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Comparative Sustainability Assessment of Organic Versus Conventional Cotton Production

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Abstract: The global textile and clothing fabric industry is one of the top polluters annually, underscoring the need for sustainable production innovations (Bonou-zin et al., 2019). Traditional cotton cultivation frequently entails extensive water use and synthetic pesticide and fertilizer applications, leading to water pollution, soil erosion, biodiversity decline, and lasting impacts on ecosystems and human health (Bonou-zin et al., 2019). Despite growing consumer awareness of textile sustainability and advancements promoting organic cotton, its adoption remains notably lower than conventional cotton (Delate et al., 2021). Organic cotton, championing environmental, social, and economic sustainability, markedly reduces the environmental challenges linked with traditional methods (Delate et al., 2021). This review provides a comprehensive assessment of organic cotton, highlighting its advantages over conventional cotton across economic, environmental, and social sustainability dimensions, and anticipates future growth trends.

Keywords: Textile industry, Organic Cotton, Economic Impact, Social Impact, Environmental Impact, Challenges and Recommendations.

1. Advocates of Organic Cotton

The International Organic Agriculture Certification standard delineates the comprehensive tenets of organic cotton farming: eschewing chemical pesticides and synthetic fertilizers, emphasizing soil stewardship and biodiversity preservation, and upholding social responsibilities (Flachs, 2019). Organic cotton's hallmark traits center on its environmental stewardship, socio-economic fairness, and financial feasibility (Flachs, 2019). Concurrently, organic cotton farming adheres to organic agricultural principles and practices. The sustainable methodologies employed in its cultivation, such as strategic site selection, soil fertility conservation, water management, and the incorporation of organic fertilizers and biological control mechanisms, negate the need for conventional fertilizers and pesticides. Furthermore, manual weeding and mulching techniques are adopted for weed management. Organic cotton farming steadfastly avoids chemical pesticides and synthetic fertilizers, instead championing practices that prioritize soil health and biodiversity, ensuring a symbiotic relationship with nature (Flachs, 2019).

1.1. Economic Factors

According to a 2022 Textile Exchange report, global organic cotton production experienced a robust growth of approximately 37.37% year-over-year, rising from 249,153 tonnes in 2019-2020 to 342,265 tonnes in 2020-2021 (Gallantintl, 2022). In the U.S., the organic fiber sector grew by 10%, with organic cotton sales leading the way at an impressive $2.1 billion in 2020 (Gallantintl, 2022). The market value of organic cotton in the US continues to rise; for example, organic cottonseed prices range from $500-700 per tonne, in stark contrast to the $225-345 per tonne for conventional cotton (Gallantintl, 2022). Highlighting this trend, renowned American jeans brand, Levi's, has partnered with India's Bhaskar Denim for an organic cotton initiative, emphasizing sustainable farming practices that reduce reliance on chemical pesticides and synthetic fertilizers (Ndure, 2023). Such partnerships notably enhance the sustainability of the organic cotton sector.

1.2. Environment Factors

As highlighted in the Textile Exchange's Preferred Fibres and Materials Market Report 2021, organic cotton—which abstains from the utilization of synthetic chemicals, synthetic pesticides, or genetically modified seeds—constituted a mere 0.95% of the cotton market share during the 2019/2020 cultivation season (Roberts-Islam, 2021). Such a figure underscores the imperative of grasping both the environmental and social ramifications of pesticide application in cotton cultivation, especially given the diminutive proportion of cotton grown without these pesticides (Roberts-Islam, 2021). Illustrating industry shifts, the European retailer C&A has forged a collaboration with the Pesticide Action Network UK (PAN UK) to champion the cultivation and procurement of organic cotton (Newsroom, 2017). Through this partnership, they are facilitating farmers' transition to organic cotton cultivation, empowering them with appropriate training, enhancing soil health, and considerably curtailing chemical pesticide usage (Newsroom, 2017).

1.3. Societal Factors

The Fair Wear Foundation's findings highlight troubling conditions in the garment sector. A concerning 85% of female garment workers fear potential sexual harassment, while 65% of male workers have experienced such harassment (Thread, 2022). In developing nations, traditional cotton farming employs 7% of the workforce, with over 90% of farmers working on plots smaller than 2 hectares. Notably, major cotton exporters in these regions force up to 2 million children, some below 10 years, to work in harsh conditions during harvests (Thread, 2022). Despite these challenges, there's growing optimism. The organic cotton movement is gaining mainstream traction. Over 200 universities have students participating in the Student Union's "Sweatshop Free Campus Campaign", advocating against sweatshops and promoting

the use of fairtrade organic cotton in university-branded clothing (Owre, 2006).

2. Detractors of Organic Cotton

As reported by Cotton Incorporated (2022), conventional cotton production boasts a series of benefits over its organic counterpart. These include notably higher yields, enhanced productivity, cost-efficiency, superior pest management, the scalability inherent in large-scale production, and a smoother pathway to market competitiveness and technological adoption (Re, 2022). Notwithstanding these advantages, Cotton Incorporated has also acknowledged that the environmental repercussions of conventional cotton cultivation are considerably graver than those associated with organic cotton's sustainable practices (Re, 2022).

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2.1. Economic Factors

The economic impact of traditional cotton on the global apparel fabric market is pronounced (Delate et al., 2021). Professor Kathleen Delate's 2021 study highlights the apparel industry's $1.3 trillion valuation, supporting over 300 million jobs across its value chain. In some low-income countries, cotton farming accounts for nearly 7% of employment opportunities (Delate et al., 2021). As a cornerstone in the textile supply chain, traditional cotton furnishes a consistent fiber supply for various stakeholders, with garments constituting 60% of total textile consumption (Delate et al., 2021). Furthermore, Professor Delate (2021) emphasizes the critical contribution of traditional cotton cultivation and textile processing. These sectors not only provide employment to millions but also drive economic progress and rural development. By encompassing the full spectrum from cotton trade to fabric production, they contribute significantly to export revenues, economic acceleration, and technological progression in many nations, thus propelling continuous textile innovation (Delate et al., 2021).

2.2. Environmental Factors

Professor Hilal Kazan's 2020 study highlights the excessive water demands of traditional cotton cultivation, which strains local ecosystems and depletes water reserves, leading to significant water scarcity issues (Kazan et al., 2020). While conventional cotton offers some benefits over organic varieties, its reliance on synthetic pesticides, herbicides, and fertilizers is concerning. Misuse of these chemicals can lead to environmental harm, soil degradation, and adverse impacts on biodiversity (Kazan et al., 2020). As depicted in Figure 1, detailing the process of creating a shirt from traditional cotton, the cultivation stage is the primary contributor to global warming. Specifically, the growth phase (P1 stage) emits a considerable 1350kg of CO2 (Kazan et al., 2020). The carbon footprint of conventional cotton is further exacerbated by chemical usage and associated deforestation for land clearance, intensifying climate change consequences (Kazan et al., 2020). As a result, conventional cotton's environmental impact is notably harsher than that of organic cotton (Kazan et al., 2020).

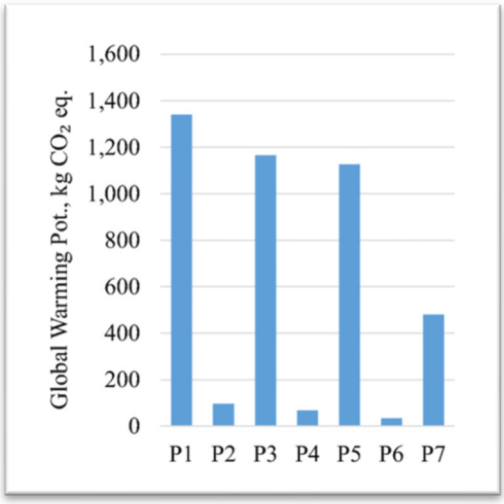

Figure 1. The impact of traditional cotton shirt production stage on global warming (P1: cotton cultivation, P2: cotton transportation, P3: yarn production, P4: yarn transportation, P5: woven fabric production, P6: fabric transportation, P7: shirt production) (Kazan et al., 2020).

2.3. Social Factors

According to the Australian Government's Department of Agriculture, Fisheries, and Forestry, traditional cotton cultivation is integral to the global apparel fabric industry, particularly in rural areas. This boosts employment and elevates farmers' income and living standards (Ashton et al., 2016). Figure 2 showcases the trajectory of cotton farmers in the Murray-Darling Basin from 2006-2007 to 2014-2015. By early 2016, about 65% of these farmers indicated their intent to maintain their existing farming practices for the next three years. For this group, their cumulative income reaches a remarkable $2,042,720 (Ashton et al., 2016). Furthermore, conventional cotton production has spurred rural economic growth and strengthened farmers' bargaining power and market presence, facilitated largely through collaborative initiatives (Ashton et al., 2016).

Average per farm	Unit	Growers intending no change	Growers intending to retire/sell farm	All other farms
Area operated	ha	3,270	1,449	2,800
Area of irrigated crops	ha	380	228	357
Area of dryland crops	ha	841	783	791
Water applied to crops	ML	1,701	869	1,580
Total cash receipts	$	2,042,720	1,376,389	1,888,580
Total cash costs	$	1,525,990	822,100	1,376,330
Farm cash income	$	516,740	554,290	512,250
Farm business profit	$	323,730	490,160	340,200
Farm debt at 30 June	$	1,346,240	732,930	1,224,470
Rate of return	%	5.3	6.7	5.7
Equity ratio	%	56	59	57

Figure 2. Physical and Financial Metrics of Cotton Farms in the Murray-Darling Basin, 2006-07 to 2014-15 (Ashton et al., 2016).

3. Critical Analysis and Discussions

When juxtaposed against conventional cotton, organic cotton emerges as a more sustainable option, echoing its merits across three dimensions: economic, environmental, and social. This stems from its unwavering commitment to the tenets of sustainable development. Foregoing the utilization of synthetic chemicals and genetically modified seeds, organic cotton not only addresses the environmental quandaries instigated by its traditional counterpart but also rectifies labor-related concerns, thus propelling the socio-ethical advancement of the garment sector. It distinctly opposes the pronounced detrimental repercussions associated with conventional cotton cultivation—ranging from exacerbating water scarcity and obliteration of ecosystems and biodiversity to fanning the flames of climate change. Nevertheless, when charting the textile and fabric production trajectory, organic cotton, despite its evident sustainability, finds itself economically overshadowed by traditional cotton. This is attributable to the intrinsic attributes of organic cotton—primarily, its diminished yield and escalated production expenditures.

4. Conclusion and Recommendations

In conclusion, our literature review highlights the environmental and social benefits of organic over conventional cotton. This prompts the question: what's the future outlook for organic cotton in the textile industry? Organic farming should prioritize soil conservation and biodiversity, while rigorously safeguarding labor rights and farmer welfare. Economic trends indicate a growing demand for organic cotton. To advance its growth, we recommend specialized training and strategic partnerships to encourage major textile entities to adopt organic cotton, strengthen certification standards, and enhance transparency to instill consumer trust. Raising awareness of organic cotton's benefits among stakeholders is vital, as is fostering collaboration among farmers, researchers, and industry leaders. By supporting small-scale farmers, prioritizing research and development, and emphasizing knowledge sharing, we foresee an expansion in organic cotton production, propelling the textile sector towards more sustainable and ethical practices.

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