Research on the Application of Environmental Policy based on Nudge Theory

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Abstract: This paper investigates the application of nudge theory in environmental policy, focusing on its effectiveness, limitations, and ethical controversies. Through a review of behavioral policy literature, this study determines five core ethical concerns: Autonomy and Manipulation, Transparency and Democratic Legitimacy, Context-Dependency and Cross-Cultural Validity, Limited Long-term Effectiveness, and Fairness and Distributive Justice. In return to these concerns, this paper constructs a governance framework for the five pillars of green nudging: Initiative Enhancement Design, Transparency and Explainability, Cultural Adaptability, Long-term Effectiveness Assurance, and Fairness and Distributive Justice. This paper conducts a literature based conceptual review and the framework is based on empirical evidence from diverse geographical contexts. A set of tools that are both theoretically grounded and practical are provided in this study for policymakers, enabling them to use methods of behavioral insights to promote environmental sustainability without violating ethical responsibilities.

Keywords: Green Nudges, Behavioral Public Policy; Ethical Governance; Environmental Policy; Five-Pillar Framework

1. Introduction

From climate change and biodiversity loss to resource depletion and plastic pollution, environmental protection has become one of the most pressing challenges that governments are facing all over the world. Although public awareness of these environmental crises has been increasing, there remains a gap between citizens' environmental attitudes and their factual behavior [1]. This gap between attitude and behavior poses a enormous challenge to policymakers who attempt to achieve environmental goals through traditional tools such as regulations, taxes, and subsidies. To solve this gap, policymakers and various organizations are increasingly utilizing insights from behavioral science to explore new methods of influencing decisions through psychological mechanisms [2]. Nudge is one such method, which can guide individuals choosing more environmentally friendly behaviors without restricting their freedom of choice or relying on economic incentives. Nudge is defined in economics as a change in the decision environment that influences people's behavior without prohibiting any choices or significantly changing the financial incentives [2]. It argues that we influence these unconscious behaviors by altering how the choices are framed [1].

This paper synthesizes the growing body of literature on green nudges by addressing three core questions: First, what is the current status of the application of nudge theory in environmental policy? Second, what empirical evidence exists regarding the effectiveness and limitations of these interventions? Third, what are the main ethical controversies surrounding the use of nudges as policy tools, and what are the mitigation measures? Through the discussion of these issues, to provide researchers and policymakers with clear knowledge graphs and current research progress, meanwhile, survey the effectiveness of nudge theory and its ethical boundaries. This will help policy makers make more posted decisions and set the direction for future research in behavioral environmental economics.

The rest of this article is arranged below. The second part is a literature review, which mainly focuses on the application and development of nudge theory in environmental policy. It summarizes the main points and research shortcomings of each stage. The third part is the methodological part, which proposes a five-pillar governance framework for green nudging based on the five core ethical concerns in the literature, namely autonomy and manipulation, transparency and democratic legitimacy,

situational dependence and cross-cultural validity, limited long-term effectiveness, and fairness and distributive justice. The fourth part is the conclusion part, which summarizes the structure and contribution of the framework. It also points out its limitations and proposes future research directions.

2. Literature Review

The application and development of nudge theory in environmental policy can be divided into three stages: theoretical foundation construction stage, empirical research extension stage, and critical and reflective stage.

2.1 Theoretical Foundation Construction Stage

The formal origins of nudge theory can be traced back to the seminal book of Thaler and Sunstein "*Nudge: Improving decisions about health, wealth, and happiness",* which introduced the concept of "choice architecture", and laid the theoretical foundation for applying behavioral insights to public policy [3]. They proposed that humans are not fully "rational economic agent" but "social beings" prone to cognitive biases. By changing the way options are presented, people can be encouraged to make better decisions without restricting their freedom of choice. Building on this theory, J. Shogren and Laura O. Taylor explore the intersection of behavioral economics and environmental policy in their research "*On Behavioral-Environmental Economics*" [4]. Traditional environmental and resource economics uses rational choice theory to guide the evaluation of alternative policy options and correct market failures. However, behavioral economics challenges this conventional thinking by showing that people often make choices and values that deviate from rational assumptions. In the same period, Tversky and Kahneman's work on loss aversion also gained attention. The insight that "losses loom larger than gains" become a cornerstone of designing effective environmental messaging, such as describe energy conservation as "avoid loss" rather than "gain" [5].

2.2 Empirical Research Extension Stage

At this stage, empirical research on driving interventions has proliferated across various environmental sectors. For example, in Allcott's study of the OPOWER project, providing households with energy consumption reports compared to neighbors showed a reduction in energy consumption of about 2%, suggesting that nudge theory can also work effectively outside the laboratory and apply to large populations [6]. Similarly, Pichert and Katsikopoulos' experiments on green default options have shown that simply changing the default option, such as automatically registering customers as green electricity users, can significantly increase the adoption of renewable energy [7]. Building on this, Arvai et al. further expanded the scope of environmental nudges from the energy and waste sectors to consumption behaviors with a significant carbon footprint, and their research showed that menu design and default options have a significant impact on consumers' vegetarian choices [8].

2.3 Critical and Reflective Stage

The characteristic of this stage is an increasing focus on the limitations, ethical dimensions, and context-dependency of green nudging. Carlsson and Johansson-Stenman conducted an investigation into the impact of behavioral economics for environmental policy, emphasizing that while behavioral interventions can supplement traditional tools, they are not a panacea and must be carefully designed according to specific context [9]. Correspondingly, Shogren examined the relationship between behavioral economics and environmental policy, the metaphor of "money pump and nudging" was used to distinguish different types of interventions, highlighting the importance of understanding when to use nudging and when more traditional economic tools are needed [10]. Meanwhile, Sunstein's book conducted a more comprehensive philosophical examination of nudging. He delved deeply into issues of manipulation, autonomy, and democratic legitimacy [11]. Building on this, a comprehensive review covering the years 2008 to 2024, further analyzing the evolution and application of nudging strategies in different fields. The review points out that while nudging interventions have potential, cross-cultural research is still lacking to test how different cultural background affect the validity of interventions, and longitudinal tracking studies of nudging strategies remain scarce [12].

Based on the existing research, nudging theory has established a relatively mature theoretical foundation in the field of environmental policy,

and has accumulated rich empirical evidence in many aspects such as energy conservation, green consumption, and resource recycling, proving its effectiveness in guiding individual behavior. However, there are still shortcomings in the actual research. The ethical review of nudging is relatively lagging behind, and there is a lack of systematic discussion of its legality boundaries [13,14,16]. Moreover, most studies focus on short-term effects in a single context, and lack of attention to cross-cultural applicability and long-term sustainability [12,15,17]. Furthermore, the differentiated impact of nudging on different social groups has not been fully emphasized [15]. In response to these above shortcomings, this paper will propose an integrated five-pillar governance framework, aiming to provide theoretical basis and practical guidance for the use of booster tools.

3. Framework Construction: Green Nudge Five-Pillar Theoretical Framework

Based on the growing public policy literature on environmental protection, this section proposes a governance framework covering five comprehensive safeguards aimed at alleviating the research limitations and ethical controversies mentioned above, presented in the form of narratives and visual charts to enhance clarity and practicality. The five-pillar governance framework constructed in this study is shown in Table 1, each equipped with clear operational safeguards and empirical cases to support its feasibility.

Table 1. Overview of the Five Pillar Governance Framework

Pillar	Core principles	Operational recommendations	Ethical concerns in response	Empirical cases
Pillar 1	Initiative Enhancement Design	Nudge+ / Boosts / Debiasing	Autonomy and Manipulation	Online food ordering experiment [18]
Pillar 2	Transparency and Explainability	Publish a nudge impact statement/ Test data fully disclosed	Transparency and Democratic Legitimacy	UK BIT Annual Report [19,20,21]
Pillar 3	Cultural Adaptability	Cross-cultural validation / Localization design	Context-Dependency and Cross-Cultural Validity	Pakistan cricket nudge [22]
Pillar 4	Long-term Effectiveness Assurance	Vertical evaluation / Post-removal tracking	Limited Long-term Effectiveness	Eleme two years tracking [24] Simulated takeaway experiments [25]
Pillar 5	Fairness and Distributive Justice	Fair Impact Assessment / Independent Supervision	Fairness and Distributive Justice	Swiss green electricity default experiment[26] Italian commuting choices study [27]

3.1 Pillar 1: Initiative Enhancement Design

The first pillar addresses concerns about autonomy and manipulation by integrating emerging proactivity-enhancing behavioral frameworks. Banerjee et al. (2024) argued that behavioral public policies that enhance agency can alleviate both ethical and efficacy limitations, leading to more lasting and meaningful behavioral change [14]. They outlined three complementary approaches: Nudge+ enables citizens to think together with nudges and evaluate them transparently; Boosts empowers people by building skills; Debiasing reduces automatic impulse reactions through awareness and training [14]. An experiment on an online food ordering platform found that the “Nudge+” method, which asked participants to think ahead about whether they would like to choose a sustainable diet, increased the effectiveness of nudges by 40% compared to the default option nudge alone [18].

3.2 Pillar 2: Transparency and Explainability

The Pillar 2 operationalizes transparency as a legitimacy mechanism. The European Legal Institute's Good Green Nudging Framework (2020) establishes transparency and interpretability as guiding principles [16]. All government-implemented green nudges should be registered in a publicly accessible database. The Nudge Impact Statement should be published prior to implementation and subject to public review and expert review. Since its inception in 2010, the UK Behavioural Insights Team has published an annual report detailing the interventions, methods and effectiveness evaluations it has carried out. Multiple publicly

disclosed cases are shown in Table 2.

Table 2. Transparency and Explainability Cases

Interventions	Disclosed content	Effect
Reduced food waste in hotel restaurants [19]	Posters and signage encourage customers to avoid waste; Smaller plates and meals are available; Use a transparent trash bin	Food waste has been reduced by 44%, without affecting customer satisfaction
Repairability index test in France [20]	Implement the "repairability index" to help consumers identify products that are easy to repair and guide consumers to choose repairable products rather than direct replacement	Promote sustainable consumption behavior and raise consumer awareness of product repairability
Household electricity peak demand response [21]	In partnership with Australian energy supplier Powershop, send SMS reminders to customers who have automatically opted out during peak electricity usage periods, informing them that it is currently peak time and encouraging them to reduce electricity consumption.	Peak-hour electricity consumption decreased by 13.8%

3.3 Pillar 3: Cultural Adaptability

The third pillar responds to the gaps in cross-cultural research identified by Amiri et al. (2024) [12]. Policymakers should localize nudge designs through pilot testing and emphasize context-specific frameworks rather than one-size-fits-all solutions. A study published in the journal Springer conducted an eight-week intervention experiment at a university coffee shop with 9,000 students in Lahore, Pakistan. The researchers tapped into the deep cricket culture between Pakistan and India, the most influential sport in South Asia. The matches between the two countries often inspire a strong sense of national identity. Participants need to choose between a reusable cup (for Team Pakistan) and a disposable cup (for Team India). Daily match results are recorded and displayed in public areas. This created a constant competitive atmosphere. The intervention resulted in an average increase of 39.46 daily reusable cups, a threefold increase in baseline use, and a 27.77 daily reduction in plastic cups, a decrease compared to the control group. These findings suggest that the nudges based on community identity and cultural context can be effective in promoting sustainable practices [22].

3.4 Pillar 4: Long-Term Effectiveness Assurance

The Pillar 4 responds to the lack of longitudinal research highlighted by Amiri et al. [12] and de Costa et al. [15]. Some scholars believe that nudge only produces short-term effects due to its reliance on automatic cognitive processes [23]. However, longitudinal studies by some scholars reveal a more complex situation. He et al. (2023) partnered with Alibaba's online food ordering platform Eleme, China's second-largest food delivery company, to track its default nudge for two years in the customer checkout interface with the default setting of "no cutlery". As shown in Figure 1, they found that although the effect reduced slightly after the first few months, it was still significantly higher than the baseline level throughout the study period [24].

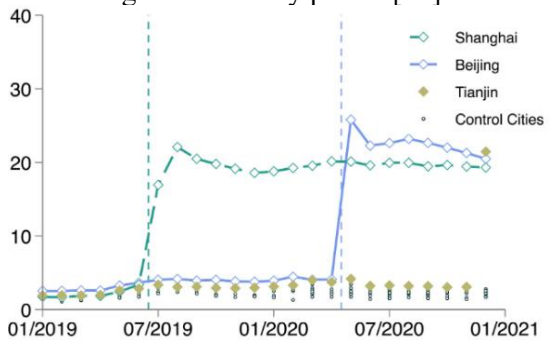

Figure 1. Share of "No Cutlery" Orders [26]

However, Hess et al. (2025) warned that in simulated takeaway experiments, when the selection architecture was removed, the effect of nudge completely disappeared because it failed to enhance consumers' sense of responsibility [25].These findings suggest that green nudges should be subject to mandatory longitudinal assessments, followed at appropriate time intervals such as 6 months, 1 year, and 2 years, and followed up after withdrawal, while periodically adjusting based on attenuation evidence.

3.5 Pillar 5: Fairness and Distributive Justice

The Pillar 5 responds to the call by de Costa et al. for research on socio-demographic factors, focusing on the fairness impacts of green nudging [15]. The same nudge has significantly

differentiated effects on groups of different incomes, genders and educational attainments. A field study on the green electricity default option in Switzerland found that while effectively reducing carbon emissions, it caused low-income households to pay more for their electricity consumption than they would like, while high-income households were not fully satisfied to pay for green electricity [26]. An Italian study of commuting choices found gender heterogeneity: female commuters were more reluctant than men to give up their private cars when faced with carbon footprint information boosts, which researchers believe may be related to different travel patterns, safety concerns, and lower social expectations [27].

In light of these examples, this framework argues that green nudges should be implemented with equity impact assessments covering income, education, gender, etc., including targeted adjustments for vulnerable populations, and independent oversight mechanisms to ensure continued equity.

4. Conclusion

In response to the main concerns, this study proposes a five-pillar governance framework that systematically integrates the limitations and ethical issues scattered in the literature into five core concerns, corresponding to each pillar, and equipped with corresponding practical safeguards. As climate change intensifies, governments increasingly rely on behavioral approaches, and frameworks that balance effectiveness, democratic accountability, cultural sensitivity, long-term sustainability, and distributive equity are essential for maintaining public trust and achieving sustainable outcomes. This framework can help policymakers quickly identify the ethical risks that specific green nudges may face and take targeted governance measures. Policymakers can use behavioral insights to drive environmental sustainability without violating ethical responsibilities.

Although this study has the above contributions, several limitations need to be acknowledged. The empirical basis of the framework relies on secondary literature and the strength of evidence in each pillar is uneven. The framework focuses on governance mechanisms of “pre-design” and “post-evaluation”, but does not involve institutional arrangements for “in-process supervision” and “accountability for violations”. How can policy implementers ensure compliance with framework requirements? What kind of accountability should be held for green nudges that violate the framework? These questions need to be supplemented by future research.

Based on the above limitations, future research can be carried out in multiple directions. Explore the mechanisms of association between the five pillars, identify possible synergies, and weigh them. This can help policymakers make more deliberate choices rather than mechanically applying one uniform standards. The value of the theoretical framework must ultimately be based on practical application. Future research should further explore how to institutionalize the five-pillar framework and truly integrate it into the existing policy-making process and administrative oversight system. Only by translating the principles into actionable and accountable institutional arrangements can the five-pillar framework move from academic conception to policy reality.

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