Title: Tannery solid waste generation trend and sustainable management techniques for commercialization

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Abastact: The global rise in leather consumption has led to a significant increase in tannery solid waste (TSW), especially in developing countries where inadequate treatment practices pose serious environmental and public health risks. This study reveals that TSW generation has surged more than 100-fold over the past six decades, with production shifting predominantly to Asia. In this review, as a representative developing country, we outlined the details of the TSW generation scenario for Bangladesh and sustainable approaches to manage them, as it faces disproportionately severe impacts despite contributing less than 1% of global TSW. The review identifies major challenges in current management practices, including the inefficiency of direct disposal methods and the limited scalability of conventional dechroming techniques. Critical findings show that emerging valorization approaches, such as biodiesel production from fleshing, enzyme-assisted anaerobic co-digestion, which boosted biogas build-up to 81%, and low-temperature gasification, offer environmentally sound and commercially viable alternatives. Likewise, pyrolysis and immobilization strategies demonstrate potential for both energy recovery and resource stabilization. The study also proposes a context-sensitive hypothetical circular economy model for TSW management, integrating technological pathways with socio-economic indicators to support long-term sustainability. Ultimately, this review offers strategic insights for transitioning from linear to circular waste management frameworks. It emphasizes the importance of policy reform, stakeholder collaboration, and future research focused on Life Cycle Assessment (LCA) and Techno-Economic Analysis (TEA). The proposed framework aligns with multiple Sustainable Development Goals, including SDG 3 (Good Health and Well-being), SDG 7 (Affordable and Clean Energy), and SDG 15 (Life on Land), providing a pathway toward safer, inclusive, and globally certified tannery practices.

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