, 2025).

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more crucial to focus on areas that are less recognized for their significant environmental impact, such as the fashion industry. The fashion industry is a global powerhouse valued at over $2 trillion and employing approximately 300 million people worldwide. However, its rapid growth and reliance on resource-intensive production have made it a significant contributor to environmental degradation and social inequality, placing it at the center of discussions around the United Nations Sustainable Development Goals (SDGs).The fashion sector is responsible for 10% of global carbon emissions-more than international flights and maritime shipping combined-and produces 20% of global wastewater (Abbate et al., 2023: Thakker and Sun, 2023).

Innovative Fibers

For example, lotus fibers have unique properties: they provide a cooling effect in warm weather, thermal insulation in winter, and a lasting pleasant fragrance.

Farzpourmachiani M. and Farzpourmachiani A.'s 2024 work introduces "Attrition Entrepreneurship": income without societal wealth, possibly detrimental. They argue government and society can cause this, like war industries, inheritance tax, and discrimination. This contrasts with genuine entrepreneurship, fueling growth. Attrition entrepreneurship just reallocates. While IP is not directly addressed, a link exists. Attrition entrepreneurship likely overlooks IP protection, crucial for true innovation and economic advance. Its short-term focus favors imitation over novel IP. Consequently, weak IP can foster attrition entrepreneurship, hindering true innovation and sustainable development (Farzpourmachiani M.,Farzpourmachiani A., 2024).

Sustainable Fashion and Social Change

With the growing interest in sustainable and eco-friendly fashion, and a shift in social behaviors towards natural cycles, there is an opportunity to reduce excessive textile production and promote the use of biodegradable fibers.

Case Study: lotus as an Eco-Friendly Fiber Source

This research highlights lotus as a source of eco-friendly fibers for textile production. Although this plant is cultivated in many countries, in Iran, there has been little study or investment in using lotus fibers for textiles, and polluting fibers are still commonly used. Educating people about cultivating lotus could create new job for entrepreneurs who understand market demands and can find suitable business partners.

Environmental Impact of the Clothing Industry

However, the clothing industry is responsible for about 10% of environmental pollution, especially in Europe. This pollution is often linked to the use of chemical materials, which are highly harmful to the environment. Even when natural materials like cotton are used, other environmental issues arise, such as the use of pesticides and fertilizers, greenhouse gas emissions, and water shortages. Other natural fibers like linen, hemp, and nettle tend to be less damaging to the environment.

Consumerism and Waste

The trend of increasing consumerism has led to more clothing waste, with many garments ending up in household trash and rarely being recycled. Recently, synthetic fibers have overtaken natural fibers due to their lower cost and durability, but they are not biodegradable and contribute significantly to environmental pollution.

Eco-Friendly Fibers

Eco-friendly fibers are made from renewable and biodegradable materials that cause minimal harm to the environment. These fabrics are typically produced from natural or semi-natural fibers grown under specific conditions and expert supervision, without the use of harmful chemicals like fertilizers or pesticides. The water and soil quality in these regions is regularly monitored. Additionally, carcinogenic dyes and toxic residues are not used in the production of these fabrics. Tests ensure that heavy metals and chemical additives are kept within safe limits, and the fabrics are usually neutral or slightly acidic in ph.Eco-friendly fabrics must contain at least 95% organic fibers and are used in various industries, including clothing, home goods, furniture, paper, and packaging. The "eco-friendly" label indicates that these fibers are beneficial for the ecosystem and do not harm nature. However, this does not mean that all natural fibers are automatically eco-friendly; they can be plant-based, animal-based, or recycled (such as rPET polyester fibers, which, despite being synthetic, are considered eco-friendly due to their recyclability).

The Sustainable Development

It’s important to integrate the SDG goals across various sectors and industries, from agriculture to medicine (Kioumarsi et al., 2022; Kioumarsi and Liu, 2025). However, it is even

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Image 1: The Macciani factory is shifting its focus towards sustainable and eco-friendly products. Aghil Ahmadi Machiani (Macciani), the founder of the Macciani brand, stated: "Macciani is a luxury menswear label that draws its inspiration from the vibrant cultural traditions of Machian village in Iran. The brand was founded by someone born in Gilan and raised in Milan.

II. MATERIAL AND METHODS

To achieve accurate findings and identify new career opportunities related to silk production from lotus plants in the Anzali region, this study utilized qualitative methods, including interviews and library research. The statistical population included respected professors in environmental science, natural resources, agriculture, entrepreneurship, various textile industry experts, local farmers, investors, and young people interested in creating new jobs in the silk production and extraction industry from lotus plants.

Specialized and practical questions were posed to both experts and local stakeholders to gather precise and diverse data about their direct experiences, challenges, opportunities, and motivations. This approach provided valuable insights into the specific obstacles and potential for career development in this field. The study aimed to enhance understanding of entrepreneurship in the context of environmentally friendly fibers, using the case of lotus silk as a leading example.

Anzali Wetland, also known as MurdabAnzali, covers about 20,000 hectares in northern Iran, specifically in Gilan Province near the port of Anzali on the southwestern coast of the Caspian Sea. The wetland is situated between latitudes 28 to 37 North and longitudes 25 to 49 East. It is bordered by Anzali County to the north, Monastery County to the south, Khammam County to the east, Rasht County to the southeast, and Carp and Anzali Waterfront to the west. The region opportunities, especially for unemployed youth and women in Gilan Province.

The tiny home we all inhabit, Earth, is threatened by environmental and climate damage caused by human activities. Therefore, every branch of science and industry must be reevaluated to become more environmentally sustainable (Mahdavian et al., 2024).

Elizabeth Gort, an engineer, was the first to study the lotus in the context of textiles. She discovered something surprising about this plant: it produces microfibers. These fibers are extremely small-measured in micrometers-and can be up to ten times thinner than a human hair. Lotus is unique because it produces natural microfibers, whereas all other microfibers are synthetic (Sekhar Das and Manik Bhowmick, 2023).

The self-cleaning mechanism of the Lotus was discovered in the 1990s by two German scientists, Bartlett and Nienhuis. Using scanning electron microscopy (SEM), they found that the leaves of this plant have a rough, hierarchical surface structure, and a waxy crystalline coating. This unique structure gives the leaves their self-cleaning properties. The lotus holds a sacred place in many cultures and is often associated with purity and enlightenment (Sekhar Das and Manik Bhowmick, 2023).

In Europe, consumers spend about 5% of their income on clothing, with 80% of that going to clothes and 20% to shoes. In 2015, Europeans purchased 6.4 million tons (about 12.66 kg per person) of clothing. Between 1996 and 2012, clothing purchases in the European Union increased by 40%. Interestingly, about 30% of clothes in people's wardrobes are not worn within a year (Friedkian, 2021).

In traditional Chinese medicine, the seeds of the lotus are used to treat nervous disorders, insomnia, heart diseases, high blood pressure, and arrhythmia. lotus seed powder mixed with honey is also used to treat coughs (Patil Kavita, 2018).

The Lotus is a medicinal plant that helps protect fish and insects in its ecosystem by keeping the water clean and supporting ecological balance. This aligns with the principles of sustainable development (Patil Kavita, 2018).

In July, the lotus grows in deeper waters, reaching heights of 6-7 feet. During the rainy season, the plants can grow up to 8-9 feet tall, which is why more lotus is harvested during this period compared to other seasons (Chaw Su Hlaing, 2016).

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ushering in innovative, sustainable products and business models that reduce environmental impacts and enhance circularity. With the newest advancement in biofabrication, sustainable use of renewable resources, and collaborative supply chains, these entrepreneurial ventures are not only fixing environmental problems but also generating new economic opportunities. Continuous encouragement for them is essential to achieving a sustainable textile future.

Given the significant role of clothing and textiles in society and the economy, especially in Iran, it is essential to explore entrepreneurship in the eco-friendly fiber industry. This study focuses on extracting silk from lotus fibers as a case study.

Image 2: Macciani is investing in sustainable and eco-friendly products, focusing on research and development while maintaining its commitment to high quality.

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generally experiences warm, humid summers and mild winters, with winter temperatures rarely dropping below zero degrees Celsius and summer highs between 33 and 36 degrees Celsius, according to local meteorological stations.

The wetland is one of Iran's most significant and largest natural habitats for both animals and plants, which are categorized as submerged, floating, and marginal species. Anzali Wetland is a coastal wetland connected to the Caspian Sea by a shipping channel supported by two breakwaters at Anzali Harbor. Its drainage basin covers about 374,000 hectares. In 1975, Anzali Wetland was registered under the Ramsar International Wetlands Convention.

Anzali Wetland is fed by 11 main rivers and 30 tributaries, which bring irrigation runoff from upstream farms and rice fields. The maximum water depth in the western parts of the wetland during spring can reach up to 2.5 meters, though this varies due to fluctuations in the Caspian Sea's water level. The land use in the drainage basin is as follows:

- 53.9% forest and pasture
- 2.33% agricultural land
- 7.8% wetland, water locks, and pools
- 7.3% man-made regions assigned for various uses

III. RESULTS AND DISCUSSION

The growing demand for fashion, combined with the negative environmental impact of textile waste, has made the use of renewable resources a necessity. Biodegradable lotus fibers can serve as a promising alternative to synthetic fibers, which are difficult and uneconomical to recycle. The use of artificial fibers leads to irreversible environmental damage and increased waste, requiring more landfill space and causing long-term ecological harm due to their non-biodegradable nature.

In contrast, biodegradable materials like lotus fibers are beneficial for the soil and support the natural cycle, making them a suitable replacement for conventional textile fibers. This shift supports sustainable development and addresses the shortage of primary materials needed by the fashion and clothing industries.

Given their environmental benefits and the reduction of pollution, using biodegradable lotus fibers in textile and fashion products is gaining attention and importance. Supporting farmers in cultivating lotus plants can also create new employment opportunities in this sector.

Green textile entrepreneurship is spearheading a vital shift of the textile industry by

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