Natural Fibres for a Fossil-Free Future: Why the Global Shift Must End Fossil-Fuel Fertilisers

1. Introduction: A World in Crisis and the Urgency of a Fossil-Free Natural Fibre Transition

The world is once again confronting the fragility of its dependence on fossil fuels. The escalating conflict between the United States and Iran, and the resulting instability in the Strait of Hormuz, has sent shockwaves through global energy markets. As oil prices rise and supply chains tighten, the political and economic vulnerabilities of a fossil-fuel-dependent world become impossible to ignore. Every geopolitical flashpoint exposes the same structural truth: the global economy is built on a resource that is volatile, finite and deeply entangled with conflict.

This moment of crisis is not an anomaly but a symptom of a system that has reached its limits. The textile sector, one of the most energy-intensive industries on earth, sits at the centre of this instability. Synthetic fibres such as polyester, nylon and acrylic are direct petrochemical products, and their price, availability and environmental footprint rise and fall with the oil markets. When oil prices surge, the true cost of synthetic textiles becomes visible. When geopolitical tensions disrupt supply, the fragility of petro-textiles is laid bare.

Yet even the natural fibres that should offer an escape from this volatility have been quietly pulled into the same fossil-fuel orbit. Cotton, flax, hemp, jute, pineapple, apple orchards, avocado plantations — all are grown in agricultural systems dominated by synthetic nitrogen fertilisers made from natural gas. The fossil-fuel dependency is not only in the fibres we spin but in the soil that grows them. This means that even as consumers and brands turn toward natural fibres in search of ecological stability, they are still tethered to the same fossil-fuel infrastructure that drives geopolitical conflict, climate breakdown and economic insecurity.

The current geopolitical crisis makes the stakes unmistakably clear. A world dependent on fossil fuels is a world vulnerable to war, price shocks, political instability and environmental collapse. A world dependent on fossil-fuel fertilisers is no different. If natural fibres are to offer a genuine alternative to petrochemical synthetics, they must be liberated from the fossil-fuel inputs that undermine their ecological promise.

This is the moment for a decisive shift. The instability in the Strait of Hormuz is not only an energy crisis; it is a warning. It signals that the global textile system must break its dependence on fossil fuels at every stage — from the oil used to make polyester to the natural gas used to manufacture fertilisers for cotton, flax, hemp and fruit crops used in vegan leather alternatives. The transition to natural fibres must therefore be a transition to fossil-free natural fibres, grown without synthetic nitrogen, transparently traced from seed to fibre, and rooted in regenerative agricultural systems that are resilient to geopolitical shocks.

The world cannot wait for stability to return to fossil-fuel markets, because instability is built into the system itself. The only path forward is to reduce the power that fossil fuels hold over our economies, our materials and our political futures. Natural fibres can lead that transformation — but only if they are truly natural, and only if the industry commits to ending fossil-fuel fertiliser use once and for all.

2. How Fossil Fuels Came to Dominate Natural Fibre Agriculture

The dominance of fossil fuels in natural-fibre systems is the result of a century-long industrialisation of agriculture, driven by the Haber–Bosch process, which converts atmospheric nitrogen into ammonia using natural gas. This process remains the foundation of global fertiliser production. Paudel's global analysis of fertiliser use shows that synthetic nitrogen has become so widespread that a "10 per cent increase in the use of fertilizers is associated with a 3.09 per cent increase in agricultural nitrous oxide emissions" and a "15.28 per cent increase in water withdrawals" (Paudel 2025, p.617). These impacts are structural, not marginal. Paudel concludes that nitrogen pollution from fertiliser consumption has "exceeded planetary boundaries" (Paudel 2025, p.618), and estimates that fertiliser-induced nitrous oxide emissions contribute to "approximately 15,450 annual deaths worldwide" (Paudel 2025, p.619).

These findings apply directly to natural fibres. Cotton, flax, hemp, jute, nettles and other plant-based fibres are grown in agricultural systems that rely heavily on synthetic nitrogen. The environmental harms associated with fertiliser use are therefore embedded in the fibres themselves. The global dominance of fossil-fuel fertilisers means that natural fibres, unless explicitly grown without them, are part of the fossil-fuel economy.

3. Natural Fibres Are Not Natural When Grown with Fossil-Fuel Fertilisers

The scientific literature on natural fibres acknowledges this dependency, even if it rarely foregrounds it. In their review of natural-fibre composites, Peças et al. note that the physical and chemical properties of natural fibres depend on "plant source, cultivation location, climate conditions, harvest window, use of Genetic Modified Organisms (GMO), pesticides and fertilizers" (Peças et al. 2018, p.5). This statement, though brief, is crucial. It confirms that fertilisers — and therefore fossil fuels — shape the very structure of natural fibres.

The review also highlights the "large variability of soil composition and morphology" and the influence of "cultivation location" and "weather and post-treatment" on fibre properties (Peças et al. 2018, pp.5–8). These variations reflect the uneven distribution of fertiliser regimes across global agriculture. A cotton fibre grown with 200 kg/ha of fossil-fuel nitrogen cannot be considered "natural" in any meaningful ecological sense. Yet current labelling systems make no distinction between fibres grown with synthetic nitrogen and those grown with organic or regenerative methods.

The life-cycle assessment study by Gonzalez et al. reinforces this point. The authors show that the agricultural phase is where natural fibres diverge most sharply in environmental impact, noting that "five impact categories… have the most significant differences across these fibers: fossil resource scarcity, global warming, land use, terrestrial ecotoxicity, and water consumption" (Gonzalez et al. 2023, p.7). They explicitly state that cotton cultivation involves "heavy use of water, land, fertilizers, pesticides, and energy" (Gonzalez et al. 2023, p.4). These impacts are not inherent to natural fibres; they are the result of fossil-fuel-dependent agricultural systems.

To support natural fibres is to support fibres grown in ways that honour their ecological potential. This cannot be achieved while fossil-fuel fertilisers remain the dominant input.

4. The Global Shift to Natural Fibres Must Include an End to Fossil-Fuel Fertiliser Use

The world urgently needs to transition away from synthetic fibres derived from petrochemicals. Natural fibres offer a pathway toward a regenerative textile economy, but only if they are produced in ways that reflect ecological principles. A natural fibre grown with fossil-fuel fertilisers is not a natural fibre; it is a fossil-fuel product grown in a field rather than a refinery.

The global shift toward natural fibres must therefore include a commitment to ending fossil-fuel fertiliser use. This is not a marginal adjustment but a structural transformation. It requires rethinking agricultural systems, supporting organic and regenerative practices, and investing in alternatives such as green ammonia, bio-fertilisers and legume-based nitrogen fixation. It also requires transparency. Consumers cannot make informed choices if fertiliser sources remain hidden.

5. Vegan Leather Alternatives and the Illusion of Naturalness

The rise of plant-based and fruit-based "vegan leathers" is often presented as a progressive alternative to petrochemical synthetics. Materials made from apple pomace, pineapple leaves, cactus pads, grape skins, mushroom mycelium and avocado waste are marketed as ethical, low-impact and aligned with the values of a post-fossil-fuel future. Yet these materials inherit the same structural problem that affects natural fibres: the agricultural systems that produce the plants, fruits and residues used in these leathers are overwhelmingly dependent on synthetic nitrogen fertilisers derived from fossil fuels.

The environmental integrity of a vegan leather made from apple waste cannot be separated from the agricultural practices that produced the apples. If the orchard relied on fossil-fuel fertilisers, then the leather alternative carries the same embedded fossil-fuel burden as any conventional crop. The same applies to pineapple-based materials such as Piñatex. Pineapple cultivation is nitrogen-intensive, and unless explicitly grown under organic or regenerative conditions, it is almost certainly fertilised with synthetic nitrogen. The pineapple leaves used to make the leather alternative are therefore not agricultural by-products in a neutral sense; they are by-products of a fossil-fuel-dependent system.

The same logic applies to avocado-based materials. Avocado orchards are typically fertilised with high levels of nitrogen to maintain yields, particularly in export-oriented production regions. Without fertiliser-source disclosure, a vegan leather made from avocado skins or stones cannot be assumed to be fossil-free. Even when the raw material is framed as "waste," the waste itself is the product of an agricultural system shaped by fossil-fuel inputs.

Paudel's global analysis makes this clear: fertiliser use drives significant increases in nitrous oxide emissions and water withdrawals, concluding that nitrogen pollution has exceeded planetary boundaries (Paudel 2025). These impacts are embedded in every crop grown with synthetic nitrogen, whether the crop is destined for food, fibre or biomaterial production. The environmental harms do not disappear simply because the crop residue is repurposed into a leather alternative.

For vegan leathers to be credible as sustainable materials, they must be produced from plants grown without fossil-fuel fertilisers. This requires the same seed-to-plant traceability demanded for natural fibres. It is not enough to state that a material is made from fruit waste; the industry must disclose how the fruit was grown, what fertilisers were used, and whether the agricultural phase aligns with a fossil-free vision. Without this transparency, vegan leather alternatives risk replicating the same contradictions that undermine natural fibres: they appear natural, but they are structurally dependent on fossil fuels.

6. The Need for Seed-to-Fibre Fertiliser Disclosure

A credible natural-fibre transition must include seed-to-fibre fertiliser traceability. This means documenting nitrogen sources at the seed stage, recording fertiliser applications during cultivation, and carrying this information through ginning, retting, spinning, weaving and finishing. Without such transparency, sustainability claims remain unverifiable.

None of the documents reviewed — nor any existing certification system — require fertiliser-source disclosure. Organic certification prohibits synthetic nitrogen, but even organic labels do not explicitly state "no fossil-fuel fertiliser used." This opacity allows fossil-fuel dependency to persist unnoticed.

A natural-fibre future must be a fossil-free future. Anything less is a continuation of the status quo under a different name.

7. Conclusion

I support natural fibres because they offer a pathway out of the petrochemical textile economy. But this pathway is only meaningful if natural fibres are truly natural — grown without fossil-fuel fertilisers, rooted in regenerative agriculture, and transparently labelled from seed to fibre. The global shift toward natural fibres must therefore be accompanied by a clear and uncompromising demand: end fossil-fuel fertiliser use in all natural-fibre systems. Only then can natural fibres fulfil their ecological promise and lead the world toward a genuinely sustainable textile future.

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