



Green Household Budgeting and Low-Carbon Consumption

Prof. Bhagwan Chowdhry

Professor, Indian School of Business (ISB), India

Abstract

Household consumption is a significant component of consumption-based greenhouse gas emissions, yet climate-oriented household interventions often focus on isolated behavioral actions rather than the recurring financial decisions through which consumption is organized. Green household budgeting offers an alternative perspective by integrating environmental considerations into routine decisions concerning energy, mobility, food, durable goods, waste, services, and discretionary expenditure. This study develops a simulation-based framework for examining whether systematic environmental budgeting may strengthen low-carbon consumption behavior. Because no verified household survey dataset was supplied, the article does not present hypothetical observations as empirical findings.

A reproducible analytical corpus of 120 simulated households was constructed using four dimensions: Green Budgeting Intensity, Environmental Literacy, Affordability and Access, and Low-Carbon Consumption. Households were classified into limited, emerging, established, and integrated green-budgeting stages. The simulated results produced a Pearson correlation of $r = 0.774$ between Green Budgeting Intensity and Low-Carbon Consumption. Mean Low-Carbon Consumption Index values increased progressively from 50.4 among limited green budgeters to 74.3 among integrated green budgeters.

The findings illustrate that environmentally informed budgeting may provide a practical bridge between climate awareness and repetitive purchasing decisions by making environmental priorities visible within household resource allocation. However, green budgeting should not be understood as transferring climate responsibility exclusively to consumers. Household choices remain conditioned by income, prices, infrastructure, product availability, housing circumstances, public transportation, and broader production systems. The study proposes a household-level framework that combines expenditure planning, carbon-sensitive consumption categories, affordability safeguards, behavioral feedback, and periodic budget review. Green budgeting is consequently conceptualized as a financial-behavioral mechanism capable of supporting lower-carbon lifestyles while preserving household financial stability and consumption equity.

Keywords: green household budgeting; low-carbon consumption; household carbon footprint; sustainable consumption; environmental behavior; household expenditure; climate mitigation; green finance; consumption planning.

1. Introduction

Household consumption occupies a central position in the relationship between economic activity and environmental pressure. Hertwich and Peters' global consumption-based analysis estimated that household consumption accounted for a substantial majority of greenhouse gas emissions when emissions embodied throughout supply chains were attributed to final demand. Subsequent work by Ivanova and colleagues similarly demonstrated that household consumption creates substantial greenhouse gas, material, land, and water pressures across national economies. These findings indicate that residential energy use alone provides an incomplete representation of the environmental consequences associated with household lifestyles because emissions are also embodied in food, mobility, housing, products, and services.

Households nevertheless do not make environmental decisions in an abstract ecological environment. Consumption choices occur through budgets. Income is allocated repeatedly among housing, electricity, transportation, food, clothing, communication, health, education, leisure, household goods, savings, and other needs. The OECD's work on greening household behavior showed that environmental choices are shaped by factors including relative prices, household characteristics, policy conditions, information, and the availability of environmentally preferable alternatives. The OECD surveys specifically examined energy, water, transportation, food, waste, and recycling, demonstrating that household environmental behavior is distributed across multiple domains rather than confined to a single consumption category.

Research in environmental psychology further shows why favorable environmental attitudes cannot automatically be equated with environmentally preferable behavior. Steg and Vlek emphasized that behavioral interventions require identification of environmentally significant behaviors, analysis of their underlying determinants, appropriate interventions, and evaluation of behavioral effects. Dietz and colleagues likewise demonstrated that household behavioral actions can contribute materially to emissions reduction when technically feasible actions are implemented at sufficient scale. These contributions suggest that effective household mitigation requires mechanisms capable of transforming environmental intention into routine decisions.

Green household budgeting is conceptualized in this study as one such mechanism. Rather than simply asking individuals to "consume sustainably," a green budget incorporates environmental considerations into normal financial planning. A household might establish electricity-consumption targets, allocate funds toward public transportation or efficient appliances, prioritize lower-carbon food options where affordable, extend the useful life of durable products, reduce avoidable waste, and reserve expenditure for efficiency improvements that lower subsequent operating costs. The approach therefore connects environmental behavior with the recurring financial architecture through which household consumption actually occurs. This framing is particularly relevant because Dubois and colleagues concluded that household consumption and behavioral decisions are important components of low-carbon transition strategies, while also emphasizing that effective mitigation must consider different consumption domains and structural conditions.

The present study examines Green Household Budgeting and Low-Carbon Consumption through a simulation-based analytical framework. The research does not claim that household budgeting alone can resolve climate change or that consumers should carry responsibility that properly belongs to

governments and producers. UNEP's 2020 emissions assessment emphasized the need for substantial economy-wide transformation, while consumption-based evidence also shows important inequalities in household carbon footprints. The study instead investigates whether incorporating environmental considerations into household financial planning may help households make recurring consumption choices more consistent with their environmental intentions while explicitly recognizing affordability, access, and structural constraints.

2. Objectives of the Study

2.1 To Conceptualize Green Budgeting as a Household Decision Mechanism

The first objective is to develop a clear conceptual interpretation of green household budgeting. Conventional household budgeting primarily seeks to coordinate income, essential expenditure, discretionary consumption, savings, and financial resilience. A green budget extends this process by adding an environmental criterion to expenditure decisions. The resulting question is not merely whether a purchase is affordable but whether an available alternative can satisfy the same household requirement with lower environmental pressure while remaining financially and practically reasonable.

This approach is consistent with research showing that household environmental impacts arise across multiple consumption categories. Ivanova and colleagues evaluated the environmental consequences of household consumption across numerous categories, while OECD household-behavior research concentrated specifically on major environmental domains such as energy, food, transportation, waste, and water. Green budgeting therefore provides an organizing mechanism through which these otherwise separate domains can be considered within a unified household financial plan.

2.2 To Examine the Association Between Green Budgeting and Low-Carbon Consumption

The second objective is to examine whether greater intensity of green budgeting is associated with stronger low-carbon consumption within a controlled simulation. Low-carbon consumption is interpreted as a multidimensional pattern rather than a single action. It may involve conserving energy, selecting lower-impact mobility, reducing unnecessary purchases, extending product life, decreasing food waste, selecting lower-carbon consumption options where feasible, and avoiding expenditure that creates limited household value but substantial environmental impact.

Behavioral research demonstrates that households can undertake actions capable of reducing emissions, but adoption is influenced by behavioral, economic, technical, and contextual conditions. Dietz and colleagues identified meaningful emissions-reduction potential from household behavioral actions in the United States, while Dubois and colleagues examined a broader portfolio of household consumption and behavioral options relevant to low-carbon futures. The present analysis investigates whether a budgeting framework could provide the organizational discipline required to make such behaviors more persistent.

2.3 To Identify Affordability and Equity Conditions for Green Consumption

The third objective is to avoid interpreting sustainable consumption as a simple matter of individual willingness. Household environmental choices are constrained by disposable income, relative prices, rental or homeownership status, transportation infrastructure, appliance availability, urban form, product

accessibility, family size, and other contextual conditions. OECD evidence has shown that price signals and policy environments influence environmental household behavior, meaning that households cannot be analyzed independently of the systems within which they consume.

This consideration is particularly important for lower-income households. Green budgeting should not become an expectation that financially constrained households purchase premium-priced products simply because they carry an environmental label. A defensible framework must distinguish between reducing unnecessary high-carbon consumption, investing in cost-saving efficiency, and shifting essential expenditure toward alternatives that could increase financial hardship. The present study therefore incorporates an Affordability and Access variable into its simulation rather than representing green consumption as the direct consequence of environmental concern alone.

3. Review of Literature

3.1 Household Consumption and Carbon Footprints

Hertwich and Peters provided one of the foundational global analyses of consumption-based carbon footprints by tracing greenhouse gas emissions through international production and trade systems to final consumption. Their analysis estimated that household consumption accounted for approximately 72% of global greenhouse gas emissions under the consumption-based framework used in the study. The contribution was important because it shifted attention from the geographical location of production toward the consumption ultimately driving economic activity.

Ivanova and colleagues extended this type of analysis by examining multiple environmental pressures associated with household consumption using a multiregional input-output framework. Their 2016 study assessed greenhouse gas emissions alongside land, material, and water pressures, demonstrating that the environmental significance of household consumption extends beyond direct fuel and electricity use. This finding is especially relevant to green budgeting because a household may reduce direct electricity consumption while continuing to generate substantial embodied emissions through mobility, food, manufactured goods, or other expenditure categories.

Research has also demonstrated substantial heterogeneity in household carbon footprints. Ivanova's 2020 analysis of European households identified pronounced inequalities in consumption footprints within and across countries and socioeconomic groups. Such differences caution against prescribing identical consumption targets to households with substantially different income, housing, mobility requirements, household composition, or baseline consumption. Green budgeting consequently requires a proportional and context-sensitive design.

3.2 Environmental Behavior, Prices, and Household Decision Making

Steg and Vlek's integrative review of pro-environmental behavior emphasized that environmental interventions should begin by identifying behaviors with meaningful environmental consequences and the factors influencing those behaviors. Their framework distinguishes between diagnosing behavioral determinants and selecting appropriate interventions, making it particularly suitable for household budgeting research. A household budget can function as a recurring intervention because it requires priorities to be revisited whenever expenditure decisions are made.

Dietz and colleagues investigated household actions that could provide relatively rapid reductions in carbon emissions without assuming revolutionary technological change. Their work demonstrated that behavioral implementation of available technologies and practices could create a meaningful emissions-reduction contribution. This suggests that household climate policy should not be restricted to information provision. Households may understand that energy or fuel conservation is desirable while failing to integrate that understanding into recurring purchasing routines.

The OECD's household behavior research offers further insight into the role of economic signals. Its surveys examined how prices, household characteristics, environmental attitudes, information, and policy conditions relate to choices concerning energy, water, transportation, food, waste, and recycling. Green budgeting is therefore best conceptualized as an intermediary mechanism: prices and environmental information influence the household, while the household budget determines how these signals compete with financial constraints and other priorities.

3.3 Sustainable Consumption and Low-Carbon Lifestyle Transitions

Dubois and colleagues examined how household consumption and behavioral decisions could contribute to low-carbon futures in European high-income contexts. Their work emphasized that a portfolio of behavioral and consumption changes is required rather than dependence on a single household action. This portfolio perspective is closely compatible with budgeting because household finance already involves balancing multiple expenditure categories simultaneously.

This distinction is essential. Green household budgeting should support low-carbon consumption, but consumer behavior cannot compensate indefinitely for carbon-intensive infrastructure, unavailable public transportation, inefficient housing, or production systems that offer few lower-carbon alternatives.

The literature therefore indicates a research gap between two well-developed areas: studies measuring environmental impacts of household consumption and studies explaining pro-environmental behavior. Less attention has been devoted to the household budget itself as a repeated decision architecture connecting environmental priorities with expenditure. The present paper addresses this conceptual gap by positioning green budgeting as a financial-behavioral process through which carbon-conscious intentions can become recurring household consumption rules.

4. Research Methodology

4.1 Research Design and Simulated Analytical Corpus

The study adopts a quantitative simulation-based research design. Simulation was selected because no verified survey dataset, expenditure diary, household carbon-footprint inventory, or respondent-level information was supplied. Consequently, the numerical observations reported in the study are not actual household data and must not be represented as empirically collected evidence. The simulation is intended to demonstrate how a future household study could operationalize relationships among budgeting behavior, environmental knowledge, affordability, and low-carbon consumption.

A reproducible analytical corpus consisting of 120 simulated households was generated. Green Budgeting Intensity, Environmental Literacy, Affordability and Access, and Low-Carbon Consumption were standardized on 0–100 scales. Variation was intentionally retained to prevent low-carbon behavior



from being a deterministic function of budgeting alone. This structure reflects the established literature showing that household environmental behavior depends on multiple behavioral, economic, policy, and contextual factors.

4.2 Proposed Measurement Instrument

A five-item questionnaire is proposed for future empirical validation. These questionnaire statements were not administered to respondents in the present study. Future researchers could use a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The instrument focuses on budget planning rather than environmental attitudes alone because the purpose is to measure whether environmental priorities are incorporated into actual expenditure decision processes.

Table 1: Proposed Measurement Instrument for Green Household Budgeting

Item	Construct	Proposed Questionnaire Statement	Measurement Purpose
Q1	Budget integration	Our household considers environmental impact when planning significant monthly expenditure.	Measures incorporation of environmental criteria into budgeting
Q2	Energy and mobility planning	Our household allocates expenditure in ways intended to reduce avoidable energy and transport-related emissions where practical.	Measures carbon-sensitive allocation
Q3	Consumption restraint	Before purchasing nonessential goods, our household considers whether the purchase can be avoided, delayed, repaired, reused, or replaced with a lower-impact alternative.	Measures consumption discipline
Q4	Affordability alignment	Our household adopts lower-carbon alternatives when they remain compatible with essential financial needs and household affordability.	Measures financially sustainable green behavior
Q5	Budget review	Our household periodically reviews expenditure to identify opportunities for reducing both unnecessary costs and environmental impact.	Measures feedback and continuous improvement

The questionnaire deliberately includes an affordability condition because environmentally desirable behavior should not be measured through expenditure capacity alone. A household unable to purchase a new efficient appliance should not automatically receive a lower behavioral assessment than a wealthier



household capable of making large capital investments. The proposed instrument therefore measures planning, restraint, allocation, and review in addition to purchasing behavior.

4.3 Simulation Procedure and Evaluation Method

The simulation generated Green Budgeting Intensity with broad variation representing households ranging from minimal environmental budgeting to systematic integration. Environmental Literacy represented the household's capacity to identify environmental consequences of consumption, while Affordability and Access represented the practical availability of lower-carbon choices within household financial constraints. Low-Carbon Consumption was modeled as a weighted combination of these variables plus random variation.

The simulated households were classified into four stages: Limited green budgeting for index scores below 35, Emerging for scores from 35 to below 55, Established for scores from 55 to below 75, and Integrated for scores of 75 or above. Pearson correlation was calculated as a descriptive measure of association between Green Budgeting Intensity and Low-Carbon Consumption. Because the dataset is synthetic, the correlation illustrates the analytical design and should not be interpreted as an estimated population effect.

5. Analysis

5.1 Green Budgeting Stages and Low-Carbon Consumption

The simulated corpus contains 37 households within the Limited stage, 39 within Emerging green budgeting, 32 within Established green budgeting, and 12 within the Integrated category. Mean Green Budgeting Intensity increased from 26.4 in the Limited group to 86.7 among Integrated households. Low-Carbon Consumption displayed a corresponding progression from 50.4 to 74.3.

The pattern indicates that systematic budgeting may be more strongly associated with low-carbon consumption than occasional environmental purchasing. This distinction matters because isolated purchases, such as buying one environmentally preferable product, do not necessarily transform the wider household consumption pattern. Integrated green budgeting instead requires environmental considerations to become part of the recurring allocation process.

Table 2: Simulated Outcomes Across Green Household Budgeting Stages

Green Budgeting Stage	Simulated Households	Mean Green Budgeting Index	Mean Environmental Literacy	Mean Affordability and Access	Mean Low-Carbon Consumption Index
Limited	37	26.4	60.6	57.8	50.4
Emerging	39	46.4	60.1	61.7	57.2
Established	32	63.7	65.2	62.2	67.3
Integrated	12	86.7	65.9	57.5	74.3

This illustrates an important theoretical proposition: environmentally organized budgeting is not identical to financial affluence. Households may engage in consumption restraint, maintenance, energy conservation, waste avoidance, shared mobility, or careful purchasing even when premium-priced environmental products are not readily affordable.

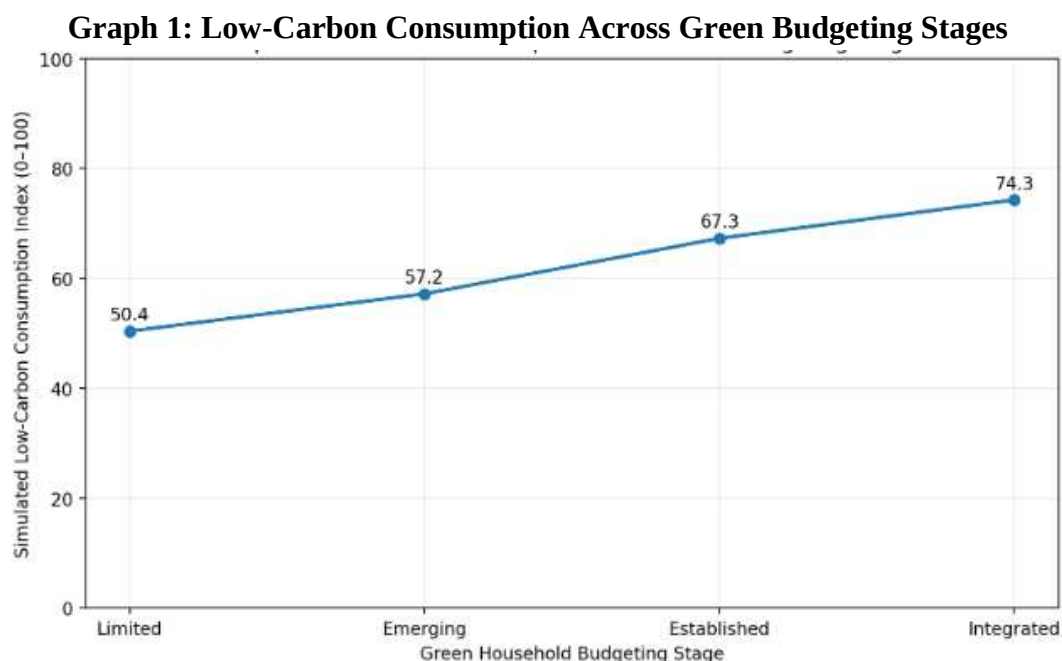
5.2 Association Between Budgeting Intensity and Consumption Behavior

Across the complete simulated sample, Green Budgeting Intensity and the Low-Carbon Consumption Index produced a Pearson correlation of approximately $r = 0.774$. Within the simulation, this represents a strong positive association. The result is consistent with the theoretical expectation that environmental priorities become more behaviorally consequential when they are embedded within repeated financial decisions instead of remaining general attitudes.

The finding should nevertheless be interpreted cautiously. Because Low-Carbon Consumption was modeled partly as a function of budgeting intensity, the coefficient is an illustrative analytical outcome rather than independent empirical confirmation. Future household surveys should test whether the relationship persists after controlling for household income, family size, homeownership, urban or rural location, access to public transportation, dwelling efficiency, education, environmental values, and local prices.

5.3 Graphical Comparison of Green Budgeting Stages

The graphical comparison shows a consistent increase in simulated Low-Carbon Consumption as household budgeting becomes more environmentally integrated. The use of a stage-based line graph emphasizes progression from occasional or limited consideration of environmental impacts toward systematic inclusion of those impacts within household financial planning.





The simulated Low-Carbon Consumption Index increases from 50.4 in the Limited stage to 57.2 in the Emerging stage, 67.3 in the Established stage, and 74.3 in the Integrated stage. The total simulated difference between the lowest and highest categories is 23.9 index points. This progressive pattern illustrates the central proposition of the paper: environmentally oriented consumption may become more consistent when environmental goals are translated into recurring expenditure rules rather than addressed through occasional purchases.

The key finding is not that every household should maximize a standardized green score. Household needs and constraints differ. Instead, the graph demonstrates the analytical value of examining budget integration—the extent to which households routinely consider environmental consequences while balancing affordability, necessity, and quality of life.

6. Discussion

6.1 Green Budgeting as a Bridge Between Environmental Intention and Action

The principal implication is that household budgeting can be conceptualized as a behavioral infrastructure. Many environmental decisions are financial decisions repeated over time: how much electricity to consume, which transportation mode to finance, how frequently to replace products, what food to purchase, whether to repair or discard an item, and how discretionary income is distributed. When environmental priorities remain outside the budget, they must compete for attention separately at each transaction. Integrating them into the budget creates an opportunity to establish decision rules before individual purchases occur.

This interpretation complements rather than replaces established behavioral research. Steg and Vlek emphasized the importance of understanding behavioral determinants and applying appropriately designed interventions. Green budgeting can operate as a self-management intervention by converting broad environmental intentions into expenditure categories, limits, priorities, and review mechanisms. A household might not calculate the exact carbon footprint of every purchase; it could nevertheless establish rules that favor reduced energy waste, longer product use, less avoidable food waste, or lower private-vehicle dependence where feasible.

The approach also addresses the persistence problem. Environmental campaigns frequently encourage individual actions at a particular moment, whereas budgets are recurrent. Monthly or weekly review creates feedback, permitting households to observe whether cost savings and environmental objectives reinforce each other. Green budgeting therefore has potential value not because it introduces entirely new environmental behaviors but because it organizes existing behaviors into a repeatable financial process.

6.2 Affordability, Carbon Inequality, and the Limits of Consumer Responsibility

The second implication concerns equity. Consumption-based environmental footprints are unevenly distributed, and household expenditure levels are strongly related to environmental impact. Ivanova's 2020 European analysis documented substantial inequalities in household carbon footprints across socioeconomic groups. Earlier research by Ivanova and colleagues likewise found that greater household expenditure is associated with greater environmental pressure. This means climate-oriented budgeting



should focus particularly on discretionary high-impact consumption rather than imposing equivalent expectations on households whose expenditure is concentrated on basic necessities.

Green budgeting must therefore distinguish sufficiency from deprivation. Reducing avoidable high-carbon luxury consumption and improving resource efficiency can contribute to mitigation, while forcing financially vulnerable households to reduce essential heating, cooling, mobility, nutrition, or healthcare expenditure would constitute a fundamentally different outcome. Environmental budgeting should preserve adequate living standards while identifying consumption that can be changed without undermining basic well-being.

Consumer responsibility also has structural limits. A household cannot budget for reliable public transportation where none exists, select an efficient building envelope when living in a rental property whose owner controls major improvements, or purchase lower-carbon products that are unavailable in the local market. OECD findings regarding prices and infrastructure reinforce the importance of enabling conditions. Governments and firms consequently remain responsible for creating markets, infrastructure, standards, and products that make lower-carbon household choices feasible.

6.3 Implications for Household Finance and Climate Policy

Green household budgeting may produce a useful convergence between financial and environmental objectives where lower-carbon actions reduce recurring expenditure. Energy conservation, avoiding unnecessary purchases, reducing food waste, maintaining products for longer periods, and selecting efficient transport options can potentially reduce both expenditure and environmental pressure. Dietz and colleagues demonstrated that several readily available household actions can contribute meaningfully to emissions reduction. These areas may be particularly suitable entry points because environmental improvement does not depend exclusively on households accepting higher costs.

However, some lower-carbon investments require initial capital. Efficient appliances, building improvements, renewable-energy systems, or electric mobility may involve substantial upfront expenditure even where lifetime operating costs are favorable. Green budgeting alone cannot overcome such liquidity constraints. Complementary instruments—including financing, incentives, standards, information, and infrastructure—may therefore be required if sustainable options are to become accessible across income groups. OECD household-behavior research similarly demonstrates that policy instruments and household circumstances interact in shaping environmental choices.

For policymakers, the green-budget concept may also provide a more practical communication framework than asking households to calculate complete life-cycle carbon footprints independently. Public agencies could provide standardized expenditure categories, credible carbon information, energy-cost calculators, transport comparisons, food-waste tools, and simple household review templates. Such programs should be evaluated against actual consumption outcomes rather than environmental intention alone. Dubois and colleagues emphasize the importance of household behavioral choices within low-carbon pathways, but their analysis also reinforces the need for portfolios of actions and supportive policy rather than reliance on a single behavioral change.

7. Conclusion

Green household budgeting provides a potentially useful connection between financial management and environmental behavior. Household carbon footprints arise through recurring decisions concerning housing, energy, transportation, food, goods, services, and waste. Conventional environmental information may influence attitudes, but sustained change requires these considerations to enter the routines through which household resources are allocated. A green budget offers one mechanism for making environmental priorities operational within everyday economic decisions.

The simulation developed in this study illustrates a strong positive analytical relationship between Green Budgeting Intensity and Low-Carbon Consumption, with a simulated Pearson correlation of $r = 0.774$. Mean Low-Carbon Consumption increases from 50.4 among Limited green budgeters to 74.3 among Integrated green-budgeting households. These figures are synthetic and must not be represented as results obtained from actual household respondents. Their purpose is to demonstrate a transparent framework that can subsequently be evaluated with verified household expenditure, time-series, energy, mobility, and consumption data.

The study contributes the concept of green household budgeting as a financial-behavioral decision architecture. Its value lies not in encouraging households to purchase more products marketed as environmentally friendly but in incorporating necessity, sufficiency, lifetime cost, efficiency, repair, reuse, waste prevention, and carbon-sensitive alternatives into expenditure planning. Such an approach can potentially align environmental objectives with household financial resilience, particularly when environmental actions also reduce unnecessary expenditure.

Important limitations remain. The numerical analysis is simulated, actual household carbon footprints require detailed measurement, and expenditure is only one determinant of environmental behavior. Household choices are influenced by income, prices, infrastructure, housing, employment patterns, family circumstances, market availability, and public policy. Future empirical research should therefore apply the proposed five-item instrument alongside verified expenditure diaries, utility records, mobility data, household characteristics, and consumption-based carbon estimates. Longitudinal studies could determine whether households that use structured green budgets sustain lower-carbon consumption over time and whether the financial consequences differ across income groups.

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