From Waste to Wealth: Agro-Waste Textiles as a Catalyst for Ethiopia's Green Industrial Revolution

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Ethiopia has been making efforts to develop its textile and garment industry. The country is known for initiatives like the Hawassa, Debre Berhan, Bole Lemi, and Adama industrial parks, which aim to attract investment in the country's manufacturing sector. The Ethiopian apparel industry has the potential to contribute significantly to the creation of jobs and the promotion of sustainable practices. However, challenges such as water usage, chemical pollution, and waste management require attention in the East Africa giant's textile industry to mobilize sustainability and alignment with Sustainable Development Goal (SDG) 12: Responsible Consumption & Production. One possible solution is to leverage agro-waste fabrics, textiles made from waste generated in the food industry. Examples of agro-waste fabrics include pineapple leaf fibres, banana fibres, and orange peel fibres. Plant-based fabrics come directly from plants or their fibres, while agro-waste fabrics are created from the disregarded by-products of the food industry.

Although Ethiopia was never formally colonized, it has long been entangled in neocolonial dependency structures that perpetuate environmental and economic injustices. Dependency theory, particularly as articulated by Raul Prebisch, highlights how the Global South is often locked into exploitative economic relationships with the Global North. The extraction of raw

materials and the import of manufactured goods leading to declining terms of trade and sustained underdevelopment characterize these relationships. Ethiopia, as part of the periphery, faces environmental and economic injustices stemming from this dynamic, including waste colonialism, environmental degradation, and economic dependency.

This article argues that agro-waste textiles represent a transformative form of resistance to these structural injustices. The valorization of agricultural by-products such as enset and coffee grounds may allow Ethiopia to disrupt core-periphery dynamics, reduce reliance on imported goods, and reclaim agency in the global textile industry. Grounded in Prebisch's principles of dependency theory, this piece explores how agro-waste fabrics mitigate environmental degradation, challenge waste colonialism, and prevent carbon colonialism while promoting sustainable development and cultural reclamation.

Here, it is argued that agro-waste textiles are a vital form of resistance to the environmental injustices that African countries face. This article highlights how this innovative manufacturing technique provides a sustainable solution that addresses both waste management and the socio-economic and ecological systems perpetuating inequality in the Global South. I look at agro-waste's ability to mitigate environmental degradation associated with conventional textile production, to challenge waste colonialism, and to prevent carbon colonialism. This piece explains why the uptake of agro-waste fabrics in Ethiopia's textile manufacturing industry has the potential to transform waste into wealth. Sustainable growth in the textile sector would contribute

to SDG 12 and reduce dependence on foreign goods.

Background

Despite its history of avoiding formal colonization, neo-colonial economic structures deeply affect Ethiopia. The country exports raw materials, such as coffee and enset while importing synthetic textiles and second-hand clothing, perpetuating dependency and environmental harms.

Global food loss and waste contribute 8-10% of global greenhouse emissions (Chomba, 2022). In Sub-Saharan Africa, approximately 37% of food produced is lost or wasted, totalling 120-170 kg per capita annually. This not only results in economic losses for farmers but also wastes valuable resources such as water, fertilizers, energy, and land. Ethiopia is currently facing a significant post-harvest food loss crisis that affects both its food security, economy, and environment (Urugo et al., 2024). Studies indicate that post-harvest loss (PHL) in grains ranges from 20 to 30%, while horticultural products, it is substantially higher, reaching 30 to 50% (FDRE Ministry of Agriculture, 2024). Poor harvesting, storage, transportation, and consumer behaviours drive PHL (Food and Land Coalition, 2019). These losses translate to an economic impact of 1.72 billion CAD annually, equivalent to 10% of Ethiopia's average national budget from 2018 to 2022 (Teferra, 2022). Despite efforts like the construction of Africa's first waste-to-energy plant near Addis Ababa's Koshe landfill in 2018, which was intended to tackle waste, the country's increasing waste rates remain a significant

environmental and economic burden (Alfa Shaban, 2019).

A key area for Ethiopia to address is the massive waste generated by coffee, a crop that has been integral to the country's culture and economy for centuries. Agriculture contributes to over 35% of Ethiopia's gross domestic product (GDP), almost 90% of exports, and over 72% of employment. Coffee accounts for 4-5% of Ethiopia's GDP, 10% of total agriculture production, 40% of total exports, 10% of total government revenue, and 25-30% of total export earnings (Ayele, 2021). However, the coffee industry also produces vast amounts of spent coffee grounds – around 25 billion kilograms annually worldwide, of which only 4% is recycled. The remaining 90% becomes waste, contributing to methane (CH4) and carbon dioxide (CO2) emissions. In Ethiopia, the coffee pulp is often improperly disposed, polluting nearby water sources and harming public health (Woldesenbet, 2015).

Despite these challenges, there is growing potential to recycle and repurpose coffee grounds. Companies such as Singtex in Taiwan have developed technologies to transform coffee grounds into fibres used for fabric production. Singtex's S. Café yarn is made from 5% recycled coffee grounds mixed with 95% recycled polyester, offering benefits such as odor control, UV protection, water repellency, and eco-friendliness. This innovative process reduces the need for virgin polyester, cutting down on the use of fossil fuels, and lowering the carbon footprint of fabric production (Cowley, 2022).

Plant-based fibres like banana, coir, sisal, and jute have shown significant industrial potential, with banana waste

standing out due to its availability and versatility. In 2018, global banana production reached 115.7 million tonnes, making its by-products, such as the pseudo-stem, an abundant source of high-quality fibre. This fibre has been used for applications ranging from sanitary products and textiles to reinforced composite materials. For example, the Philippine Department of Science and Technology developed sustainable banana fibre masks as an eco-friendly alternative to plastic (Balda, 2021).

In Ethiopia, enset offers similar potential. Enset (ensete ventricosum), or false banana, is a drought-resistant staple crop in Ethiopia. Unlike bananas, its fruit is inedible, but its pseudo-stem and corm are processes into foods like kocho, bulla, and amicho. Among 20 million Ethiopians, enset is known as the "tree against hunger," supporting food security, providing animal feed, and having uses in medicine and crafts (Heuzé et al., 2017). Enset produces not only food but also fibre from its leaf sheaths and midribs, used traditionally for rope, mats, baskets, and building materials. Among the Wolaitta people, indigenous knowledge has identified enset species like tuffa and lalukiya as ideal for fibre production, valued for its durability and waterproof properties (Olango, 2014). Moreover, enset cultivation supports sustainable practices, as its propagation and landrace management enhance its utility for food and fibre. Indigenous Ethiopian communities also contribute expertise in textile dyeing, exemplified by the Tigray people's use of Gunda gundo orange peels to colour fabrics (Werede, 2021). This rich heritage, combined with hand-woven traditional clothing designs like "gabi", "netela," and "Qemis," highlights the potential of agro-

waste textiles to elevate Ethiopia's presence in sustainable fashion. Embracing fibres like enset could reduce waste, honour traditional practices, and position Ethiopia as a leader in eco-friendly apparel production.

Looking ahead, Ethiopia's manufacturing industry is expected to see significant growth, particularly with its new membership in the BRICS (Brazil-Russia-India-China-South Africa) bloc. Membership in BRICS+ offers advantages such as reduced transaction costs through de-dollarization and favourable exchange rates when trading with member nations (Goshu et al., 2024). Additionally, Ethiopia's involvement in the BRICS International Fashion Federation facilitates global collaborations and promotes slow, sustainable fashion initiatives (Dawson, 2024). The federation provides knowledge-sharing opportunities and encourages the adoption of sustainable practices in textile production. Ethiopia's participation in BRICS offers new economic opportunities through foreign direct investment (FDI), access to international trade markets, and technology transfers from emerging economies. Furthermore, BRICS+ countries have a history of investing in African manufacturing sectors, including textiles, and Ethiopia could benefit from these investments, particularly in infrastructure such as energy and transportation , which are critical for scaling its textile industry (Mekonnen, 2024). This combination of financial technological, and infrastructural support could significantly enhance Ethiopia's global competitiveness in textiles, positioning the country as a key player in the emerging global textile market. Overall, Ethiopia's membership in BRICS provides access to new

markets and FDI in sustainable textiles made from agro-waste, such as coffee, pineapple, and other plant-based materials. As the global market for food waste products is projected to grow at a compound annual growth rate of 5%, reaching US $85.9B by 2033, Ethiopia has an opportunity to benefit from the sustainable textile market by turning agro-waste into high-quality fabrics (Choudhury, 2023). In this context, Ethiopia's participation in BRICS and its strategic focus on sustainable agro-waste products could position the country at the forefront of the green economy movement. Ethiopia has the potential to boost its economy, create jobs, especially for women in garment sectors, and strengthen its position in global markets by leveraging its local resources to create innovative, eco-friendly textiles.

Fashion companies are increasingly focused on sustainability, and the adoption of food waste textiles could provide a cost-effective solution that reduces production expenses, allowing companies to invest in higher wages for workers. Ethiopia can shift to a circular economy model to reduce its reliance on primary resource extraction and instead employ its abundant agro-waste resources to create value-added products. This approach not only supports environmental sustainability but also positions Ethiopia as a leader in the growing waste-to-products sector, contributing to the reduction of global textile waste and its environmental impacts.

As stated in The Economic Development of Latin America and its Principal Problems, "The peripheral countries export raw materials to the industrial centers and import manufactured goods. This results in a fundamental disequilibrium in the

distribution of the gains from trade." (Prebisch, 1950, p. 11). Prebisch (1950) emphasized that structural change is essential for breaking free from this cycle, he explained that industrialization is not merely an option for the periphery but a necessity to achieve equitable participation in the global economy. Agro-waste textiles, by transforming raw agricultural by-products into high-value fabrics, represent a concrete step toward such industrialization, enabling Ethiopia to move up the value chain and reduce its dependency on external markets.

1. Mitigating environmental impacts

Agro-waste textiles present a sustainable solution that aligns with SDG 12 by transforming local crop residues, such as coffee grounds and enset peels, into materials that reduce water and air pollution. This innovative approach also minimizes reliance on petroleum-based fabrics and energy-intensive manufacturing, providing Ethiopia with a greener, more self-sufficient alternative to polyester and polyamide. Globally, the textile industry contributes 10% of carbon emissions due to its reliance on petroleum-based raw materials, energy-intensive manufacturing, and the release of harmful chemicals during dyeing and finishing. If Ethiopia adopts agro-waste textiles, it can significantly reduce its dependence on these polluting materials and foster a more sustainable economy. In Ethiopia, agriculture accounts for 75% of the country's total CO2 emissions of 150 million tonnes CO2 equivalent (Atinkut et al., 2020). Globally, crop residues are often used for animal feed, cooking fuel,

composting, and roof thatching. However, in Ethiopia, particularly in the Amhara Region, large amounts of crop biomass, and feedstock are burned after harvest. This causes severe land, water, and air pollution. Repurposing agricultural residues for textiles offers a practical way to address these environmental issues while supporting sustainable development.

Agro-waste textiles offer a promising alternative to synthetic fabrics, particularly in reducing water contamination – a significant issue in Ethiopia's textile industry. Synthetic textiles such as polyester and polyamide contribute heavily to water pollution due to their resource-intensive production processes and the discharge of untreated industrial wastewater (Assegide et al., 2022). Textile effluents are among the largest sources of industrial soil and water pollution in Ethiopia, as many factories lack effluent treatment plants and discharge waste directly into the environment, depleting natural resources, disrupting ecosystems, and endangering human health. For instance, a study in the Amhara region found that liquid waste from the Bahir Dar Textile Factory endangered aquatic habitats and downstream users of the Blue Nile River (Mehari et al., 2015). Similarly, effluents from factories in the Oromia region producing polyester and acrylic yarn consistently exceeded the pollutant levels permissible under Ethiopia's Federal Environmental Protection Authority (Dadi et al., 2016). Lax regulatory frameworks exacerbate these issues with industries operated by foreign investors facing minimal enforcement of wastewater treatment requirements. Weak regulations worsen the problem,

allowing foreign-owned industries like the Hawassa Textile Industry to drill private boreholes and discharge untreated wastewater into the environment (Dixon et al., 2023).

In contrast, agro-waste textiles present a more sustainable approach. Agro-waste yarns, like Piñayarn made entirely from pineapple leaves, are fully biodegradable, recyclable, and require no additional land, water, or pesticides for production. This waste valorization process not only reduces the environmental impact of burning agricultural residues but also prevents up to 6 kg of CO_2 emissions for every kilogram of yarn produced (Ananas Anam, 2017). Similarly, fibres derived from banana stems offer a sustainable alternative to cotton and polyester. They use less water, hold dye more effectively, and rely on natural dyes such as turmeric and paprika powder instead of synthetic dyes (Nol Collective, 2023). This method avoids synthetic dyeing processes and minimizes water contamination while reducing reliance on harmful chemicals. Moreover, the valorization of agricultural waste extends to natural dye production, exemplified by a study that utilized *Gunda gundo* orange peels for dyeing cotton fabrics in Northern Ethiopia. This innovative approach reduced the reliance on synthetic dyes, lowered water contamination, and supported local farmers by creating new income streams. Such closed-loop systems, combining agro-waste yarns and natural dyes, demonstrate a holistic method to water management in the textile industry (Werede, 2021).

However, not all agro-waste textiles are free from chemical-intensive processes. For example, agro-waste leathers like

Piñatex, though derived from pineapple leaf fibres, include semi-synthetic components such as polylactic acid (PLA) and polyurethane (PU) resin, which prevent them from being fully biodegradable (Ananas Anam, 2017). Similarly, semi-synthetic textiles like Lyocell (Adekunle, 2015) and Rayon (Singh, 2017) rely on chemical-intensive production processes. While these options reduce the reliance on petrochemicals, sustainable management practices and stringent environmental regulations are necessary to minimize chemical waste and industrial water contamination. Thus, while some agro-waste textiles like Piñayarn provide a truly sustainable solution, the adoption of semi-synthetic agro-waste products must be accompanied by improved environmental regulations and wastewater management. By integrating agro-waste textiles with natural dyeing practices, Ethiopia and other countries can move toward an environmentally friendly textile industry that prioritizes both sustainability and economic empowerment for local communities.

Secondly, agro-waste fabrics prevent air pollution. Air pollution is a growing concern Ethiopia, exacerbated by the recent establishment of nylon production by Kingdom Ethiopia in Adama Industrial Park (Ethiopian Monitor, 2021). Kingdom Ethiopia, a subsidiary of China's Kingdom Group known for its expertise in linen manufacturing, made its largest overseas investment from Zhejiang Province in 2015. The Adama plant, constructed with an investment exceeding $50 million, outstrips its parent company's facility in China and it is confirmed to be the largest linen spinning facility in the entire African continent.

Initially, the company seemed poised to contribute to eco-friendly textile production, with the potential to evolve toward using agro-waste fabrics – materials derived from agricultural byproducts, such as rice husks or sugarcane, which are typically discarded. This would have represented a significant step beyond plant-based fabrics like linen, which are made from crops specifically grown for textile production.

However, in 2021, Kingdom Ethiopia shifted away from such sustainable practices and began importing synthetics, including nylon. The nylon manufacturing process is highly damaging to the environment, as it creates nitrous oxide, a greenhouse gas 300 times more potent than CO_2, and is associated with significant energy consumption and CO_2 emissions. Specifically, producing nylon requires 69 kWh of energy per kilogram of fibre, resulting in 37 kg of CO_2 emissions per kilogram of nylon (Rana et al., 2015). This shift demonstrates a purposeful regression in sustainability efforts, with the company prioritizing pollution-heavy production methods that position Ethiopia as a pollution haven, rather than advancing toward the more environmentally conscious use of agro-waste fabrics.

Thirdly, agro-waste fabrics could support the reduction of waste accumulation in landfills. It is estimated that at least 37% of all food produced in Sub-Saharan African countries is wasted and 90% of this food waste ends up in landfills, inevitably producing greenhouse gasses (GHGs) such as methane (Chomba, 2022). Professor Ali Mohammed, in collaboration with the Food and Agriculture Organization (FAO), reports that Ethiopia experiences an annual waste or loss of around 282

billion birr (3.17 billion CAD) worth of food. His study, based on data from 14 districts, identifies the major factors of waste as poor practices in harvesting, storage, transportation, market, and consumer behaviour. In Ethiopia, over 40% of tomatoes, papayas, and mangos fail to reach consumers due to the lack of scientific preservation methods. To highlight the need for systematic food management, Mohammed points out that Ethiopia spends 55.5 billion birr annually on food imports, emphasizing the potential for a significant reduction through strategic approaches (Etefa, 2022). In 2017, because of Ethiopia's poor waste management, there was a landslide at Addis Ababa's oldest landfill, known as "Koshe" by locals. This disaster resulted in the deaths of 113 people and left many missing or homeless. The Koshe landfill, in operation for over five decades, has been a hazardous environment for scavengers and the unhoused population in the area. The construction of Africa's first waste-to-energy plant near the landfill, in August 2018, was expected to solve this issue, but the innovative solution could not keep up with the rate of food waste increase. Another landslide in June 2019 thus killed an elderly man (Alfa Shaban, 2019). Upcycling coffee grounds as well as enset, orange papaya, pineapple, and mango peels could reduce some of the waste accumulated in landfills, decreasing the emissions of Koshe.

In essence, agro-waste fibres offer a promising avenue to prevent Ethiopia from becoming a pollution refuge for core and semi-periphery nations seeking to evade responsibility for their environmental footprint. The exploitation of natural resources in

the periphery to fuel the consumption of the core has left countries like Ethiopia grappling with environmental degradation. Dependency theory explains how this imbalance forces the Global South to bear the ecological costs of global production systems. Agro-waste textiles challenge this dynamic by offering a low-impact alternative to conventional textile production. By upcycling enset and coffee by-products into textiles, Ethiopia can reduce water contamination, air pollution, and landfill waste caused by synthetic fabrics. For example, replacing polyester with agro-waste textiles reduces toxic dye runoff and fossil fuel dependence, preserving local ecosystems. This innovation not only resists environmental exploitation but also aligns with SDG 12 by promoting responsible consumption and production.

2. Challenging waste colonialism

The global trade in second-hand clothing grew tenfold between 1990 and 2004, reaching a value of approximately CAD 1.4 billion. By 2021, its market value was estimated at CAD 48 billion and is projected to grow to CAD 103 billion in 2025. Major net exporters include the United States, China, the United Kingdom, Germany, and South Korea, while the top importers are Ghana, Nigeria, Kenya, and Tanzania (Cobbing et al., 2022). In Ethiopia, new clothing is often prohibitively expensive due to production costs, profit margins, and import fees tied to transportation. Many boutiques in Addis Ababa import garments from Turkey and the UAE, where quality is perceived to be higher but remains expensive compared to local incomes. This has

fueled the rise of "bonda" culture—buying second-hand clothing imported from the Global North—a practice linked to fashion waste colonialism. Known as “bonda” in Ethiopia, “chagua” in Rwanda, and “mitumba” in Tanzania, Uganda, and Kenya, bales of used clothing have become a dominant source of affordable apparel for many (Siele, 2021). Africa’s second-hand clothing imports grew by 28% in one year, reaching CAD 2.5 billion in 2021. To counter this dependency and address the economic and environmental consequences, Ethiopia could focus on innovative solutions like agro-waste fabrics. This approach has the potential to reduce reliance on imports, foster self-reliance, and stimulate sustainable economic growth, offering a viable alternative to waste colonialism.

Firstly, agro-waste fabrics challenge waste colonialism by decentralizing trends and consumption habits, creating space for African creativity, heritage, and pride at an affordable price. Bonda culture is marketed as an affordable way to access trendy North American lifestyles, yet it hides the destruction of local textile industries and stifles opportunities for local creatives. This unsustainable cycle exacerbates waste problems while fostering overconsumption patterns linked to the Global North. In Ethiopia, bonda clothes are prized for their perceived global appeal, with items worn in nightclubs and university campuses symbolizing youthfulness and modernity. However, as trends fade, these clothes are discarded, contributing to massive waste in local landfills. TikTok videos often showcase Ethiopian teenagers laughing over their “bonda hauls” (Alem, 2024), only to discard the clothes shortly after. Agro-waste fabrics that are

made from materials like pineapple fibers, coffee grounds, or banana stems, offer an affordable, sustainable alternative to imported second-hand clothing.

Ethiopian designers can use these materials to blend traditional patterns with modern sustainable fabrics, revitalizing the country's textile industry. For example, ye habesha libs, a traditional Ethiopian garment, could be modernized by incorporating eco-friendly fabrics such as enset silk or coffee fiber. This approach celebrates indigenous craftsmanship while shifting away from Western-centric fashion norms, echoing Pan-African ideals of economic self-sufficiency and cultural pride, like Burkina Faso's faso dan fani as a symbol of resistance. Ethiopian designers, such as Mafi Mafi and Zaaf Collection, who already emphasize sustainability, can expand their creative horizons by incorporating agro-waste textiles (Adjoaa, 2023). These fabrics not only offer a unique aesthetic that highlights Ethiopia's agricultural abundance, but they also promote a local, eco-friendly fashion industry that can compete with the global waste trade. Agro-waste fabrics rely on readily available local materials, making them cheaper than traditional textiles made from synthetic or plant-based fibers (Banana Fiber, 2024). Agro-waste fabrics can directly compete with bonda culture, offering a sustainable and low-cost alternative to the affordability of second-hand clothes from the Global North. Producing goods locally could also encourage local consumption of manufactured goods because they increase clothing diversity and availability. Agro-waste fabrics have the power to support local communities, foster economic growth, and provide a

distinct fashion identity rooted in sustainability, African pride, and resistance to cultural imperialism in Ethiopia (Alayew, 2016).

Secondly, bonda culture presents itself as an economic stimulant for African economies, promising jobs in secondhand clothing sales, importation and exportation and tailoring sectors. These benefits are real, but this analysis fails to highlight the amount of clothes that go unsold, unaltered and unwanted. In receiving countries like Ethiopia, the management of secondhand clothing waste is often carried out with scarce resources, placing financial and logistical burdens on both individuals and government agencies. For individuals, debt finances the cost of secondhand clothing bales and associated operational expenses such as storage, transportation (sometimes through physically taxing means like head carrying), rent, and electricity (Alem, 2024). For governments across East Africa dealing with waste colonialism, debt is incurred to fund landfill construction, waste hauling, and other waste management processes such river sanitation projects (Diamond, 2023).

In contrast, agro-waste fabrics can challenge waste colonialism through the creation of sustainable job opportunities, while reducing national waste volumes. From 2024 to 2027, the global apparel market is projected to grow by $150 billion, with job opportunities across the agro-waste fabric value chain (Oberlo. 2024). Within the value chain, there are the following opportunities:

1. Sourcing begins with the identification of suitable agro-waste sources, establishing partnerships with food

processing industries, agricultural farms, and waste management facilities to assess the availability and quality of materials such as pineapple leaves, banana stems, and orange peels. This stage offers employment opportunities in sourcing logistics, quality assessment, and partnership negotiations.

2. Following sourcing, the processing of agro-waste materials involves innovative extraction techniques to obtain fibers while maintaining their integrity and quality. These fibers are then spun into yarn and woven into fabric, employing eco-friendly techniques to ensure sustainability. Training programs and vocational courses tailored to agro-waste processing can empower youth to fill these roles.
3. Apparel manufacturing entails design and patternmaking tailored to market trends and customer preferences. Fabric panels are cut and sewn together by seamstresses to create finished garments, emphasizing quality and craftsmanship. Youth can be trained in design and garment production, fostering entrepreneurship through small-scale manufacturing ventures and artisanal workshops.
4. Marketing and sales roles will grow as brands focus on sustainability, with young entrepreneurs creating branding firms and engaging on social media. Additionally, fintech opportunities will arise from developing payment systems for sustainable fashion, while customer service jobs can be created through feedback and support

services (Duke Education, 2017).

Overall, agro-waste apparel offers a sustainable, job-creating solution that presents as a meaningful opponent to the economic benefits enabling waste colonialism.

Thirdly, bonda culture presents itself as environmentally sustainable means of approaching fashion, giving a second life to the disregarded garments of those living in the Global North. Today, the only thing circular about fashion waste colonialism is that the clothes are being produced in Africa, shipped abroad, and then returned to Africa to be disregarded. If bonda culture continues, the best way to ensure a sustainable environmental future and reduce waste accumulation in African lands and seas is by committing exclusively to producing agro-waste fabrics. A sole focus on agro-waste textiles ensures that the waste that inevitably returns to Africa would at least be biodegradable, minimizing long-term environmental harm. In East Africa, particularly in countries like Kenya and Tanzania, a significant portion of the imported second-hand clothing, known locally as *mitumba* or bonda, is of such poor quality that it is immediately discarded in landfills, often in open-air sites. Unsold bonda items are often repurposed by tailors, known for their resourcefulness and business acumen. High-cotton material scraps, valued for their absorbency, are converted into oil rags, while other textiles are used for cushion stuffing or as cost-effective fuel for fires.

Still, vast amounts of textile waste remain unmanaged. The situation is dire in Tanzania and Kenya, where textile waste has severe environmental and health implications. In Kenya, for

example, up to 40% of imported second-hand clothing is unusable and becomes waste immediately, amounting to approximately 150–200 tonnes of textile waste per day. Many of these garments, made from synthetic fibers, release microplastics into the environment as they degrade, further polluting soil, waterways, and even food supplies. Overflowing dumpsites and blocked waterways, such as the Nairobi River, create additional hazards, such as floods during heavy rains, which further destabilize communities (Cobbing et al., 2022). Agro-waste fabrics provide an opportunity for Ethiopia to address these challenges before they reach the dire situations observed in neighbouring countries like Kenya and Tanzania by reducing the export of synthetic fabrics entirely, opting to produce agro-waste fabrics. Using agricultural byproducts to create textiles not only alleviates the economic burden of managing imported waste but also supports a circular economy that benefits local communities and reduces environmental harm.

In sum, waste colonialism, marketed as the second-hand clothing industry, exemplifies how the Global North exploits the periphery as a dumping ground for its excess, particularly through second-hand clothing exports. Ethiopia, a major importer of discarded garments, faces detrimental effects such as the undermining of its local textile industries and overflowing landfills. According to Structural Dependency Theory pioneers, the structure of the global economy perpetuates a system where the periphery shoulders the costs of progress in the industrial centers (Prebisch, 1950, p.13). Dependency theory critiques this waste flow as a mechanism that perpetuates inequality. A

promising solution lies in mobilizing the production of agro-waste textiles, such as enset silk and coffee-ground fabrics, to create affordable, locally produced alternatives to second-hand imports. This approach would not only reduce Ethiopia's reliance on the Global North for apparel but also foster self-sufficiency and dismantle exploitative systems. By replacing *bonda* with sustainable, fashion-forward options, Ethiopia could weaken the second-hand clothing market and challenge the Global North's negligent manufacturing practices, ultimately strengthening its position in the global textile market.

3. Preventing carbon colonialism

At below 4%, Africa accounts for only a tiny share of greenhouse gasses (GHG) emissions. Yet, as acknowledged by the 2022 Intergovernmental Panel on Climate Change (IPCC) Report, the African continent will be the most negatively affected by climate change. That reality is already painfully evident in East Africa, "The region has been suffering its worst drought in 40 years since October 2020, with extended dry conditions punctuated by short intense rainfall that has often led to flash flooding," (Harvey, 2023). Carbon colonialism describes the practice where wealthy nations, responsible for the majority of global carbon emissions, exploit poorer countries by shifting the burden of climate change impacts onto them. These countries, often in the Global South, face the brunt of environmental destruction, such as extreme weather and rising sea levels, despite contributing the least to global emissions. This system

perpetuates inequality by allowing rich nations to continue emitting while poorer nations bear the environmental and economic costs (FairPlanet, 2020).

Firstly, agro-waste fabrics can enable Ethiopia to preserve its significant stock of carbon credits while advancing its goal of becoming a manufacturing hub in Africa. Carbon markets allow entities to buy and sell carbon credits, with one credit representing one tonne of carbon dioxide or its equivalent removed, reduced, or avoided. These credits become offsets once utilized and are no longer tradable (UNDP Blog, 2022). With carbon rights increasingly as valuable as land ownership, a nation's prosperity will hinge on its ability to leverage these assets. Ethiopia currently holds a considerable reserve of carbon credits, a critical resource depleted when the Global North exports pollutive industries to the Global South. This practice, a key element of carbon colonialism, transforms regions like Ethiopia into "pollution havens." Pollutive industries are relocated to areas with weaker environmental regulations, enabling the Global North to retain the carbon credits tied to its emissions reductions while externalizing environmental and social costs. This not only burdens the Global South but also undermines its ability to benefit from carbon credit markets or strengthen its global bargaining power (Tenkir, 2023).

Ethiopia can avoid becoming a pollution haven and maintain its competitiveness in global markets through the adoption of agro-waste fabrics. The transition to innovative and eco-friendly production methods can align Ethiopia's textile industry with global trends. Many brands in the Global North, such as

Allegorie, Altex, Bolt Threads, and Desserto, are already embracing biodegradable, low-emission fabrics (Feldman, 2022). In contrast, continuing to produce cheap, pollutive garments from polyester and cotton risks marginalizing Ethiopia's textile industry, keeping it in the global periphery. This failure to encourage modern textile production technologies in the Global South exemplifies the dependency theory philosophy that, "The spread of technical progress from the countries where it had its source to the rest of the world has been [...] relatively slow and irregular," (Prebisch, 1950, p.1). Failure to adopt agro-waste fabrics could have long-term repercussions for Ethiopia's position in the carbon market, reducing its share of valuable carbon credits. Conversely, embracing this transition would not only enhance Ethiopia's textile innovation but also fortify its role as a sustainable manufacturing leader in Africa.

Secondly, agro-waste textiles emerge as a viable alternative to rectify deficiencies in the carbon credit market, particularly concerning the ownership of offset projects. They tackle significant market failures, especially the excessive reliance on land-based offset initiatives, which can lead to carbon colonialism. The forceful displacement of the Maasai in Tanzania and Indigenous peoples in Uganda for carbon offset endeavors and foreign investments in forestry projects exemplify this form of carbon colonialism (Greenberg, 2024; Lang, 2006). Such projects often commodify nature at the expense of local populations, benefiting corporations and affluent nations.

Ethiopia already has a strong foundation to support agro-waste textile production within its carbon market strategy.

Initiatives such as the Horn of Africa Regional Environment Centre and Network Carbon Project have successfully promoted carbon-reducing projects that benefit both the environment and local communities (Addis Ababa, 2022). By integrating agro-waste textiles into its portfolio of carbon projects, Ethiopia can position itself as a leader in sustainable industrial practices while expanding its carbon credit offerings. Incorporating agro-waste textiles into Ethiopia's carbon market strategy would also align with the country's goals of economic development and sustainable manufacturing. Using frameworks like Emission Reductions Purchase Agreements (ERPA), which have committed $40 million in 2023 to cutting emissions (World Bank, 2022), Ethiopia can scale agro-waste textile production as a key driver of its climate action.

This approach would allow Ethiopia to lead the way in carbon credit innovation, promoting industrial practices that benefit both the environment and local populations. The measurement and valuation of emissions reductions from agro-waste textiles can be quantified using established methodologies like ISO 14067, which assesses the carbon footprint of products (Ditan Group, 2024). This methodology conducts a lifecycle analysis (LCA), comparing the emissions from agro-waste textiles to those from traditional synthetic textiles as well as semi-synthetic textiles. These analyses account for the entire lifecycle, from raw material extraction to product disposal, and help verify the actual carbon offsets generated by agro-waste textile production. Such quantification ensures transparency and accountability in the carbon offset process (Zamani, 2023).

While agro-waste textiles are not a cure-all for the many challenges of carbon credit markets, they offer an important part of the solution. They can diversify carbon offset mechanisms, complementing other reforms aimed at improving market transparency and accountability. These reforms should include efforts to curb carbon colonialism and ensure that carbon credits are generated through sustainable, equitable practices. Agro-waste textiles provide a realistic and scalable alternative to the current carbon credit system, addressing both environmental and social concerns without relying on land-based projects.

The strategic depletion of Ethiopia's carbon credit stocks exemplifies the dynamics of carbon colonialism, where the Global North externalizes its environmental footprint onto the Global South, reinforcing patterns of dependency and climate vulnerability. Despite contributing minimally to global emissions, Ethiopia disproportionately bears the brunt of climate change, as seen in recurrent Horn of Africa droughts. This extraction-based relationship mirrors the systemic inequalities critiqued by dependency theory, where the periphery is exploited to sustain the excesses of the core. Agro-waste textiles, such as enset silk, coffee fiber, banana, and pineapple fibers, offer a powerful form of resistance to these exploitative structures. By fostering low-emission, locally produced alternatives to synthetic materials, Ethiopia can safeguard its carbon credit stock while reducing reliance on the Global North's unsustainable supply chains. This shift not only disrupts dependency but also positions Ethiopia as a leader in green manufacturing, challenging dominant sustainability narratives controlled by the Global North.

Promoting agro-waste textiles serves as a mechanism for reclaiming agency, educating communities on the environmental and social impacts of production systems, and advancing environmental justice. Through this resistance, Ethiopia can dismantle exploitative systems and chart a self-reliant path toward sustainable development.

To summarize, agro-waste textiles provide a unique opportunity to address the dual challenges of emissions from the textile and food waste industries. Prebisch's framework underscores the importance of structural change to ensure equitable development. His work notes that the economic dependence of developing nations cannot be resolved without addressing the structural imbalances that limit their capacity for industrial growth (Prebisch, 1950, p. 20). By producing agro-waste textiles domestically, Ethiopia can preserve its stock of carbon credits while reducing its dependency on polluting industries imported from the Global North. While they are not a complete solution to the dysfunctions of carbon markets, they offer a significant step toward reforming carbon credit systems in ways that prioritize industrial innovation over land-based offsets, empowering countries like Ethiopia to drive sustainable and equitable climate action.

Limitations

While agro-waste fabrics hold great potential, there are notable limitations and challenges to consider. These insights, drawn from Adhia et al.'s (2021) *Spinning Future Threads: The*

Potential of Agricultural Residues as Textile Feedstock, are particularly relevant to Ethiopia's emerging agro-waste textile sector, which remains under-researched. Scaling agro-waste textiles in Ethiopia can benefit from practices proven in other countries, though several obstacles remain.

Firstly, the inconsistent supply of raw materials presents a challenge, varying by country and crop. For instance, rice husk availability in Vietnam is tied to the rice harvesting cycle, creating supply gaps, while in India, the seasonal nature of sugarcane farming affects the consistency of bagasse for fiber production (Adhia et al., 2021, p. 86). Secondly, the high cost and limited availability of specialized technology for fiber extraction hinder progress. Countries like Indonesia and Sri Lanka lack the machinery to process agro-residues, and the financial burden of acquiring such technology can be prohibitive for many farmers (Adhia et al., 2021, p. 88). Additionally, limited decentralized processing units lead to higher logistical costs and inefficiencies (Adhia et al., 2021, p. 89). Lastly, agro-residues in countries like Pakistan and Bangladesh are highly sought after for bioenergy and livestock feed, which further restricts the materials available for textile production (Adhia et al., 2021, p. 90).

Looking ahead, integrating agro-waste collection and processing into existing agricultural systems is key. For example, partnerships between farmers and textile manufacturers could ensure consistent collection of materials such as rice husks and cotton stalks (Adhia et al., 2021, p. 87). Establishing agro-residue processing units near farming hubs in India or Vietnam could optimize feedstock aggregation and minimize transportation

costs (Adhia et al., 2021, p. 97). In Ethiopia, agro-residues like mango waste (Amhara), banana and enset waste (Hawassa), and potato waste (Adama) could be sent to regional industrial parks (FAO, 2019). Encouraging research and development (R&D) into efficient agro-residue processing will help reduce costs and improve scalability.

Furthermore, taxing synthetic textile production and subsidizing eco-friendly alternatives could incentivize sustainable practices. The Ethiopian government could impose taxes on synthetic textile companies and offer subsidies for eco-friendly alternatives, promoting waste management and reducing environmental degradation (Korsu et al., 2018). Over time, Ethiopia could diversify into fibers like hemp, bamboo, and organic cotton, reinforcing its commitment to eliminating synthetic textiles and fostering private sector investment in sustainable industries. Penalties for burning agro-residues could further optimize agro-waste textile production (Adhia et al., 2021, p. 98). Collaboration with countries advanced in agro-waste textile processing, such as Bangladesh, Pakistan, Indonesia, Brazil, the Philippines, and Kenya, could help bridge technological gaps. International partnerships would enhance technical expertise, improve production efficiencies, and drive cross-learning (Fashion for Good, 2021). By addressing these challenges, Ethiopia can lead the agro-waste textile revolution, setting a global example for sustainable development and carbon-neutral innovation.

Looking forward

Despite their benefits, agro-waste textiles face significant challenges. Semi-synthetic materials like pineapple leather (Piñatex) and apple leather, often marketed as sustainable, rely on synthetic binders that undermine their environmental claims. These materials raise concerns about biodegradability and long-term environmental impact, especially when fossil fuel-based processes are involved. Furthermore, transforming agro-waste into textiles is resource-intensive, involving energy-heavy processes for dyeing, finishing, and fiber processing. Even natural dyeing methods, while less harmful than synthetic ones, still require water, energy, and other resources that can strain local ecosystems. To mitigate these issues, consumer education campaigns are essential to differentiate genuinely sustainable options from those that merely appear eco-friendly, reducing the risk of greenwashing. Transparency about trade-offs will ensure informed choices by both consumers and producers.

The agro-waste textile industry also illustrates the tension between local empowerment and global market integration. For example, Ethiopia's Dorze women craft enset silk, an entirely artisanal product deeply embedded in cultural traditions (Alabaster International, 2023). Their work preserves local heritage and provides direct economic benefits to marginalized women. Unlike Piñatex, which relies on industrialized processes and synthetic coatings for global reach, the Dorze women's approach minimizes environmental impact through low-tech, community-driven methods. However, their small-scale

production limits broader market access, making global competition difficult. Combining the scalability of industrialized processes with the cultural sustainability of local artisans could create a more equitable and environmentally sound agro-waste textile industry, fostering both local empowerment and global participation.

All in all, agro-waste textiles represent an innovative sustainability solution by reusing biomass that would otherwise be discarded, creating economic opportunities for local communities and reducing reliance on external resources. They support localized economies, foster artisanal diversification, and encourage sustainable practices. However, they are not a silver bullet for resolving global challenges such as pollution, resource depletion, and social inequality. Instead, they are part of a broader strategy for building sustainable economies and waste management systems. While their potential to advance national economic sovereignty is promising, they must be viewed within the constraints of entrenched global supply chains, market dynamics, and trade policies.

Conclusion

Prebisch's dependency theory highlights the structural inequalities that perpetuate the environmental and economic exploitation of the Global South, keeping nations like Ethiopia in subordinate roles as raw material suppliers and waste recipients. Agro-waste textiles offer a transformative pathway for resisting these injustices, enabling Ethiopia to shift from

dependency to leadership in sustainable textile production. This shift not only mitigates environmental degradation but also fosters economic sovereignty, cultural reclamation, and global equity. Agro-waste fabrics, such as enset silk, coffee fiber, and mango or pineapple yarn, represent a profound act of resistance and decolonization. By leveraging these resources, Ethiopia can align with SDG 12 (Responsible Consumption and Production), challenge waste and carbon colonialism, and redefine its role in the global economy. These textiles offer biodegradability, renewability, and superior biochemical properties, making them preferable to synthetic materials like polyester.

By utilizing agricultural by-products such as enset, coffee grounds, and fruit peels, Ethiopia can address critical environmental challenges, including water contamination, air pollution, and landfill waste, while simultaneously reducing greenhouse gas emissions. Agro-waste textiles not only advance SDG 12 by encouraging responsible consumption and production but also serve as a tangible resistance to waste and carbon colonialism. Waste colonialism, epitomized by the import of second-hand clothing from the Global North, undermines Ethiopia's textile industry and exacerbates environmental degradation. Agro-waste fabrics provide an affordable, locally produced alternative to imported second-hand clothing, fostering self-reliance and reducing dependency on exploitative global supply chains.

Similarly, carbon colonialism, which shifts the environmental costs of industrial production to nations in the Global South, can be challenged through the adoption of low-emission agro-waste

textiles. These fabrics enable Ethiopia to safeguard its carbon credit reserves, avoiding pollution haven dynamics and positioning the country as an independent leader in sustainable manufacturing and carbon projects. While the path forward involves addressing challenges like resource availability, technological gaps, and market integration, Ethiopia is well-positioned to overcome these barriers through strategic partnerships, policy interventions, and investment in research and development.

Agro-waste textiles are more than a sustainable industrial solution; they represent a bold act of resistance against environmental and economic injustices. Ethiopia can lead this green industrial revolution and inspire other nations in the Global South, redefine its role in the global economy, and create a blueprint for sustainable, self-reliant development.

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