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AI Nudges and Sustainable Choices: A Behavioral Layer to Strengthen ESG with Geospatial Insight

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Abstract

As Environmental, Social, and Governance (ESG) reporting becomes a central pillar of sustainability compliance, there is a growing need to incorporate consumer behaviour into carbon accounting and Monitoring, Reporting, and Verification (MRV) frameworks. This paper explores how AI-driven digital nudges can influence sustainable consumption patterns and generate a behavioural data layer that enhances geospatial ESG systems.

A multi-construct model is applied, combining Perceived Usefulness of AI (PU-AI), Technology Adoption Intent (TAI), and a newly developed Sustainable Consumption Index (SCI). The approach examines how green defaults, tailored recommendations, and gamified prompts can shift user behaviour at scale. The resulting behavioural insights are mapped into spatial ESG dashboards to visualise and validate Scope 3 emission reductions, establish behaviour-linked baselines, and strengthen the credibility of sustainability claims.

The proposed framework bridges behavioural science, artificial intelligence, and geospatial analysis, providing industries with a scalable pathway to integrate demand-side sustainability indicators into broader strategies. By linking consumer actions to spatial environmental data, the model advances the inclusivity, accuracy, and actionability of ESG reporting for both policy and practice.

1. Introduction

Global ESG reporting frameworks increasingly demand robust, verifiable data. While operational data such as energy use or waste management is often well-documented, consumer behavior—especially downstream Scope 3 activities—remains underrepresented. This creates a blind spot: corporate sustainability goals can be derailed if consumers' day-to-day choices do not align with the intended outcomes.

Artificial Intelligence is a domain that gives us a fresh opportunity to fill this gap. The influence can be made by the organizations placing AI-based nudges within the consumer-facing platforms (applicant, web stores, loyalty, etc.) which may lead an individual to act in a specific way though only in a small but tangible way. Such behavioral data can then be geotagged, aggregated and included in the ESG dashboards which can provide a more thorough, real-time picture of sustainability performance. The progress of this conceptual framework, the integration of AI nudges and geospatial analytic is not limited to behavioral modification as such but enables installing sustainability intelligence at the system level, both in organizational and consumer ecology. Utilizing adaptive machine learning algorithms, AI systems have the capability to dynamically generate groups of users based on their responsiveness to sustainable prompts and interrupt context-dependent responses in time, place and intention to make a purchase (Olayinka, 2021). To illustrate one case, in the region of high carbon intensity, special sustainability-related messages, such as low-emission delivery or an environmental incentive of eco-packaging can be extended to consumers, the uptake of which can be traced in near real time both geographically. Moreover, geospatial integration complements the Monitoring, Reporting and Verification (MRV) through the introduction of behavioral layer of conventional environmental reports which is empirical. This allows the organizations to tie the individual consumption behavior to spatial distributed environmental effects and enhances the traceability and credibility ESG discoveries (Singh et al., 2025) on a larger scale.

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By doing that, the suggested framework will shift ESG reporting of a reactive compliance exercise into a proactive, data-based management mechanism. This kind of change is in tandem with the world turning to real time sustainability accounting, where performance indicators are constantly tracked using automated systems without referring to the past reporting periods (Mayegun & Nwanevu, 2025).

Also, using AI-based behavioural insights in combination with geospatial ESG dashboards would offer predictive sustainability modeling. Organizations can detect the emerging threats and opportunities at an early stage by predicting the level of behavioural adoption and the sustainability trends in the region (Al-Emran and Griffy-Brown, 2023). As an illustration, areas where the interest in sustainable consumption programs is on a downwards trend can be indicators of cultural or infrastructural hurdles that need to be addressed by the managers. On the other hand, high adoption areas can be capitalized on as success clusters to transfer the best practices to other areas.

In a larger scope, this integration will help in building behaviourally rich digital twins to help in sustainability management. This can be a digital improvement of consumer-environment relationships in various policy or market conditions and provide decision-makers with valuable information on how behaviour changes may alter the path of emissions or the circular economy objectives (Smith and Khastgir, 2025). This means that organizations do not simply report the sustainability outcomes, but they actively define them with the help of AI-driven behavioural governance.

2. Related Work

2.1 AI in Sustainability

Studies such as (Dwivedi et al., 2023) have highlighted AI's role in optimizing energy systems, supply chain logistics, and environmental monitoring. However, AI's role in influencing and tracking consumer sustainability behavior remains underexplored.

Artificial Intelligence has increasingly become a core enabler of sustainability transformation, capable of addressing global challenges such as carbon emissions, waste management, and resource optimization (Keskar,2022; Chaudhary,2023; Jogarao et al., 2024). With predictive analytics, AI can be applied to reinforce sustainability transformation in production and logistics system spheres, such as carbon emissions and waste management systems, and strategic reduction of emissions (Chen et al., 2024; Hasan et al., 2024). The energy industry is not an exception since with AI algorithms, smart grids are not only efficient but can also be predictive, and manage the energy demand, which directly depends on environmental sustainability (Ojadi et al., 2024; Ukoba et al., 2024).

Besides, AI-based natural language processing platforms are also used in automated ESG reporting and sentiment analysis, which offers an enhanced level of transparency and accountability (Rane et al., 2024; Majekodunmi, 2025). However, in addition to operational efficiency, the emerging volume of the literature is addressing the behavioural component of AI, i.e. the ways in which smarter systems could encourage, measure and monitor consumer behavioural patterns, which influence sustainability outcomes (Majekodunmi, 2025; Onel et al., 2025).

The insights are especially important to take into consideration downstream Scope 3 emissions when consumers choices like delivery methods, use of products, and recycling behaviour have a huge impact on the performance of the sustainability in general. Hence, the present research brings the previous AI-sustainability literature to its edge, where AI nudges can be seen as a behavioral interface between corporate ESG systems and end-user consumption, which creates a deeper data layer to be observed and monitored in terms of sustainability. This feature will raise the count of supporters as well as the customer base (Bocken and Allwood, 2012; Li et al., 2019; Borchardt et al., 2025).

2.2 Digital Nudges and Behavioral Change

(Thaler and Sunstein's, 2008; Chan & Qin ,2017) concept of nudging, later expanded in digital contexts, has shown that interface design, choice framing, and gamification can shift behaviour without coercion. When powered by AI, nudges can be personalized, adaptive, and context aware.

Digital nudging is the art of digital interfaces being strategically designed to influence the desired behaviours of users by altering the environment in which they make decisions instead of limiting choice (Weinmann et al., 2016; Mirsch et al., 2017). Such interventions tend to use either default options, feedback or framing effects to make sustainable decisions easier or more attractive. (Mont et al., 2014; Mertens et al., 2022). In combination with AI-driven personalization, nudges can be tailored to the preferences, demographics, or the situation of the users in real-time (Sadeghian and Otarkhani, 2024; Mohammadian, 2024; Rakhmanovich et al., 2025).

For Instance, AI-based recommendation systems in e-commerce can prioritize goods with less-carbon footprint or display greener delivery options, which is effectively a combination of behavioral economics and machine learning (deploying AI) to encourage environmental choices (Silalahi, 2024; Mahajan et al., 2025; Sadeghi Foroushani, 2025). Furthermore, digital nudges may be gamified where consumers gain points, badges, or social reward because of sustainable behavior, providing the added benefit of engagement and motivation (Lin et al., 2022; Matta et al., 2025; Wittayakom et al., 2025) as well.

2.3 Geospatial Data in ESG Reporting

Geospatial analytics is increasingly used for environmental monitoring, from land-use mapping to carbon accounting. Advances in photogrammetric computer vision have significantly improved the accuracy and automation of geospatial data processing, enabling more detailed environmental monitoring (Forstner & Wrobel, 2016). However, most ESG geospatial datasets focus on physical assets rather than consumer activity, creating a data gap that this study addresses.

Environmental management has undergone a revolution due to recent developments in remote sensing, satellite imaging, and GIS (Geographic Information Systems), which have become the means to track deforestation, pollution, and land-use change in a much more granular manner than ever before (Rai et al., 2024; Mishra et al., 2025; Ndubuisi and FNisafetyE, 2025). Geospatial technologies have become part of the monitoring of carbon emissions, supply chain risks, and even biodiversity impacts in the corporate ESG arena (Leogrande, 2024; Vaiyapuri and Julie, 2025). These data layers will add transparency and verifiability, responding to the increasing stakeholder demand to have evidence-based sustainability reporting (Mayegun & Nwanevu, 2025; Koskinen, 2025).

Although these progresses have been made, there is still a gap in research and practice in integrating behavioural data to geospatial ESG systems. One of the possible solutions to this challenge is the incorporation of geotagged behavioural data, because of AI-based nudges, which allows organisations the ability to map and authenticate consumer behaviour in the context of sustainability at the spatial level. This is a hybrid solution that will improve Monitoring, Reporting and Verification (MRV) systems, linking consumer choices and local environmental effects, thereby increasing the traceability and provability of ESG performance claims.

3. Methodology

3.1 Conceptual Framework

The proposed approach involves three constructs:

1. **Perceived Usefulness of AI Nudges (PU-AI)** – The degree to which consumers see value in AI-generated sustainability prompts.

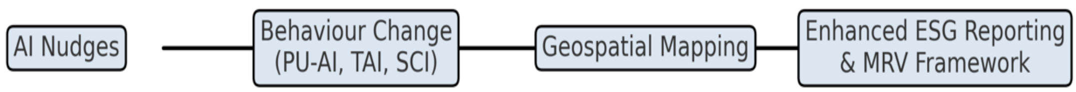
2. **Technology-Assisted Influence (TAI)** – The personalization and timing of nudges to maximize behavioural adoption.

3. **Sustainable Consumption Impact (SCI)** – The measurable effect of behaviour changes on ESG indicators, especially Scope 3 emissions.

3.2 Process Flow

1. AI nudges are deployed on digital consumer touchpoints (apps, e-commerce platforms).

2. Behavioural responses are recorded and geotagged (e.g., choice of low-carbon delivery, opting for recycled packaging).



3. Data is integrated into ESG MRV dashboards alongside operational metrics.

4. Geospatial visualization enables hotspot detection for targeted interventions. One challenge in integrating behavioral and geospatial data is the risk of classification errors when outdated or noisy spatial datasets are used, as noted in remote sensing literature (Maas et al.,2017).

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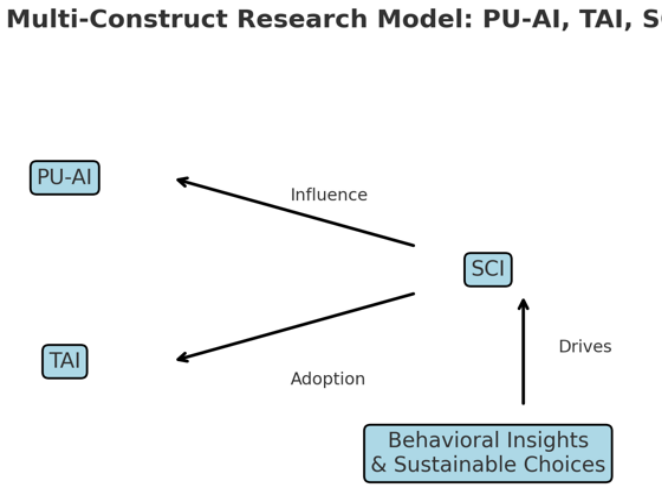

4. Hypothetical Implementation Scenario

A multinational retail chain seeks to improve its ESG scores, particularly in Scope 3 emissions from customer product use and delivery. The company integrates AI nudges into its mobile shopping app:

Green Defaults: Eco-friendly delivery is priorly selected at checkout. The system can play with the behavioural inertia by ensuring that the low-carbon delivery option becomes a default one; consumers tend to remain with the option that is pre-selected, instead of being active and choosing a less sustainable one. In the long run, such default nudge results in massive cumulative cuts in transportation related emissions.

Gamified Challenges: Customers earn points for choosing recycled packaging three times in a row. The use of gamification can make sustainable actions more engaging by turning them into reward-driven behaviors (Lim et al., 2025; Wittayakom et al., 2025). Immediate feedback and gradual rewards encourage customers to participate and become satisfied (Keh and Lee, 2006; Elwakeel et al., 2025). This design transforms abstract sustainability objectives into realizations, which motivates the users to act in a consistent manner towards being green.

Smart Tips: AI suggests lower-carbon alternatives based on purchase history. Smart Tips uses recommendation systems that are based on machine learning to review what they had previously purchased and propose a more environmentally friendly alternative that has a reduced lifecycle impact. Context-aware, these pieces of advice are changed according to the seasonal demand, the availability of the area, and the price sensitivity of the consumer (Biancalana et al., 2013; Rayarao and Donikena, 2025). The feature makes sustainable decisions appear equally convenient and advantageous by establishing the notion of a sustainable choice as one that is both convenient and advantageous.

Over a hypothetical 12-month period, the AI nudge system logs:

- **24%** increase in green delivery adoption.
- **18%** shift towards recycled packaging.
- Regional heatmaps showing higher sustainable adoption in urban Tier-1 zones versus rural markets.

5. Hypothetical Results and Discussion

It indicates that AI nudge integrations in the consumer platforms can bring about recordable sustainability benefits. Although total decreases in Scope 3 emissions must be carefully analysed at the lifecycle level, based on the hypothetical situation, any percentage shifts in consumer behavior, when applied on an aggregate of millions of transaction cases, can cause meaningful changes to the ESG indicators.

Geospatially, there are differences between adoption patterns depending on the region, and thereby, a company can design interventions to suit those differences. This then adds to the credibility of MRV and ties the benefits on record to measurable behavioral data so that there is less chance of being accused of greenwashing.

Furthermore, combining AI-driven behavioral data and geospatial ESG dashboards offer organizations a 5continuous feedback loop, which allows tracking the sustainability performance in near-real time (Ahuja, 2023). This establishes a dynamic connection in the context of consumer macro-behavior, like packaging or delivery preferences or product choices, with macro-level ESG indicators, which increase transparency and accountability (Mayegun & Nwanevu,2025; George, 2024). Spatial representation of trends in behavior helps also in identifying gaps in sustainability in regions and thus enables companies to roll-out the specific awareness campaigns or the localized incentive programs in the low-performing regions.

In addition, the scalability of AI-based nudges enables companies to view the environmental impact that altering behavior may cause in the future and optimize the efficiency of sustainability planning (Wazi et al., 2025; Mhlanga, 2025). The process of quantifying the cumulative effect of incremental consumer decisions on any given piece to a quantifiable change in emissions can help businesses to better align their marketing, logistic and corporate reporting practices with evidence-based sustainability results. This does not only enhance the robustness of MRV system strength but also gives the stakeholders more confidence to ESG disclosures by showing actual quantified improvement as opposed to a wishful and dreamy statement.

6. Conclusion

The combination of AI-driven nudges into ESG MRV systems provide a good avenue to close the gap between the corporate goals of sustainability and real consumer reactions. With the introduction of a behavioral overlay to geospatial ESG analytics, the organization can record a deeper data sample, act more specifically and draw up more convincing reports. The next round of research work is on field-tested work, information privacy issues, and cross-sector with scalability.

Moreover, incorporating behavioral and spatial intelligence in ESG measurement systems is a paradigm of change between reporting in place and active sustainability management (Karthik et al., 2025; Mayegun and Nwanevu, 2025). With AI algorithms constantly reviewing the interaction with the consumers, organizations will be able to recognize new behavioral patterns and act on them instead of adapting to them (Abdullah et al., 2024; Van Chau & He, 2024; Radhakrishnan, 2023). The latter comes to get lodged in the psyche of individuals and gains access to their social life by first stabilizing itself as a factual concept, but later the mind is flooded with pernicious beliefs and propaganda. This does not only enhance monitoring precision but also participatory sustainability which makes the consumer an active actor who provides data to influence corporate ESG outcomes (Salamzadeh et al., 2025)

Moreover, the empirical investigation may be pursued in the future about the potential of using behavioral AI models when used with geospatial analytics to enhance predictive forecasting of sustainability indicators in an industry. As an example, AI nudges combining with carbon accounting technologies could enable companies to model the environmental impact of consumer choices on a large scale, increasing the accuracy of estimation of the Scope 3 emissions. The other prospective field is cross-sectoral applications like smart cities, mobility services and agriculture where AI systems that face the consumer might be used to inform both the public policy and individual sustainability plans.

Finally, researchers will need to tackle ethical or governance issues in digital sustainability ecosystems related to algorithmic transparency, consent management as well as responsible data sharing (Pappas et al., 2023; Gursoy et al., 2025; Yamuna and Madhuvarsini, 2025). The AI-related ESG verification should create international norms aimed at preventing technological innovation to serve as the instrument to make sure that the corporate social and environmental integrity are inherent and robust enough to raise the validity and status of corporate sustainability statements.

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