Social Implications of Sustainable Concrete in Haiti

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Haiti is a nation too often at the mercy of its geography. Repeatedly struck by natural disasters such as earthquakes and hurricanes, the country faces a chronic crisis of inadequate infrastructure. In 2010, a catastrophic earthquake killed over 200,000 people and left more than a million homeless. Despite a surge in humanitarian aid and international interest in rebuilding efforts, Haiti continues to struggle with durable, affordable housing solutions. These challenges are compounded by long standing political instability and economic hardship. In recent years, the country has faced persistent government dysfunction, widespread corruption, and a surge in gang violence that has weakened state capacity and displaced thousands. Economically, Haiti remains the poorest country in the Western Hemisphere, with over half the population living below the poverty line and limited access to formal employment or social services. These conditions have undermined reconstruction efforts and eroded public trust in both local and international institutions. While sustainable construction materials like green concrete and 3D printing technologies show promise for cost-effective, disaster-resilient infrastructure, their successful adoption in Haiti has been inconsistent. Why have some efforts to introduce sustainable concrete in Haiti failed, while others have gained traction? What social, political, and economic barriers stand in the way of implementation?

Green concrete, also referred to as sustainable concrete, differs from traditional concrete in that it incorporates recycled or industrial by-product materials such as fly ash, slag, silica fume, or recycled aggregates to reduce its environmental footprint. It produces fewer carbon emissions compared to conventional concrete and often enhances durability and resource efficiency (Sandanayake et al., 2020). Green concrete reduces reliance on virgin materials and

can be tailored to suit various environmental and structural demands, making it an attractive option for disaster-prone regions like Haiti.

In this paper, I will argue that the slow and inconsistent adoption of green concrete in Haiti is not merely a technical or financial issue, but a deeply social one—shaped by a history of distrust in foreign-led development, limited community engagement, and the marginalization of local labor and expertise in reconstruction efforts. Using the Social Construction of Technology (SCOT) framework, I show that the success or failure of sustainable infrastructure initiatives depends on how technologies are interpreted, accepted, and embedded within local practices. This paper begins by outlining the SCOT framework and key literature on technology adoption in post-disaster contexts. It then analyzes several case studies of green concrete initiatives in Haiti, identifying cultural, economic, and institutional barriers. Finally, it discusses how aligning technological innovations with social meanings and community-led approaches can enhance long-term adoption.

Theoretical Framework: Social Construction of Technology (SCOT)

Social Construction of Technology (SCOT) The Social Construction of Technology (SCOT), developed by scholars such as Pinch and Bijker (1984), argues that technological development is not linear or inevitable but is shaped by social groups who interpret and influence it (Pinch & Bijker, 1984). Technologies, according to SCOT, possess what is called interpretive flexibility: different social groups can assign different meanings and values to the same artifact. These interpretations are shaped by Pinch and Bijker (1984) terms technological frames, which include the shared goals, problems, and practices of a group.

A key concept in SCOT is that of relevant social groups, which may include engineers, users, regulators, or communities. In the case of green concrete in Haiti, these groups include local builders, community members, international NGOs, government planners, and outside donors. The process of closure occurs when one interpretation becomes dominant and stabilizes the technology's meaning or use. SCOT thus offers a way to trace how cultural and political dynamics can hinder or help the closure process and why certain technologies may never be fully adopted. For example, Wafai and Aouad (2022) re-interpret construction innovation through SCOT to show that new technologies succeed when they are framed in alignment with local norms and practices. Similarly, Engle (2018) demonstrates how trust and participatory engagement shaped post-disaster rebuilding efforts in Haiti. This paper builds on these insights to analyze why sustainable concrete, despite technical feasibility, has struggled to achieve closure in the Haitian context.

Historical and Case Context: Infrastructure in Crisis

The persistent infrastructure crisis in Haiti's construction sector has been extensively documented in both academic and policy literature. Scholars have emphasized the role of informality, weak institutional oversight, and deep-rooted economic inequality in shaping construction outcomes (Kijewski-Correa & Taflanidis, 2012). Following the 2010 earthquake, numerous international agencies implemented rapid housing solutions, yet much of this aid failed to align with the social, cultural, or technical realities on the ground. Kijewski-Correa and Taflanidis (2012) highlight how top-down housing imports often disregarded local construction practices and builder preferences, resulting in limited acceptance and long-term instability. Existing research also reveals that the informal construction sector, comprising the majority of Haiti's building labor, remains disconnected from formal innovation pipelines (Kijewski-Correa

& Taflanidis, 2012). While NGOs like Build Change, a program that focuses on providing technical assistance, training, and resources to help communities rebuild and retrofit their homes, have introduced earthquake-resilient retrofitting techniques, adoption has remained limited due to gaps in training, lack of cultural congruence, and minimal engagement with traditional building knowledge (International Federation of Red Cross and Red Crescent Societies, 2009). Similarly, USAID's "core house" initiatives and Habitat for Humanity's efforts to deploy concrete block factories faced operational breakdowns rooted in unresolved land tenure issues, material unfamiliarity, and inconsistent local participation (Engle, 2018).

In the broader field of sustainable construction, studies have affirmed the technical promise of green concrete. Reviews by Al-Hamrani et al. (2021), Bbosa (2024), and Sandanayake et al. (2020) demonstrate how incorporating industrial byproducts like fly ash or slag can enhance structural durability while reducing environmental costs. Yet these studies largely remain decontextualized from the political, economic, and cultural barriers that exist in low-income and post-disaster settings. For instance, while such materials may reduce emissions or improve strength on paper, their adoption in Haiti is often hindered by unstable supply chains, insufficient funding, or absence of institutional coordination (Moore & Doyon, 2023). Scholars such as Moore and Doyon (2023) argue that material innovation alone cannot drive sustainable transitions. Instead, success depends on sustained policy alignment, community engagement, and the presence of supportive governance structures, factors frequently missing in Haiti's reconstruction landscape (Marcelin, Cela, & Shultz, 2016). The literature has thus begun to move toward more holistic interpretations of sustainability, but few studies explore in depth how social interpretations, economic feasibility, and political stability jointly determine the uptake of new building technologies.

This paper builds on these foundations but addresses a specific gap: the question of why certain sustainable concrete initiatives in Haiti have gained traction while others have not, remains underexplored, particularly through a sociotechnical lens. By applying the Social Construction of Technology (SCOT) framework, this study extends the discussion beyond technical feasibility and engages with the interpretive flexibility and closure processes that influence whether new materials are adopted, resisted, or reconfigured by relevant social groups. In doing so, it contributes to a more grounded understanding of how innovation in disaster-prone, resource-limited environments can either falter or flourish based on the social meanings attached to technologies.

Methods

This research uses a qualitative case study approach guided by SCOT. The analysis synthesizes academic and technical literature, NGO reports, government documents, and historical media coverage of Haiti's post-disaster reconstruction. A range of case studies from the 2010 earthquake reconstruction period and recent sustainability initiatives have been reviewed, including documentation from USAID, the Clinton Foundation, Build Change, and Habitat for Humanity. Data were gathered from scholarly sources such as the Journal of Construction Innovation and Earth and Environmental Science, as well as policy reviews by the UN Office for Disaster Risk Reduction (UNDRR).

Thematic analysis is used to trace how different relevant social groups such as NGOs, local builders, donors, and government bodies have historically framed the value and purpose of green concrete. The study also incorporates textual analysis of documents that position sustainable building materials within Haitian policy discourse. Additionally, this analysis draws

on quotes and firsthand observations from Jonathan M. Katz's *The Big Truck That Went By: How the World Came to Save Haiti and Left Behind a Disaster* (2014) which provides a ground-level journalistic account of Haiti's post-earthquake reconstruction. Katz's reporting captures the disconnect between international aid efforts and local realities, he notes that "aid was distributed based on visibility, not need," (p.84) and that "there was no mechanism to systematically involve Haitians in deciding what to do with the billions of dollars flowing in their name." These observations highlight how foreign interventions are often overlooked or misunderstood grassroots priorities, sidelining local knowledge and decision-making processes essential for long-term sustainability and application. These narratives help illuminate the lived experiences of affected communities and provide contrast to official accounts. This dual lens helps identify key mismatches between technical possibilities and social interpretations.

Analysis:

Technical Feasibility and the Limits of Innovation

From a purely technical perspective, sustainable concrete is viable for Haiti's needs, but we can't forget that social elements need to be considered. Numerous studies confirm that incorporating recycled materials into concrete can reduce costs and environmental impact while maintaining durability (Sandanayake et al., 2020; Bbosa, 2024). Al-Hamrani et al. (2021) show that green concrete mixes can outperform traditional ones in resilience and environmental sustainability. Experimental applications of 3D printing with eco-concrete have shown promise in reducing labor and material waste—an attractive feature in a country with scarce resources.

However, SCOT reminds us that technical success does not automatically lead to social adoption. Interpretive flexibility means that what engineers see as "innovative" or "efficient,"

local builders may see as "unfamiliar" or even risky. In Haiti, skepticism about non-traditional materials can be high, especially after decades of failed development interventions. Without shared understanding across relevant social groups, innovation remains stalled. Past efforts by foreign firms or donors to introduce new concrete technologies often failed to translate due to communication gaps or an absence of training infrastructure. For example, Haitian masons receiving unfamiliar prefabricated materials sometimes reverted to traditional practices due to perceived fragility or lack of instruction (Kijewski-Correa and Taflanidis 2012).

A further issue involves logistics. Though technically promising, green concrete sometimes requires imported components such as admixtures or stabilizing agents that are difficult to source consistently in Haiti. This disrupts supply chains and undercuts claims of affordability or sustainability. A 2019 review by the International Finance Corporation found that lack of reliable access to sustainable concrete ingredients posed a significant risk to scaling such technologies in Caribbean nations.

Cultural and Economic Barriers to Adoption

Cultural resistance to unfamiliar building materials or methods poses a significant challenge to adoption. Many Haitians prefer traditional masonry techniques, which are seen as tried and trustworthy. As Engle (2018) explains, post-earthquake rebuilding efforts that ignored community preferences often failed to gain traction. The technological frame of local builders and residents emphasizes familiarity, affordability, and hands-on knowledge. Green concrete, especially when tied to high-tech methods like 3D printing, may be interpreted as foreign or unproven.

Economic conditions further complicate adoption. Most of Haiti's construction labor operates in the informal economy, meaning there is little access to training, standardized materials, or regulation (Slapakova et al., 2024). Sustainable concrete technologies often require upfront investment in equipment, training, or new supply chains that informal builders cannot afford. Even if the material is cost-saving in the long run, the lack of immediate capital is a major constraint.

Furthermore, SCOT's notion of closure is useful here: without community buy-in and economic feasibility, the technology cannot stabilize or be seen as a legitimate solution. Instead, it remains one option among many, often overshadowed by cheaper, better-known methods. Informal builders often rely on local supply chains and familiar techniques not only for cost but also for speed and reliability, important when reconstruction is urgent (Kijewski-Correa and Taflanidis 2012).

Political and Institutional Constraints

Weak institutions and inconsistent policy support have undermined sustainable infrastructure efforts. Haiti's government struggles to enforce building codes or to coordinate large-scale construction projects. Regulatory gaps mean that even when better materials are available, there is little incentive, or requirement, for their use (Halicioglu, 2020). In SCOT terms, the relevant social groups that might push for innovation such as government regulators or planning bodies, lack cohesion or authority.

International actors like NGOs or development banks have tried to fill this void, but their efforts often remain fragmented Engle (2018). Moore and Doyon (2023) highlight how sustainable housing transitions succeed only when supported by coherent, long-term strategies

involving multiple stakeholders. In Haiti, projects often start strong but falter without ongoing policy support, reliable funding, or integration into national development plans.

In some cases, political instability has directly disrupted green construction efforts. For instance, following the 2016 Hurricane Matthew disaster, a UNDP initiative to rebuild homes using sustainable methods was halted due to changing leadership in local agencies (Marcelin). Policies promoting sustainability often remain aspirational rather than enforceable. The disconnect between Haiti's National Housing and Habitat Policy and municipal building enforcement illustrates the gap between top-level strategy and implementation on the ground.

Discussion

Sustainable concrete in Haiti is not simply a technical fix, it is a sociotechnical system whose success depends on how different actors interpret and engage with it. While material innovations like green concrete and 3D printing offer measurable environmental and economic benefits, their adoption is mediated by cultural norms, logistical barriers, and institutional weaknesses. SCOT's framework clarifies that failure often stems not from the material itself, but from mismatches in meaning between stakeholders. For example, while engineers may value sustainability and efficiency, local builders prioritize affordability, reliability, and alignment with familiar methods.

These divergent technological frames help explain why past projects have stalled. Without shared understanding or meaningful engagement, sustainable materials remain unfamiliar or even suspect, the SCOT definition of closure remains. Until builders, planners, and policymakers can negotiate shared goals and practices, green concrete will continue to be seen not as a solution, but as a risky alternative to the status quo.

Past initiatives often suffered from insufficient engagement with relevant social groups. As journalist Jonathan Katz (2014) has noted, Haitians were often excluded from critical decisions about how billions in aid were spent—highlighting the disconnect between foreign-led reconstruction and community-led priorities.

But as SCOT emphasizes, technologies do not exist independently of their social meanings. In Haiti, trust in construction practices is built through generations of lived experience, and any new material must prove itself within those frameworks (Engle, 2018). Failure to involve builders, homeowners, and community leaders in the decision-making process can lead to misaligned priorities, as seen in several post-2010 housing interventions.

There are already some encouraging signs. In recent years, smaller NGOs have piloted sustainable construction workshops in Haiti, training masons in alternative concrete mixes and gathering feedback in real time . These grassroots efforts have not only increased technical knowledge but have also begun to reframe sustainable concrete as a tool that empowers local builders rather than replacing them (International Federation of Red Cross and Red Crescent Societies, 2009). This kind of reframing is critical for closure and for shifting the cultural narrative around what counts as trustworthy infrastructure (Wafai and Aouad 2022).

It is also important to briefly consider the opposing argument, that perhaps Haiti should not prioritize novel materials like green concrete when basic construction needs are unmet. This position suggests that conventional, widely available materials offer a more immediate path to rebuilding. Proponents of this view argue that innovations can slow down progress by complicating logistics, requiring new training, or raising costs in the short term. In this view, sustainable concrete may be a distraction from more urgent housing concerns. While this concern

is valid in the context of disaster response, it overlooks the long-term costs of continuing with traditional methods. Conventional concrete is expensive, environmentally damaging, and often poorly suited to Haiti's seismic risks (Kijewski-Correa & Taflanidis, 2012). The high carbon footprint of cement production, combined with weak enforcement of quality standards, means that what is "conventional" is not always what is effective (Ramsden, 2020). Relying on older methods can perpetuate structural inequalities in the construction sector, leaving informal workers with little opportunity to upskill or access new tools.

SCOT offers a middle ground by focusing on negotiation. Rather than choosing between old and new methods, it encourages us to look at how technologies are interpreted and reinterpreted through social engagement. Green concrete will not be adopted simply because it is better; it will be adopted if it fits into the stories that Haitian communities tell about resilience, safety, and self-determination. The work ahead is not only technical but also symbolic to craft a vision of infrastructure that aligns sustainable innovation with cultural meaning and social justice.

Conclusion

Now that you've read the paper, it should be clear that the adoption of low-cost, environmentally friendly concrete in Haiti hinges not only on technical performance but on cultural legitimacy, economic feasibility, and institutional support. Past efforts have shown that even the most advanced materials cannot succeed without alignment across social groups. Using the SCOT framework, this paper has highlighted the importance of interpretive flexibility, relevant social groups, and closure in understanding why green concrete has struggled to gain ground in Haiti.

Yet, the future is not without hope. One area where promise lies is in shifting from top-down implementations to community-led pilot programs that foster co-construction of knowledge. When local builders are involved in the design and testing of green concrete, when they can see its performance, ask questions, and compare it with traditional methods, they become part of the process of meaning-making. This collaborative approach is more likely to generate a technological frame that supports long-term adoption.

Recommendations moving forward include integrating sustainable concrete into community-led rebuilding initiatives, providing targeted financial and training support for informal laborers, and strengthening regulatory frameworks through public-private collaboration. By learning from past efforts and recognizing the social nature of technology we can better align innovation with the realities and priorities of Haitian communities. In doing so, we lay the groundwork for a more resilient, equitable, and sustainable future.

Importantly, the lessons from Haiti are not confined to its borders. Many developing countries face similar challenges: vulnerable populations, informal labor economies, limited regulatory oversight, and donor-driven reconstruction efforts. SCOT provides a valuable framework for analyzing these environments because it foregrounds the social processes that determine technological success or failure. Whether in rural Nepal, post-cyclone Mozambique, or earthquake-affected Turkey, the introduction of sustainable materials must engage the local actors who will ultimately use and maintain the technology.

By focusing on shared meanings, trust-building, and collaborative framing of infrastructure innovations, countries can adapt sustainable technologies to their specific contexts rather than replicating models from abroad. Haiti's experience thus becomes a case study in how

to implement socially inclusive and technically appropriate solutions. This analysis can help international development practitioners, engineers, and policymakers rethink how they approach sustainability, not as a one-size-fits-all technical fix, but as a negotiated, culturally embedded process.

In short, this work underscores that building better infrastructure requires more than new materials. It demands new ways of listening, collaborating, and sharing power. That insight is as relevant in Haiti as it is across the globe.

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