



OPPORTUNITIES AND CHALLENGES OF SUSTAINABLE LOCAL WOOL PRODUCTION IN QUEBEC: AN EXPLORATORY STUDY OF SUPPLY CHAIN AND DEVELOPMENT STRATEGIES FOR THE FASHION INDUSTRY

BELLEMARE Jocelyn, FAUST Marie-Eve and FONTAINE Richard

University of Quebec in Montreal (UQAM), School of Business and Management (ESG)
E-mail: bellemare.jocelyn@uqam.ca

Abstract: *The fashion industry has a negative impact on the environment and society, leading consumers to seek more responsible alternatives. As a natural and durable material, wool is gaining popularity, but local wool sourcing is often overlooked. This article explores the opportunities for sustainable local wool production in Quebec and the challenges in developing a new local wool supply chain. The study draws on a pilot project by Fibershed Quebec, which collected feedback from 75 participants to better understand the challenges faced by new actors in the fashion industry in this logistics chain. The results show that local companies in the textile and apparel ecosystem need to assess best practices and adopt new perspectives and strategies to support local wool production and strengthen the local supply chain. An additional survey was conducted to capture the real challenges of creating a fashion collection using local fibers for a specific market. The results emphasize the importance of training and support for new actors in the wool and fashion industry to help them overcome obstacles and succeed in a highly competitive market. Finally, the article explores the challenges and opportunities of sustainable local wool production in Quebec. It examines current efforts to diversify wool production and analyzes the challenges and opportunities facing local businesses. This study highlights the importance of wool production in Canada. It highlights the need for scientists and stakeholders in the sheep industry to find new ways to make this activity profitable.*

Keywords: *Fashion Apparel Industry, Product Development, Sustainable Fashion, Local Fibers, Local Sourcing, Sheep Farmers*

1. INTRODUCTION

The fashion industry's impact on the environment, local communities, and workers worldwide is significant, if not alarming. However, a trend toward change, and consumers are becoming increasingly aware of the consequences of their clothing consumption, actively seeking more sustainable and responsible alternatives. In this context, the use of natural and sustainable materials in clothing production has become essential, with a growing interest in wool fibers. However, local wool sourcing is often neglected in favor of mass production and international competition. This article explores the potential of local wool production in Quebec, examining the opportunities and challenges of developing a new sustainable local wool supply chain.

A pilot project implemented by Fibershed Quebec, a non-profit organization promoting the use of local and sustainable fibers in fashion, gathered the testimonies of 75 participants through discussions to better understand the challenges faced by new actors in this supply chain. Many of the participants expressed their desire to access locally sourced products and clothing brands. However,



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they faced obstacles such as a lack of knowledge in managing a transformation business, difficulty in standing out in a market saturated by products from other countries and increasing pressure to produce low-cost clothing. To address these challenges, local companies in our textile and clothing ecosystem must evaluate best practices and adopt new perspectives and strategies to support local wool production and strengthen the local supply chain. In an additional survey carried out in Quebec between March and April 2023, five interviews were conducted to better understand the real challenges of creating a fashion collection with local fibers for a specific market. The results showed that one of the preliminary initial obstacles was the quality of materials in local sourcing, followed by variability in transformation, affecting design and consistency in developing a collection for specific markets. Additionally, there was a low volume per batch, and there was a lack of understanding of the process and value of stakeholders in the chain so that everyone could benefit. Participants reported that implementation was tedious, and it was sometimes difficult to make decisions in the procurement phase, material selection, and ensure standardization in fashion product development. These results emphasize the importance of training and support for new actors in the wool and fashion industry to help them overcome obstacles and succeed in a competitive market. Canadian wool production is a topic that deserves the attention of scientists and sheep industry actors. In a difficult economic context marked by high production costs and low selling prices, it is important to find new ways to make this activity profitable. In this exploratory research, we examine current efforts to diversify wool production in Quebec and examine the challenges and opportunities for local businesses.

2. SHEEP INDUSTRY DIVERSIFICATION IN QUEBEC AND CANADA

The wool industry in Canada, especially in Quebec, has been considered a less significant activity for sheep farmers over the years. Research conducted by the Wool Canadian Council and Fibershed Québec shows that the price of wool is too low to cover the cost of shearing. This has resulted in a decrease in the size of sheep herds intended for wool production in the past 20 years. This shift has led to replacing several fine wool breeds with meat-producing breeds, which has resulted in a decline in the quality of wool produced in North America. Additionally, ewes are shorn more frequently to accelerate lambing, resulting in shorter and coarser fibers. Consequently, the quality of wool available in our markets is of lower quality. However, in recent years, some breeders have turned to wool production as their primary activity. We have observed that some of them have converted their sheep herds destined for lamb meat production into flocks focused on wool production. Thus, there are farm models that produce purebred sheep wool and sell 100% local and natural skeins or balls of wool, allowing them to add value to their raw materials. Despite this, we have also noticed that the vast majority of skeins presented as locally sourced on our markets are not entirely made from local raw materials. Customers are often confused about the origin of raw materials, the percentage of fiber blends, the quality of the products, and the treatment of dyes and finishes. They are also unsure whether the wool used is sourced locally or not. One of the main reasons for this is that breeders face obstacles in wool transformation, such as washing the fleeces. Mills that have lost their production volume have mostly been shut down. In some cases, it is necessary to send the wool to other provinces to be washed, which increases processing costs. However, the main challenge for wool production in Quebec is the poor quality of wool produced due to intensive management focused on the meat market. This requires a rigorous selection of sheep breeds to obtain superior-quality wool that can compete with Australia, New Zealand, and Africa. Additionally, wool processing requires significant investment in carding and spinning equipment. This situation can create gaps in processing and integration issues in the value chain.



3. LITERATURE

The literature confirms that the wool market in Canada is struggling, facing competition from synthetic fibers, inadequate infrastructure, and difficulties in setting prices for wool. In 2021, Canadian wool producers continued to feel the effects of the COVID-19 pandemic and associated international supply chain issues. The volume of raw wool purchased directly from Canadian producers was 883 tonnes in 2021, a decrease of 1.0% from 2020. The average price paid for wool to Canadian producers in 2021 was \$0.76 per kilogram, an increase of 9.2% from 2020 [1]. Several groups and researchers have looked into the problems and opportunities to revive the wool industry in Canada. The quality of wool largely depends on sheep's living conditions and their fleece treatment [2]. As stated in the literature notes that animal welfare is essential for producing quality wool, and sheep must have access to good pasture, water, and healthy and varied food to produce quality fleece. In Canada, there are no specific tools to objectively evaluate wool quality [3], with most people relying on the "blood system" method [4]. Only a few are using tools such as a microscope to obtain a better approximation of the micron count of the fleece [5]. There is, therefore, a need for infrastructure and tools to improve the production of quality wool in Canada.

The transformation of fleece into fiber is a key step in producing quality wool, and it is important to have suitable equipment and specific know-how to carry out this transformation. According to Klepp *et al.* [6], this could represent an opportunity for local producers to stand out in the market by offering superior-quality wool. The Canadian wool market is largely oriented towards exports, with China being the main importer of Canadian wool, followed by India. Data loss and rejects of Canadian fleece are not available. Indeed, several producers prefer to directly discard the fleece rather than transform it. According to Burgess [7], there is a lack of infrastructure for the production of quality wool. As it is in Canada, the United States has faced a comparable situation where wool production has declined since the 1920s due to synthetic fibers' emergence and incentive payments' removal in 1995. Although recent data on wool production in the US is limited, it is evident that there has been a decrease in wool production in this country too. In addition, significant buyers are not interested in Canadian wool, preferring to purchase directly from New Zealand. The wool arrives already washed and graded, allowing for precisely selecting the necessary wool type. Overall, the lack of specific tools in Canada highlights the need for further research and development in this area. Studies have estimated that the environmental impact of a single use of a wool garment can be significant, with one estimate suggesting a carbon footprint of 0.17 kg CO₂ equivalent for wool produced in Australia, processed in China and India, and worn in Europe [8].

Despite the challenges the Canadian wool industry faces, there is potential for growth and innovation. One promising development is the emergence of sustainable and local wool production, prioritizing animal welfare, environmental stewardship, and community involvement. As noted by Burgess [7], consumers are increasingly interested in buying ethically and environmentally responsible products, and wool fits well into this trend. Moreover, local wool production can support small-scale farmers and artisans, who can collaborate to create unique and high-quality products that stand out in the market.

Enhancing the production of sustainable and domestic wool in Canada requires addressing the current dilemmas with infrastructure and market. The wool supply chain lacks coordination and communication between farmers, shearers, spinners, weavers, and retailers, which necessitates improvements. To support these actors, it is proposed to establish regional wool cooperatives or networks and provide technical assistance, training, and marketing support. There are opportunities for job creation and increased transparency in the wool supply chain through investment in local wool processing facilities. Scouring plants and spinning mills are instrumental in adding value to



raw wool and reducing the dependence on foreign countries for processing. Therefore, it is imperative to make such investments.

To keep wool production sustainable and local, it's key to employ inventive technologies and practices that minimize the environmental impact. For instance, research has shown that using regenerative grazing practices can improve soil health, biodiversity, and carbon sequestration while increasing wool quality and quantity [9]. Similarly, using natural dyes and avoiding harmful chemicals in wool processing can reduce pollution and promote eco-friendliness [10]. Furthermore, incorporating digital technologies, such as tracking system and blockchain, can enhance transparency and trust in the wool supply chain, allowing consumers to make informed choices about the products they buy [11].

In conclusion, the Canadian wool industry is facing challenges but also opportunities for growth and innovation. By prioritizing sustainable and local wool production, investing in infrastructure and technology, and fostering collaboration and communication among stakeholders, creating a more resilient, equitable, and environmentally responsible wool supply chain is possible.

4. OVERVIEW OF THE STUDY AND ITS PRELIMINARY RESULTS

This exploratory study was conducted over a period of 12 months, from April 2022 to 2023, to understand the challenges and opportunities related to the use of local wool in Quebec. Everything was done to reduce wool waste and recover and promote our materials in our local markets. Panels and interviews were conducted with 75 people from the processing, sheep farming, and garment manufacturing sectors in collaboration with Fibershed Québec. Toward the end of the project, five respondents were selected to share their experiences and perspectives on the issue.

The present study highlights various results on the current situation of Quebec sheep wool sector, alongside the viewpoints of designers and distributors regarding sustainable measures within this field. The results show that most sheep producers are interested in integration into the value chain and the transformation of their material but under certain conditions.

The results of the study show that the sheep wool sector in Quebec is facing several obstacles. Only eight shearers are active in Quebec, mostly as breeders and shearing three days a week or less. Currently, few producers recover the wool, which encourages breeders to leave it on the ground, as the person who requested it never returns due to the washing and cleaning work it represents. Only one major buyer is known in Quebec. It is noted that producers from remote regions sometimes organize collective transport of wool to be more profitable. This major player pays the producers 6 to 8 months after delivery, and thus low-quality Romanov wool is difficult to sell.

On average, one ewe produces about 3 pounds of wool, and the income per kilogram varies greatly depending on the quality. The current shearing cost is around \$4 per ewe, but some breeds, like Dorsett, are more expensive but yield more wool. Some have reported receiving less than \$0.76 per kilogram, with the lowest reported amount being \$0.18 per kilogram. Ninety percent is exported to Great Britain, France, Germany, Spain, Japan, the United States, China, and India. Quebec is the third-largest wool-producing province (in quantity). Quebec currently represents 23% of Canadian raw wool production, which is around 310 tonnes per year. The 1350 tonnes of wool from Canada represent only a fraction of the world's production, with 90% being exported to various countries. Therefore, wool producers face many challenges in integrating the value chain and make a profit from their material, including finding local buyers and reducing wool waste.

Regarding the opinions of designers and distributors, most of them have a positive perception of wool and sustainable practices but are concerned about production challenges and potential costs associated with it. Most respondents acknowledge the issue of environmental



overproduction and overconsumption and deem it crucial to embrace sustainable practices. However, opinions vary on the most effective methods and various factors to be taken into account. Despite these challenges, there are opportunities to be explored for wool producers in Quebec, particularly by focusing on producing fine wool sheep breeds and developing management techniques to improve wool quality. In addition, there seems to be a growing demand from consumers for natural wool offers, another path for wool production. Nevertheless, the accessibility of small-scale wool for fashion designers is currently minimal, if not entirely unavailable.

5. DISCUSSION AND FINDINGS

Our exploratory study confirmed that the absence of efficient carding mills and spinning facilities in Quebec had made wool processing complex, complicated, and unprofitable for farmers. Currently, those wishing to sell their wool often must sell it in its raw form or transport it outside the province for processing, resulting in additional costs. This finding highlights problems in the supply chain, work silos, and long-term expertise abandonment. During our interviews, participants emphasized that high-quality fibers, such as alpaca and lamb, are currently being stored in bags, awaiting sale through wholesale and market outlets. This increased storage can cause waste management problems and additional costs for farmers. Despite their efforts to process the fiber themselves or partner with others, these initiatives have failed due to the lack of specialized equipment needed for wool processing.

Furthermore, we found that some local spinning mills in Quebec, while able to sell yarn at competitive prices, import their fiber from abroad rather than buying local Canadian wool. This situation is partly explained by the inconsistency in Canadian wool quality and the absence of fiber-washing facilities in Canada. Several participants noted that mills often prefer to send their fiber to China for washing and then bring it back to Canada as it is cheaper than processing it locally. Moreover, the inconsistency in Canadian wool fiber quality, which varies from farmer to farmer, results in additional costs for mills that must process it, limiting the competitiveness of local wool in the market. These obstacles are detrimental to the supply chain and impede the growth of the wool industry in Quebec.

In contrast, we note that a few recent initiatives are leading to a revival of the wool industry in Quebec. Passionate farmers have begun raising wool breeds to produce superior-quality wool and encourage local production. Carding mills and spinning facilities have also emerged, offering on-site wool processing services and facilitating the marketing of Quebec wool. However, these initiatives are still on a small scale and need to be increased to meet the needs of the local wool industry.

Table (1) highlights the ongoing initiatives to diversify wool production in Quebec and the associated challenges and opportunities. The initiatives include the launch of local brands and certifications, the development of new sheep breeds and crosses, the use of cutting-edge technologies, consumer education, and the creation of wool production cooperatives. Challenges to be addressed include the high costs associated with research and development, technology, and cooperative creation. However, these efforts also offer opportunities to improve the quality and quantity of wool produced in Quebec. The aim is to stimulate, encourage and promote innovation in the local economy. It is essential to reduce the dependence on imports and the establishment of a collaboration mechanism between wool processors and sheep farmers is necessary.



Table 1: Challenges and Opportunities in Diversifying Wool Production in Quebec: Current Efforts and Strategies

Current efforts to diversify wool production in Quebec	Challenges	Opportunities
1. Launching new local wool brands and certifications	<ul style="list-style-type: none"> ▪ Competition from established brands and supply versus production costs 	<ul style="list-style-type: none"> ▪ Increase in distribution and demand for local products
2. Developing new sheep breeds and crossbreeds	<ul style="list-style-type: none"> ▪ Cost of research and development 	<ul style="list-style-type: none"> ▪ Production of superior-quality wool and traceability of materials
3. Using advanced technologies for wool production	<ul style="list-style-type: none"> ▪ High initial cost of technologies and their deployment 	<ul style="list-style-type: none"> ▪ Improvement of the quality and quantity of wool produced in Quebec
4. Educating consumers about the benefits of local wool	<ul style="list-style-type: none"> ▪ Raising awareness of wool attributes and the importance of buying local 	<ul style="list-style-type: none"> ▪ Stimulating the local economy and reducing dependence on foreign imports
5. Creating wool production cooperatives	<ul style="list-style-type: none"> ▪ High startup costs and lack of resources and expertise 	<ul style="list-style-type: none"> ▪ Strengthening collaboration between producers and sheep farmers

Stakeholders in Quebec recognize the need to develop a marketing strategy for introducing new local wool brands to meet growing demand but face fierce competition from established brands. Another option is to invest in researching and developing new breeds of sheep, possibly with collaboration from Eastern European countries like Romania, and utilizing advanced technologies to improve the quality and quantity of wool production on a smaller scale. Educating consumers about the benefits of buying locally produced wool and creating wool production cooperatives could also increase demand and collaboration, although these efforts require significant investment to overcome low consumer awareness.

The recent study confirms the importance of raising public awareness about the importance of Quebec wool and supporting breeders working to produce higher-quality wool. Initiatives like Fibershed should be encouraged and replicated to value our province's natural and cultural heritage. In most cases, finding a local mill to produce a 100% Quebec product is impossible. However, some individuals cherish buying the necessary equipment to card and spin their wool. However, this project would require an investment of about CAD 350,000. According to them, a valorization of agriculture can only be achieved with political will. Others insist on the importance of launching major advertising campaigns to promote local fibers to create genuine enthusiasm for natural wool since the beginning of the pandemic. Although some have managed to double their turnover, growth remains limited. Despite these challenges, there are opportunities to be exploited by wool producers in Quebec. Breeders can focus on producing fine wool sheep breeds and developing management techniques that improve wool quality. In addition, the direct purchase of washed and graded wool from New Zealand allows for a precise selection of the required wool type. It is also possible to focus on natural wool production, which is increasingly sought after by consumers.

Our research contribution has highlighted the challenges facing the wool industry in Quebec. In fact, the loss of identity and value of Quebec wool is due to its mixing with foreign wool, not to mention the variability in the materials. In addition, we stressed the importance of promoting the ecological and social benefits of local wool production to raise consumer awareness of the harmful effects of synthetic fibers compared to wool, a renewable and biodegradable material.

We have also emphasized the importance of supporting breeders and small craft businesses that maintain the tradition of producing 100% Quebec wool. By collaborating with these local actors, it is possible to promote an efficient, simple, and expert transformation of wool and thus contribute to the development of Quebec's rural communities. The key to success lies in expertise, which is crucial to supporting those involved to obtain tangible benefits.



This article reflects on the urgent need for deep transformations of the globalised textile industry dominated by fast fashion and growth logic, and the emergence of a local wool economy. The article presents three main conclusions. Firstly, the local wool economy by itself cannot challenge the global fast fashion and textile industrial complex built on economic growth. It needs much more structural support from society at large, including governmental policies aimed at de-growing the economy, and a widespread social movement to push for change in consumers' fast fashion addiction. Secondly, the inherited injustices between the global North and South will not go away even if the global North relocates its production/consumption and its environmental impact back home. There is a need to support workers attached to the global industry for wool to sustain their lives in place-based economies. Thirdly, new economies that break with the current logics of the growth economy do not emerge 'from below' by chance. They require hard work, strategic planning and visions, collaborative efforts at multiple levels and scales, and the support of meta-organisations such as Fibershed. The article emphasizes that trying to break with old systems does not happen overnight, but is work that is 'under construction,' and we need to care more for the land and each other by caring for the socio-environmental impacts of our clothes.

In addition, the article highlights the importance of a holistic approach to sustainable and local wool production. This includes the production, processing and sale of wool itself, as well as the impact of the whole process on the social environment. Collaboration and transparency are key when considering the diverse stakeholders involved in the supply chain. From growers and artisans, to processors and consumers, all parties should be taken into account. By adopting a systems perspective, it is possible to create more sustainable and equitable practices for local wool production while meeting consumer needs and preferences. Ultimately, this approach could create a fairer and more sustainable economy for the entire local wool supply chain.

6. LIMITS

The presented research has several limitations that deserve to be highlighted. Firstly, certain aspects related to sheep breeders have been omitted due to the complexity and scope of the subject. Additionally, the research focuses on a category of actors who wish to offer materials focused on fashion, which may limit the external validity of the results obtained. Finally, although the number of participants is limited, the proportion of affected participants is deemed satisfactory for drawing interesting conclusions. These limitations open the door to many avenues for future research.

7. CONCLUSIONS

In conclusion, although Quebec wool industry may not have fully regained its former glory, it is generating renewed interest in local wool and a growing awareness of the environmental impact of synthetic fibers. Initiatives have been launched to revitalize the industry, such as the creation of a wool processing group with Fibershed Québec, support programs for breeders, and the promotion of Quebec wool to consumers. With good valorization and adequate marketing, Quebec wool could have great potential to meet the growing demand for sustainable and local alternatives to synthetic fibers. However, it is important to note that Quebec has lost certain practices and knowledge to the industrialization and globalization of markets. Overall, the future seems promising for Quebec wool and the fashion industry as they strive toward sustainability and innovation. Thus, it is important to consider the practices and knowledge of other countries, such as Romania, to developing new sustainable and innovative approaches for the wool industry in Quebec.



ACKNOWLEDGEMENTS

We would like to express our gratitude to Fibershed Québec, École supérieure de mode, The Metropolitan Fashion Cluster of Montreal (Grappe mmode), and the Chaire de coopération Desjardins Guy Bernier for their collaboration and support in making this study possible. Their assistance was very valuable in making the research successful, and we also thank the participants for their time, ideas, and insights.

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