

# Biodiversity Co-Benefits in Carbon Markets? Evidence from Voluntary Offset Projects

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## Abstract

Carbon offset projects frequently claim biodiversity “co-benefits”, yet empirical evidence supporting these claims remains scarce. This study provides the first comprehensive empirical investigation of how voluntary carbon offset projects may impact biodiversity. We compile a novel dataset combining hand-collected data on 29,974 voluntary carbon offset projects with finely-resolved data on local ecosystems from satellite measures. Results indicate carbon offset projects are associated with a 3.7% increase in human impact on local ecosystems, as measured by the Human Impact Index (HII). To investigate whether certain types of projects yield biodiversity co-benefits, we analyze heterogeneity across four dimensions: (a) projects located in areas with low initial HII, (b) projects subject to specific biodiversity requirements, (c) projects that disclose biodiversity benefits, and (d) projects located in protected areas. Despite this heterogeneity analysis, we find no evidence of significant biodiversity co-benefits across these dimensions. These findings raise concerns about the additionality and effectiveness of biodiversity claims, suggesting a disconnect between stated goals and actual ecological outcomes. The results highlight potential “biodiversitywashing” in voluntary carbon markets and underscore the need for more rigorous standards to align carbon finance mechanisms with biodiversity conservation objectives.

**Keywords:** Biodiversity, Nature-based Solutions, Voluntary Carbon Offset, Carbon Farming, Additionality.

**JEL Codes:** Q01, Q24, Q28, Q54, O13.

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# 1 Introduction

The global economy faces dual crises of climate change and biodiversity loss, both of which pose significant risks to financial stability, economic growth, and human welfare (Dasgupta, 2021; Network for Greening the Financial System, 2022; Karolyi and Tobin-de la Puente, 2023). As policymakers fail to adopt the first-best solutions, the voluntary carbon market has emerged as a potential mechanism to channel private capital towards climate mitigation and, increasingly, biodiversity conservation efforts. This market, valued at \$2 billion in 2021 is projected to reach \$50 billion by 2030 (McKinsey & Company, 2021) and operates on the premise that carbon offset projects can deliver emissions reductions while simultaneously providing ecological co-benefits, particularly biodiversity conservation.

However, the true environmental impact of these projects, especially their biodiversity outcomes, remains a subject of intense debate (Seddon et al., 2020; Griscom et al., 2017). Critics argue that many offset projects, particularly those based on avoided deforestation, may overstate their benefits or even lead to perverse outcomes (e.g. West et al., 2020). Proponents, on the other hand, contend that well-designed nature-based solutions can offer cost-effective climate mitigation while enhancing biodiversity and supporting local communities (e.g. Chausson et al., 2020). This debate has significant implications for the efficacy of market-based approaches to environmental conservation and the effective allocation of billions of dollars in climate finance.

Despite the growing importance of this issue, there is a striking lack of empirical evidence on the actual biodiversity impacts of carbon offset projects. Most existing studies rely on case studies or theoretical models, leaving a critical gap in our understanding of how biodiversity considerations are integrated into the voluntary carbon market at scale. This gap is particularly concerning given the rapid growth of corporate net-zero commitments and the increasing emphasis on nature-based solutions in climate strategies (Taskforce on Scaling Voluntary Carbon Markets, 2021).

Our study addresses this critical gap by providing the first comprehensive empirical investigation of biodiversity considerations in the voluntary carbon offset market. We leverage a novel dataset that combines detailed project-level data from major carbon registries with satellite-based biodiversity metrics, firm-level financial and environmental data, and information on relevant regulatory events. **This unique dataset allows us to analyze over 29,974 offset projects and 419,267 credit retirement records from 2000 to 2023, linked to 13,664 firms across 46 countries.**

We employ a range of empirical strategies, including difference-in-differences analyses, cross-sectional regressions, and panel data methods. Our analysis yields several important findings. First, we document that carbon offset projects are associated with a 3.7% increase in human impact on local ecosystems, as measured by the Human Impact Index (HII). This effect is heterogeneous across project characteristics: (a) projects located in areas with initially low HII or (b) those subject to specific biodiversity requirements show relatively smaller HII increases compared to their counterparts. However, (c) whether projects disclose biodiversity benefits or (d) are located in protected areas does not play a significant role, as both types still increase HII. These findings raise concerns about additionality and effectiveness, suggesting

a disconnect between stated biodiversity goals and actual ecological impacts, potentially indicating “biodiversitywashing.”

Our study makes several important contributions to the literature on environmental finance and corporate environmental strategy. First, we provide novel empirical evidence on the extent and nature of biodiversity considerations in carbon offset projects. This contributes to the ongoing debate about the effectiveness of market-based approaches to biodiversity conservation (Salzman et al., 2018) and informs policy discussions on the regulation of voluntary carbon markets (Taskforce on Scaling Voluntary Carbon Markets, 2021).

Second, our analysis of the spatial relationship between offset projects and protected areas contributes to the literature on conservation effectiveness and additionality in ecosystem service markets (Pattanayak et al., 2010; Jayachandran et al., 2017; Aspelund and Russo, 2024). By quantifying the extent of overlap and examining its implications, we provide insights into the potential for carbon finance to expand or reinforce existing conservation efforts.

Third, our longitudinal analysis of biodiversity metrics in offset project areas offers new evidence on the long-term ecological impacts of carbon finance. This addresses a key critique of offset markets—whether they deliver lasting environmental benefits (Barbier, 2020)—and provides insights into the factors that influence project success.

The remainder of our paper is organized as follows. Section 2 provides institutional background on the biodiversity-related voluntary carbon offset market and details our hypotheses. Section 3 describes our data and empirical strategy. Section 4 presents our main results and additional analyses. Section 5 discusses the implications of our findings for policymakers, investors, and corporate decision-makers. Section 6 concludes.

## 2 Related Literature

Broadly speaking, economists agree on first-best policies to address climate change through GHG mitigation. The failure to implement such policies to date is stark. Even in the more progressive policy environments, average carbon prices implicit in existing governmental policies are well below that required to limit warming to 1.5 degrees Celsius (Allen et al. 2023). Capital markets may offer avenues for large and cost-effective reductions in GHG emissions even in the absence of first-best governmental policies.<sup>1</sup> This promise has helped drive growth in the marketplace for voluntary carbon offsets, projected to reach \$50 billion in 2030 (McKinsey & Company 2021). Fortunately, these are just one potentially-promising tool in the absence of sufficient political support for the adoption of carbon cap and trade or carbon taxes of sufficient ambition.<sup>2</sup> Furthermore, capital markets have the financial heft to leverage the requisite investments in mitigation. Indeed, the market for sustainable debt securities totalled nearly \$6,000 billion in 2020 (Allen et al., 2023).

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<sup>1</sup>Meanwhile a budding literature in political economy considers obstacles to first-best GHG policies, e.g. Besley and Persson 2023; Longuet-Marx 2024.

<sup>2</sup>Allen et al. 2023 argue that carbon contingent securities might improve welfare by enabling wealthier countries to finance major reductions in carbon emissions.

Forests – through reforestation and avoided forest conversion, and better forest management – are central to nature-based climate solutions. [Griscom et al. 2017](#) find that forests provide over two thirds of the nature-based mitigation needed to keep warming below 2 degrees Celsius. [Franklin and Pindyck 2024](#) focus on marginal costs, estimating a supply curve for forest-based removal of CO<sub>2</sub> in South America, factoring both land opportunity costs as well as direct forest costs. They find that more than 1 billion tons of CO<sub>2</sub> can be removed each year via forestation at a cost up to \$45 per ton, well below current estimates of the social cost of carbon.

[Huston and Marland 2003](#) highlight the general issues surrounding the ecosystem-dependence of environmental benefits, and implemented poorly, carbon sequestration can harm biodiversity. In the case of forests, [Huston and Marland 2003](#) come to a positive view:

*...carbon sequestration in living plants and soils, either through long-term protection of currently mature forests, or long-term protection of re-growing forests, is likely to have an immediate net positive effect on atmospheric carbon dioxide, plus a positive effect on biodiversity and other ecosystem services.*

[Freedman et al. 2009](#) advance a similarly sanguine view in the context of growing market for carbon offsets. Across a variety of land uses, benefits in both GHG offsetting and biodiversity are found ([Freedman et al., 2009](#), Figure 1). [Freedman et al. 2009](#) state: “Many kinds of land-management actions that are undertaken to engage ecological carbon sequestration or to protect existing reservoirs will also help to conserve biodiversity, and vice versa.”

On a more cautionary note, [Seddon et al. 2020](#) note that reforestation through commercial plantations often involve single tree species, i.e. monocultures. [Dooley et al. 2024](#)’s study of Paris Climate Agreement pledges notes their heavy reliance on land use change and that: “establishing new plantations or expanding forest areas requires a land use change, which is also the leading driver of global biodiversity loss”, referencing [this 2019 report](#). [Horn 2022](#) studies tree planting programs funded by voluntary carbon market and verified according to guidelines of Verified Carbon Standards (VCS), the “market leader” of voluntary carbon standards. A particular focus is on the number of tree species planted, which [Horn 2022](#) finds tends to reduce carbon sequestration – mono-culture commercial forestry stored more carbon. In this vein, [Huston and Marland 2003](#) likewise noted: “...the diversity of plants generally declines at high levels of productivity and is low in high productivity forests with massive trees. This counter-intuitive pattern is caused by competition among plants, which is most intense when plants are growing rapidly and achieving large sizes.” [Seddon et al. 2020](#); [Horn 2022](#) both note that such monocultures are not supportive of biodiversity.

[Flammer et al. 2023](#) approach the question of biodiversity preservation directly from the perspective of biodiversity finance and private capital, either on its own or “blended” with public or philanthropic capital. Using data from a leading biodiversity institution on deals from 2020 to 2022, [Flammer et al. 2023](#) find that blended finance projects are most common and support large-scale biodiversity projects with moderate risk, but also moderate returns. Underscoring the novelty of the research area that lags substantially behind investor practice, [Flammer et al. 2023](#) is likely the first academic paper to focus specifically on biodiversity finance.

Grupp et al. 2023 conducts the empirical analysis most similar to our own in the broadness of its scope and in deploying a large-sample, event study design. Grupp et al. 2023 find that the European Union’s Protected Area Policy did not generate any additional benefits in terms of improved vegetative cover or reduced night lights, and therefore are unlikely to have promoted biodiversity as intended.

## 3 Data and Methodology

### 3.1 Data Sources

Our analysis draws on a unique combination of datasets that allow us to examine the intersection of carbon offset markets, biodiversity, and corporate behavior. The primary components of our data are as follows:

#### 3.1.1 Voluntary Carbon Offset Data

We hand-collected comprehensive data on voluntary carbon offset projects from major registries. Our dataset covers January 2000 to December 2023 and includes 29,974 distinct projects. For each project, we collected the following information:

- Project ID, name, type
- Project location (country and, if available, geographic coordinates)
- Project developer and associated firms
- Project start date and crediting period
- Annual and cumulative credit issuances
- Any explicit biodiversity-related claims or certifications

For credit retirements, we collected data on:

- Retirement date
- Number of credits retired
- Vintage of retired credits
- Retiring entity (matched to firm identifiers where possible)

This dataset provides a comprehensive view of the supply and demand sides of the voluntary carbon market, with a particular focus on projects with potential biodiversity co-benefits.

#### 3.1.2 Biodiversity Metric

In evaluating the biodiversity impacts of carbon offset projects, the Human Influence Index (HII) is employed as the principal indicator of anthropogenic pressure on ecosystems. The selection of HII is motivated by its comprehensive integration of multiple human-driven

factors that directly affect biodiversity, making it a suitable and rigorous metric for analyzing the potential ecological consequences of carbon offset activities.

**Human Influence Index (HII):** Developed by [Venter et al., 2016](#), HII is a global, high-resolution metric designed to quantify the cumulative human pressure on natural ecosystems. The HII integrates multiple anthropogenic drivers, including population density, land use intensity (e.g., urban areas, agricultural land), accessibility to natural areas (e.g., distance to roads and railways), and infrastructure development (e.g., powerlines, navigable waterways). By incorporating these diverse variables, the HII provides a robust, temporally consistent measure of the extent and intensity of human impact on biodiversity ([Sanderson et al., 2022](#)).

The HII dataset is constructed using satellite-derived data at a 300-meter spatial resolution, offering a granular view of human influence on ecosystems. This spatial resolution is sufficiently fine to capture localized human impacts, which is essential for the assessment of carbon offset projects that often operate in heterogeneous landscapes with varying degrees of human interference. The temporal scope of the HII (2001-2020) also permits longitudinal analysis, allowing for both spatial and temporal evaluation of changes in human pressure over time, particularly in areas targeted for carbon offset interventions.

The HII assigns values on a scale from 0 to 64, where 0 represents areas with no detectable human influence (pristine ecosystems), and 64 represents areas subjected to maximal human pressure. The index captures the gradient of human impact, making it particularly useful for identifying regions where biodiversity is most at risk from anthropogenic disturbance. Areas with high HII values are typically characterized by significant habitat fragmentation, ecosystem degradation, and diminished biodiversity. Conversely, regions with low HII values often correspond to critical biodiversity hotspots, where intact ecosystems provide habitat for a high number of endemic and threatened species (See [Sanderson et al. 2022](#)).

**Rationale for Using HII in Carbon Offset Project Evaluation:** The use of HII in this analysis is justified by its ability to serve as a proxy for biodiversity pressures in areas where carbon offset projects are implemented. Carbon offset projects, such as reforestation, afforestation, or avoided deforestation, typically aim to mitigate climate change by sequestering carbon. However, these projects can also have significant implications for local biodiversity, either positive or negative, depending on the design and implementation of the project.

Carbon offset initiatives that involve land-use changes can, for example, improve biodiversity by restoring degraded ecosystems or enhancing habitat connectivity. However, they also risk reducing biodiversity if they result in practices such as monoculture plantations, the displacement of native species, or the disruption of existing ecological processes. As such, understanding the baseline level of human pressure—captured by the HII—allows for objective assessment of whether a carbon offset project is likely to alleviate existing pressures or exacerbate them.

Furthermore, HII provides a rigorous empirical lens for assessing the extent to which carbon offset projects contribute to or detract from broader conservation goals. In areas with high

pre-existing human pressure (i.e., high initial HII values), carbon offset projects could play a role in mitigating further degradation by stabilizing or restoring ecosystems. Conversely, in areas with low human influence (i.e., low HII values), poorly designed offset projects could introduce new disturbances to otherwise intact ecosystems, resulting in biodiversity loss. By incorporating HII into the evaluation framework, this study ensures that the biodiversity impacts of carbon offsets are not assessed in isolation but are instead contextualized within the broader landscape of human pressures.

**Limitations of the HII in Biodiversity Assessment:** While the HII is a robust metric for capturing human pressures, it is important to acknowledge its limitations in biodiversity assessment. The HII primarily reflects human activities and does not directly measure species richness, ecosystem health, or conservation status. Therefore, it should ideally be complemented by additional biodiversity-specific indicators, such as species distribution models, habitat suitability assessments, or biodiversity intactness indices, to obtain a more complete understanding of biodiversity impacts.

However, to the best of our knowledge, no widely available open-source database currently offers biodiversity-specific indicators with the same level of geo-spatial precision and time-series coverage as the HII. This lack of comprehensive, high-resolution biodiversity data poses a significant limitation for biodiversity assessments, particularly in large-scale projects where localized and time-sensitive biodiversity outcomes are essential for accurate evaluation.

As a robustness check, we incorporate the Biodiversity Ecosystem Resilience Index (BERI) and the Biodiversity Habitat Index (BHI). However, these measures are only available for the years 2000, 2005, 2010, 2015, and 2020, limiting their ability to provide continuous temporal coverage across the full study period.

We also attempted to replicate the methodology of the Biodiversity Intactness Index (BII) study, as outlined by [De Palma et al. 2021](#). However, we found that the publicly available data sources required to calculate BII are limited, which constrains the feasibility of generating a comprehensive and comparable BII measure for our study. As a result, our analysis relies primarily on HII, supplemented by BERI and BHI, to assess biodiversity impacts.

Despite these limitations, the HII remains a critical tool in the evaluation of biodiversity outcomes associated with carbon offset projects, particularly when used in conjunction with other ecological metrics. Its capacity to integrate spatial and temporal dimensions of human impact makes it indispensable for identifying areas where human activities have the most pronounced effects on ecosystems, and for tracking how these pressures evolve in response to conservation or offset interventions.

In summary, the Human Influence Index (HII) provides a rigorous, geographically comprehensive, and spatially resolved means for understanding the anthropogenic pressures on biodiversity. Its application in this study enables a systematic evaluation of the biodiversity risks and benefits associated with carbon offset projects, ensuring that the ecological outcomes of these interventions are assessed systematically in light of the broader landscape of human disturbance.

### 3.1.3 Satellite-based Vegetation Measures

We complement the HII with two additional satellite-based measures of vegetation:

- **Land Use Land Cover (LULC) Classification:** We employ the ESA CCI Land Cover product, which provides annual global land cover maps at 300m resolution from 2000 to 2020, allowing us to track changes in ecosystem types over time.
- **Forest Cover Change:** We use the Global Forest Change dataset from [Hansen et al. 2013](#), updated annually, which provides information on forest loss and gain at 30m resolution from 2000 to 2019.

For each carbon offset project in our sample, we extract these metrics for the project area and a 10km buffer zone for each year from 2000 (or project start, if later) to 2020. This allows us to analyze biodiversity trends before and after project implementation, as well as compare project areas to their immediate surroundings.

### 3.1.4 Protected Area Data

To assess the additionality of carbon offset projects and their relationship to existing conservation efforts, we use the World Database on Protected Areas (WDPA) (?). The WDPA is the most comprehensive global database of marine and terrestrial protected areas, offering critical insights into the existing conservation landscape. Key features of this dataset include both spatial (polygonal and point) data and attribute information for each protected area.

We use these data in several ways:

1. **Spatial Overlap Analysis:** We calculate the percentage overlap between each carbon offset project and existing protected areas. This allows us to assess:
  - The extent to which projects are expanding upon protected area coverage
  - Potential issues of additionality for projects that overlap substantially with existing protected areas
2. **Stratification:** We stratify our analysis based on the IUCN categories of overlapping protected areas to examine how the level of existing protection may influence project outcomes.
3. **Control Variables:** We use the presence and type of pre-existing protected areas as control variables in our regression analyses to account for baseline conservation efforts.
4. **Matching:** In our design-based analysis aimed at causal inference, we use protected area status as a matching criterion to ensure we compare carbon projects to control areas with similar pre-existing conservation status, along with similarity along other dimensions (to be conducted).

By combining the WDPA data with our carbon project and HII datasets, we can provide novel insights into:

1. The spatial relationship between carbon finance and traditional protected area approaches
2. The additionality of biodiversity benefits in carbon projects
3. The potential for carbon finance to complement or extend existing protected area networks

### 3.1.5 Biodiversity Awareness and Regulatory Events

To capture exogenous shocks to biodiversity awareness and regulatory pressures, we have collected data on major IPBES report releases, including the Global Assessment Report’s first draft in 2017 and final release in 2019. (see [Giglio et al., 2023](#))

These data allow us to implement difference-in-differences and event study analyses to identify causal effects of information shocks on market behavior (to be conducted).

## 3.2 Empirical Strategy

Our empirical analysis consists of several complementary approaches designed to address our research questions and test our hypotheses.

### 3.2.1 Impact of Carbon Offsetting Projects on Biodiversity

To examine the impact of carbon offsetting projects on biodiversity, we employ a difference-in-differences (DiD) approach:

$$HII_{i,j,k,t} = \alpha + \beta PostEstablishment_{i,j,k,t} + \gamma X_{i,j,k,t} + \delta_i + \eta_t + \rho_j + \sigma_k + \epsilon_{i,j,k,t} \quad (1)$$

where  $HII_{i,j,k,t}$  represents the Human Impact Index for project  $i$  in country  $j$ , registry  $k$ , and year  $t$ .  $PostEstablishment_{i,j,k,t}$  is an indicator equal to 1 for the years following project establishment.  $X_{i,j,k,t}$  denotes a vector of time-varying control variables.  $\delta_i$ ,  $\eta_t$ ,  $\rho_j$ , and  $\sigma_k$  represent project fixed effects, year fixed effects, country fixed effects, and registry fixed effects, respectively.

By including fixed effects for every project  $\delta_i$ , we isolate variation in HII coming entirely over time within each individual VCM project. This allows us to remove unobserved differences across projects and their implementations that could otherwise confound variation identifying our primary ( $\beta$ ) coefficients of interest.

We extend this base specification to examine heterogeneity across project characteristics:

$$HII_{i,j,k,t} = \alpha + \beta_1 PostEstablishment_{i,j,k,t} + \beta_2 (PostEstablishment_{i,j,k,t} \times Characteristic_{i,j,k,t-1}) + \gamma X_{i,j,k,t} + \delta_i + \eta_t + \rho_j + \sigma_k + \epsilon_{i,j,k,t} \quad (2)$$

where  $Characteristic_{i,j,k,t-1}$  represents Project-specific features measured in the year prior to the current observation, such as lagged HII levels, biodiversity requirements, or location in protected areas.

### 3.2.2 Temporal Dynamics of Biodiversity Impact

To capture the evolving impact of projects over time, we estimate:

$$HII_{i,j,k,t} = \alpha + \sum_{m=-5}^5 \beta_m I(t - t_{i,j,k}^* = m) + \gamma X_{i,j,k,t} + \delta_i + \eta_t + \rho_j + \sigma_k + \epsilon_{i,j,k,t} \quad (3)$$

where  $I(t - t_{i,j,k}^* = m)$  are indicators for years relative to project establishment, allowing us to trace out dynamic treatment effects.

### 3.2.3 Impact of Exogenous Shocks to Biodiversity Awareness

To evaluate the causal impact of increased biodiversity awareness on market behavior, we employ a difference-in-differences approach exploiting the release of major IPBES reports:

$$Y_{i,j,k,t} = \alpha + \beta_1 (Treat_{i,j,k} \times Post_t) + \beta_2 Treat_{i,j,k} + \beta_3 Post_t + \gamma X_{i,j,k,t} + \delta_i + \eta_t + \rho_j + \sigma_k + \epsilon_{i,j,k,t} \quad (4)$$

where  $Y_{i,j,k,t}$  is an outcome variable, such as number of biodiversity-linked credits issued or purchased) for project/firm  $i$  in country  $j$ , registry  $k$ , year  $t$ .  $Treat_{i,j,k}$  indicates firms or projects more likely to be affected by the IPBES reports, and  $Post_t$  indicates the post-report period.

These empirical strategies allow us to identify the causal impacts of carbon offsetting projects on biodiversity and evaluate how market behavior responds to increased biodiversity awareness, providing a comprehensive analysis of the interplay between carbon markets and biodiversity conservation efforts.

## 4 Results

### 4.1 Temporal Dynamics and Spatial Patterns

Figure 1 illustrates the temporal and geographical distribution of carbon offset projects. Panels A and B show a steady increase in the number of projects over time, with a notable acceleration in recent years, particularly for projects related to biodiversity. Panels C and D reveal that while carbon offset projects are globally distributed, there is a concentration in certain regions, such as North America, Europe, and parts of Asia.

Figure 2 depicts similar trends for carbon offset credits, showing a rapid increase in credit issuance, especially for biodiversity-related projects. Table 1 focuses on the buyers of carbon

offset credits, indicating a growing market with an increasing number of participants over time.

Figure 3 provides a visual representation of the relationship between carbon offset projects and the Human Impact Index. The comparison between Panels A (2001) and B (2020) suggests that many carbon offset projects are established in areas that have experienced increases in human impact over time.

Figure 4 offers a more detailed view of the biodiversity impact of carbon offsetting projects over time. Panel A, which includes all projects, shows a clear increase in HII following project establishment. Panel B, focusing on projects in areas with initially low human impact, reveals an even more pronounced increase in HII, consistent with our regression results.

Figures 5 and 6 further explore heterogeneity in biodiversity impact. Figure 5 shows that projects disclosing biodiversity benefits and those subject to specific biodiversity requirements exhibit different temporal patterns in their impact on HII. Figure 6 indicates that projects located in protected areas have a distinct impact trajectory compared to those outside protected areas.

Finally, Figure 7 examines the biodiversity impact of carbon offsetting projects based on land use changes. Projects involving forest expansion, particularly those converting pasture or shrubland to forest, show a more pronounced increase in HII compared to projects without forest expansion.

## 4.2 Impact of Carbon Offsetting Projects on Biodiversity

We begin our analysis by examining the impact of carbon offsetting projects on biodiversity, as measured by the Human Impact Index (HII). We note that whether we consider event study plots of the raw data (beginning with Figure 4), or regression adjusted tabular estimates, including a fixed effect for each project, the basic qualitative patterns remains the same.

Table 3 presents our baseline results, with the average HII as the dependent variable across all specifications. In Column (1) of Table 3, we observe a positive and statistically significant coefficient on the *PostEstablishment* dummy (1.297, s.e. = 0.093), indicating that carbon offsetting projects are associated with an increase in human impact on local ecosystems. This effect persists, albeit with a smaller magnitude, when we include country, year, and registry fixed effects in Column (2) (0.648, s.e. = 0.232).

To address potential confounding factors and isolate the causal effect of carbon offsetting projects, we restrict our analysis to a balanced panel of observations from five years before to five years after project establishment in Columns (3)-(7). The effect remains positive and statistically significant across these specifications. In our most stringent specification with project fixed effects (Column (6)), we find that project establishment is associated with a 0.187 increase in the HII (s.e. = 0.050), representing a 3.7% increase relative to the sample mean.

Column (7) provides a more nuanced view of the temporal dynamics. We observe that the

impact on HII is not immediate but grows over time. The coefficient on the *EstablishmentYear* dummy is positive and significant (0.243, s.e. = 0.041), and the effect continues to grow in subsequent years, reaching 0.159 (s.e. = 0.053) three years after establishment.

To account for the skewed distribution of HII and potential non-linear effects, we re-estimate our models using the log of average HII as the dependent variable in Table 4. The results are qualitatively similar, with the coefficient on *PostEstablishment* in our preferred specification (Column (6)) indicating a 5% increase in HII following project establishment (0.050, s.e. = 0.019).

### 4.3 Heterogeneity in Biodiversity Impact

We next explore heterogeneity in the biodiversity impact of carbon offsetting projects across various dimensions. Table 5 presents these results, with Panels A-D focusing on different project characteristics and Panel E providing a comprehensive analysis.

Panel A of Table 5 examines the differential impact based on the initial level of human influence. The results show that projects in areas with initially high HII show a larger and more statistically significant increase in HII post-establishment (0.223, s.e. = 0.055) compared to those in low HII areas (0.140, s.e. = 0.112). This suggests that carbon offsetting projects may be more effective in preserving biodiversity in relatively pristine areas.

In Panel B, the result reveals that projects disclosing biodiversity benefits exhibit a smaller HII increase (0.115, s.e. = 0.060) relative to those that do not (0.189, s.e. = 0.066). Both effects are statistically significant at the 10% and 1% levels, respectively, indicating that projects with explicit biodiversity benefits may have a smaller impact on human influence in the area. This unexpected result warrants further investigation and may indicate potential biodiversitywashing or overstatement of biodiversity benefits by some projects.

In Panel C, we observe that projects subject to specific biodiversity requirements have a larger HII increase (0.265, s.e. = 0.077) compared to those without such requirements (0.141, s.e. = 0.061). This result, significant at the 1% level, suggests that biodiversity requirements may not necessarily mitigate human impact on local ecosystems.

Panel D indicates that projects located in protected areas show a larger HII increase (0.236, s.e. = 0.072) than those outside protected areas (0.167, s.e. = 0.074), with both effects significant at the 1% level. The difference in coefficients suggests that carbon offsetting projects in protected areas may have a more pronounced impact on human influence, raising important questions about the additionality and effectiveness of these projects in already protected ecosystems.

Panel E of Table 5 provides a comprehensive analysis of these heterogeneous effects in a single regression framework. The results confirm our previous findings. Projects in areas with initially low human impact (*LowHIIBeforeEstablishment*) show a significantly smaller increase in HII relative to the baseline (coefficient = -0.479, s.e. = 0.063). This suggests that carbon offsetting projects may be more effective in preserving biodiversity in relatively pristine areas, potentially due to lower initial anthropogenic pressures.

Interestingly, projects subject to specific biodiversity requirements exhibit a smaller increase in HII compared to those without such requirements (coefficient = -0.430, s.e. = 0.065). This result, when considered alongside the positive coefficient on *PostEstablishment* (0.444, s.e. = 0.062), suggests a nuanced relationship between biodiversity requirements and changes in the Human Impact Index (HII). Interpreting these results requires careful consideration of potential baseline differences and selection effects. The negative interaction coefficient indicates that projects subject to biodiversity requirements experience a smaller increase in HII relative to their starting point, compared to projects without such requirements. However, this does not necessarily imply that these projects have a lower absolute HII post-establishment.

Projects that disclose biodiversity benefits show a slightly smaller, though statistically insignificant, increase in HII (coefficient = -0.121, s.e. = 0.083). This suggests that self-reported biodiversity benefits may not necessarily translate into measurable reductions in human impact.

Notably, projects located in protected areas do not show a statistically significant difference in HII increase compared to those outside protected areas (coefficient = 0.110, s.e. = 0.072). This result is particularly concerning as it suggests that carbon offsetting projects in protected areas may not provide additional biodiversity benefits beyond existing conservation efforts.

These results reveal a nuanced relationship between carbon offsetting projects and their impact on local ecosystems, as measured by the Human Impact Index (HII). These heterogeneous effects underscore the complexity of implementing effective carbon offset projects. They highlight potential unintended consequences and emphasize the need for careful project design, location selection, and monitoring. From a policy perspective, our findings suggest that current approaches to biodiversity conservation in carbon offset markets may be insufficient or even counterproductive. They call for more nuanced regulatory frameworks that account for these heterogeneous impacts and potentially reassess the effectiveness of existing biodiversity requirements and protected area designations in the context of carbon offsetting.

## 4.4 Robustness Checks and Additional Analyses

To ensure the robustness of our results, we conduct several additional analyses:

1. **Alternative Biodiversity Metrics:** For each project, we calculate zonal summaries of the HII by overlaying the project boundaries with the HII data, producing key statistics — minimum, and maximum—of HII values within each project’s area. We re-estimate our main specifications using the minimum, maximum, and standard deviation of HII as dependent variables (Table A1). The results are qualitatively similar to our main findings, with project establishment associated with increases in all three measures of HII.

To assess the robustness of our results, we conduct sensitivity analyses using two alternative biodiversity metrics: the Biodiversity Ecosystem Resilience Index (BERI) and the Biodiversity Habitat Index (BHI). BERI measures the capacity of ecosystems to

maintain biodiversity in the face of human pressures and environmental changes, while BHI quantifies the intactness of natural habitats. These measures provide complementary perspectives to the HII, allowing us to capture different aspects of biodiversity impact. However, as discussed in Sub-Section [Biodiversity Metric](#), it is important to note that BERI and BHI are only available for the years 2000, 2005, 2010, 2015, and 2020, which limits their ability to provide continuous temporal coverage across our full study period. To address this limitation, we employ a long-difference approach in our analysis, comparing changes in these metrics between the closest available time points before and after project establishment. As shown in Figure ??, the results are qualitatively similar to our main findings, with project establishment associated with decreases in all biodiversity measures.

2. **Heterogeneity:** We replicate our heterogeneity analysis using alternative HII measures (Table [A2](#)). The results largely confirm our main findings, with some variations in effect sizes and statistical significance across different HII measures.
3. **Temporal Dynamics:** Figures [A1](#), [A2](#), [A3](#), [A4](#) provide visual representations of the robustness checks. These measures consistently reveal patterns in the biodiversity impact of carbon offsetting projects across various HII metrics and project characteristics.

And should treatment effect heterogeneity appear more pronounced, we can look to effect heterogeneity<sup>3</sup> to ascertain where biodiversity improvements might be maximized through carbon markets.

## 5 Future Robustness Checks and Additional Analyses (to be conducted)

### 5.1 Robustness

To ensure the robustness of our results, we plan to conduct several additional analyses:

- Placebo tests using randomly assigned treatment dates and locations
- Propensity score matching to address potential selection bias in project location and firm participation. Following best practice, we will first consider how well the propensity score performs in balancing covariates by quintile, etc. blocks of the estimated propensity score.
- Instrumental variable regressions using plausibly exogenous variation in biodiversity risk. This component of the proposed analysis has great potential for strengthening causal inference, and is one we plan to prioritize in our project’s development going forward.

#### 5.1.1 Additional Analyses

In our future work on this project, we plan to address three questions:

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<sup>3</sup>Systematically, using the approach of [Chernozhukov et al., 2018](#).

1. What characteristics distinguish firms that develop or purchase biodiversity-linked carbon credits?
2. How do exogenous shocks to biodiversity awareness, such as major scientific reports, affect the supply and demand for biodiversity-linked offsets?
3. Describe more fully: what is the relationship between carbon offset projects and existing protected areas, and what does this imply for project additionality?

To address question 2, we plan to exploit the 2017 release of major report by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) as exogenous shocks to biodiversity awareness, allowing us to identify causal effects on market behavior. By examining market responses to exogenous shocks in biodiversity awareness, we contribute to the literature on information disclosure and market efficiency in environmental markets (Krueger et al., 2020). To the extent we observe increased development of biodiversity-focused projects in the post-release periods, this would suggest that the market is responsive to heightened awareness of biodiversity issues, though the effectiveness of these projects in delivering biodiversity benefits remains open to question. Our findings will have implications for how scientific information is incorporated into market decisions and corporate strategies.

## 6 Discussion and Conclusion

We are the first to link scientific data on human’s ecological impact to economic data on carbon offset projects at a global scale. This permits assessment of the additionality of biodiversity benefits from carbon offset projects, which may have biodiversity impacts to the extent that the local ecology is impacted by carbon-promotion strategies, especially those involving nature based solutions. Additionally, carbon offset projects frequently (and increasingly) claim biodiversity co-benefits.

Not only do we find no improvement in biodiversity, we often see perverse effects. Nor can we identify specific sub-classes of carbon offset projects that specifically benefit biodiversity. We conclude that efforts to preserve biodiversity outside of voluntary carbon markets should be redoubled.

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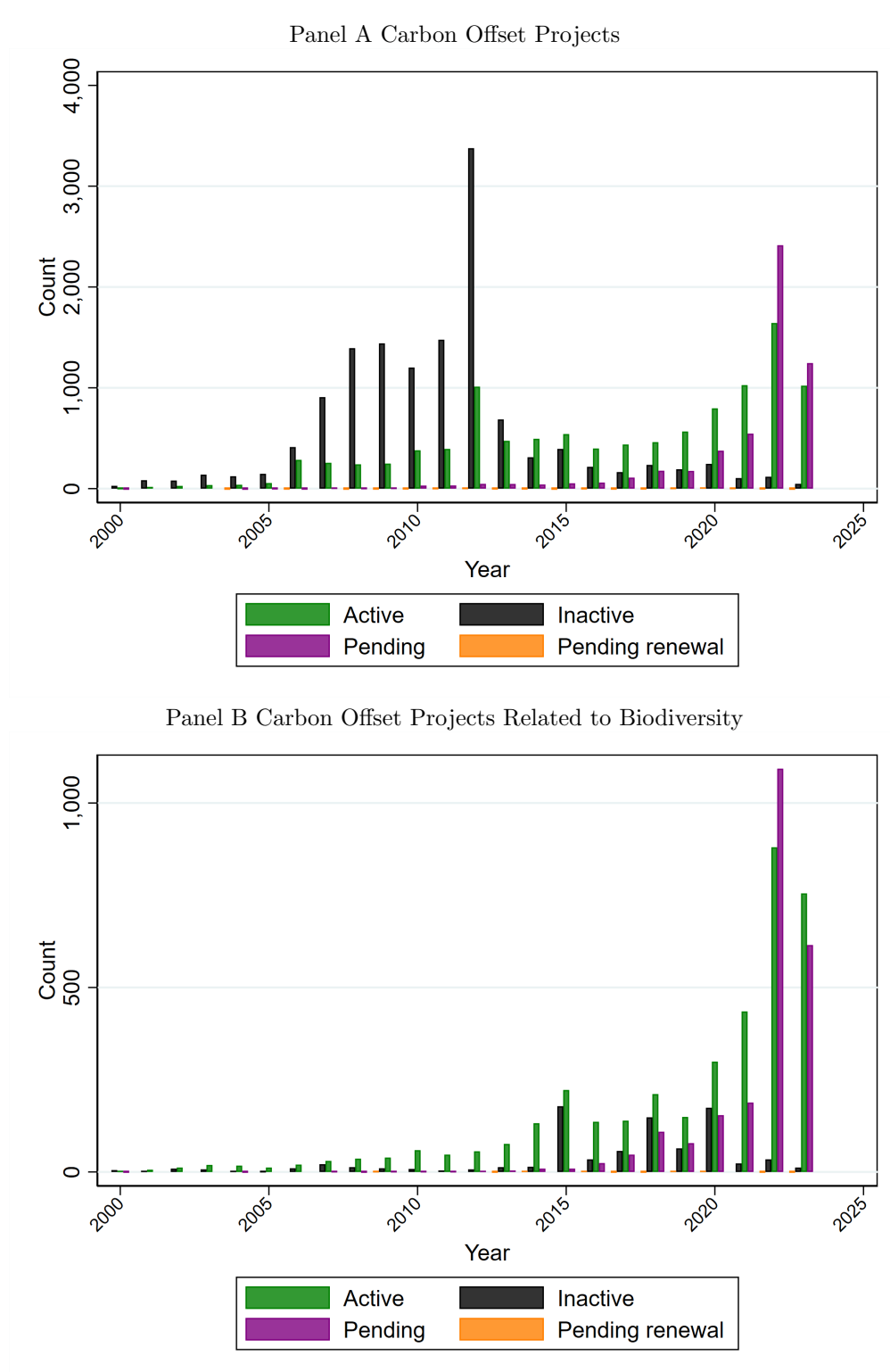
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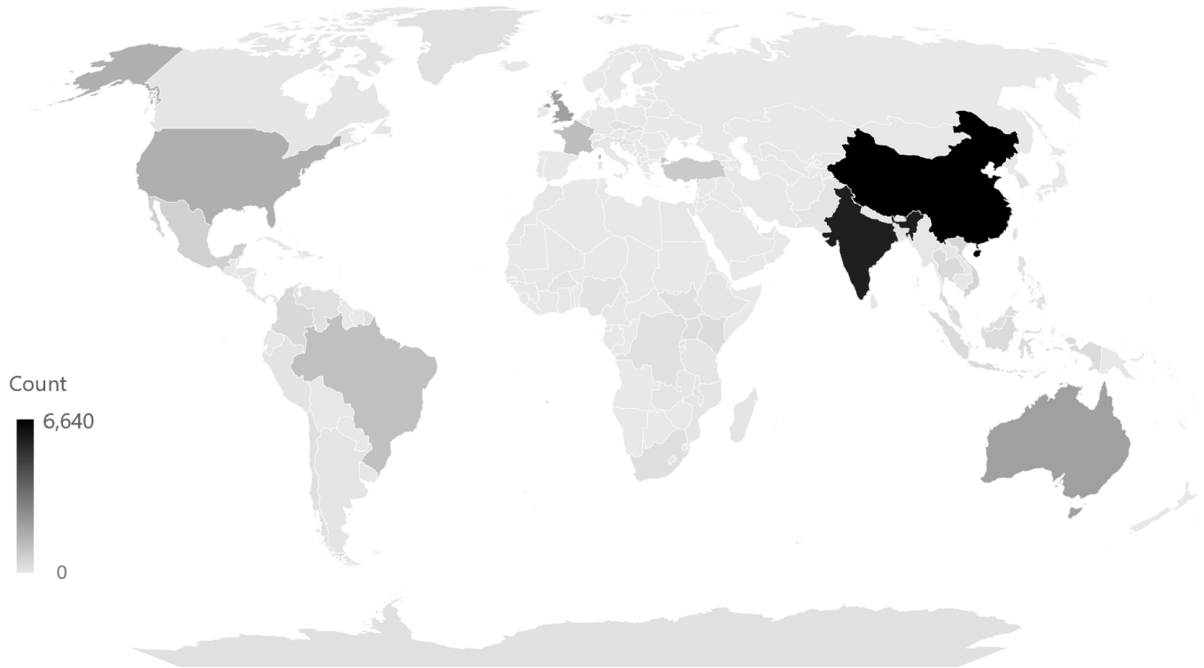
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Figure 1: Trends in Carbon Offset Projects

These figures illustrate the time and geographical distributions of carbon offset projects, with a focus on those related to biodiversity.



Panel C Carbon Offset Projects



Panel D Carbon Offset Projects Related to Biodiversity

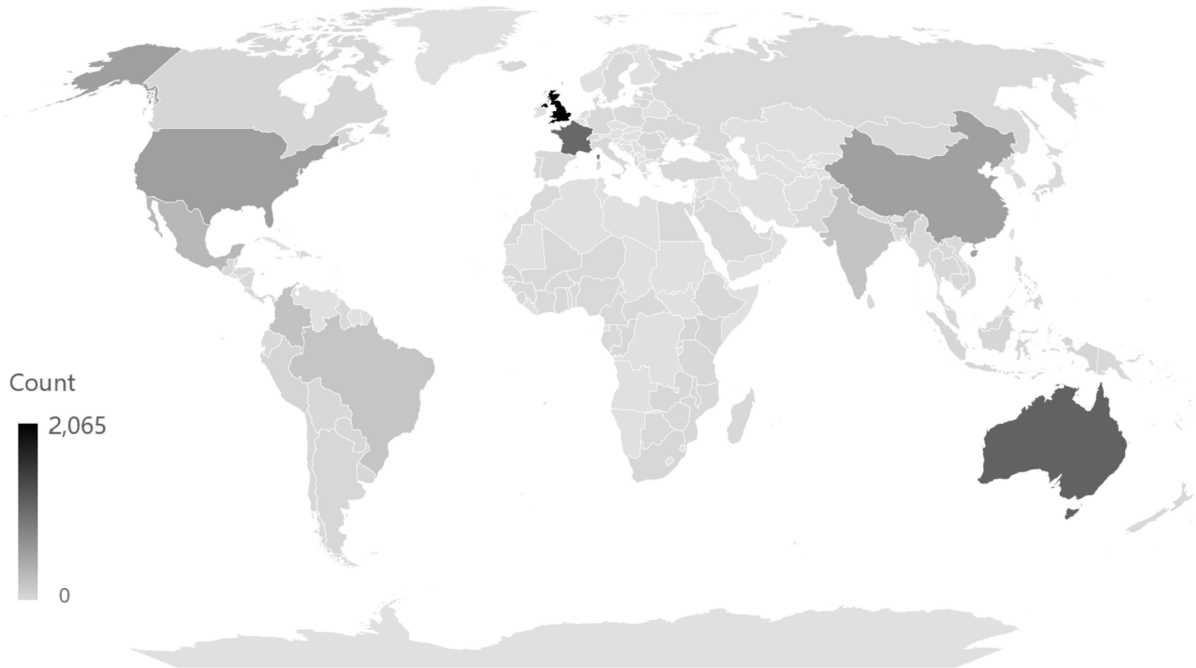


Figure 2: Trends in Carbon Offset Credits

These figures illustrate the time and geographical distributions of carbon offset insurance credits, with a focus on those related to biodiversity.

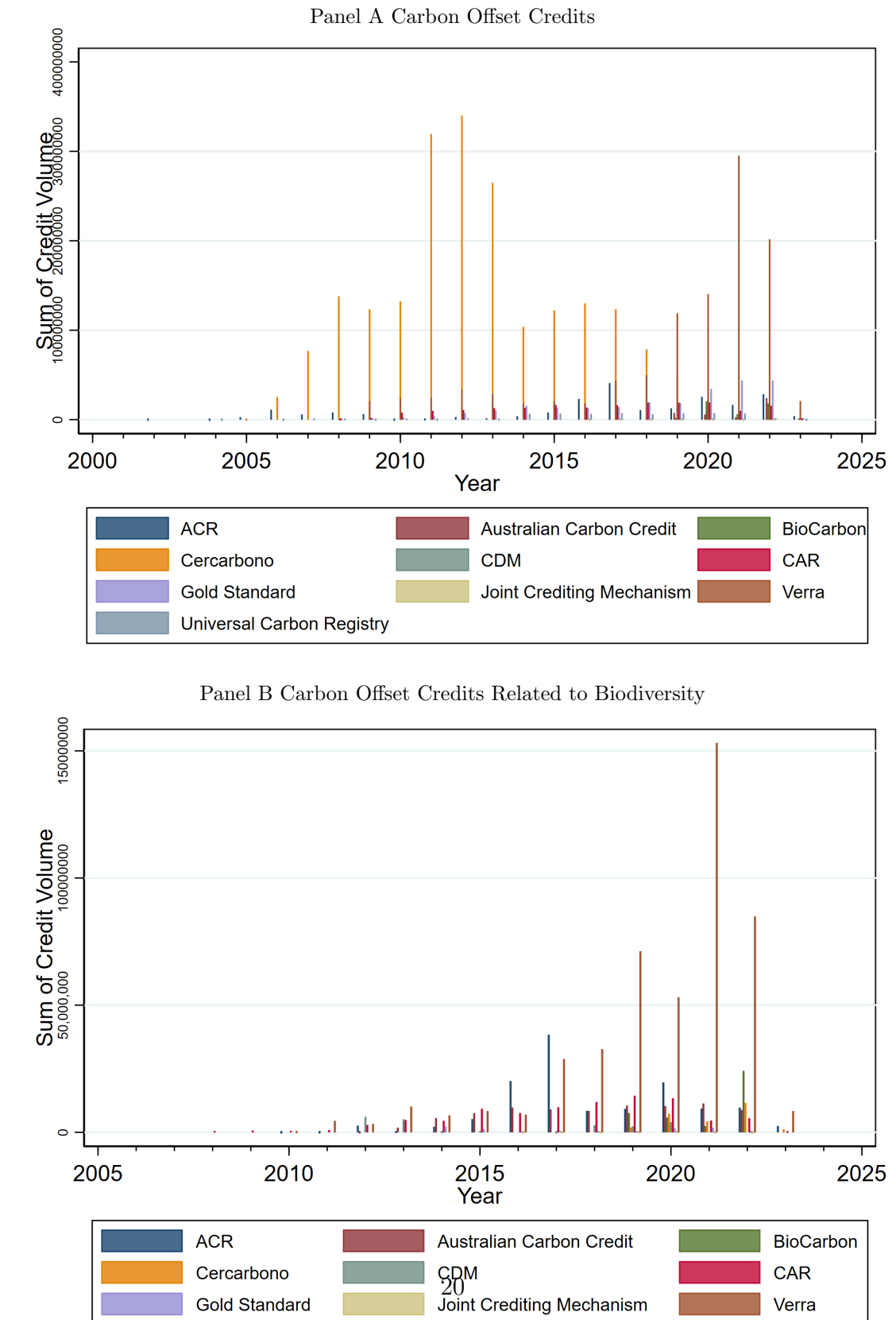
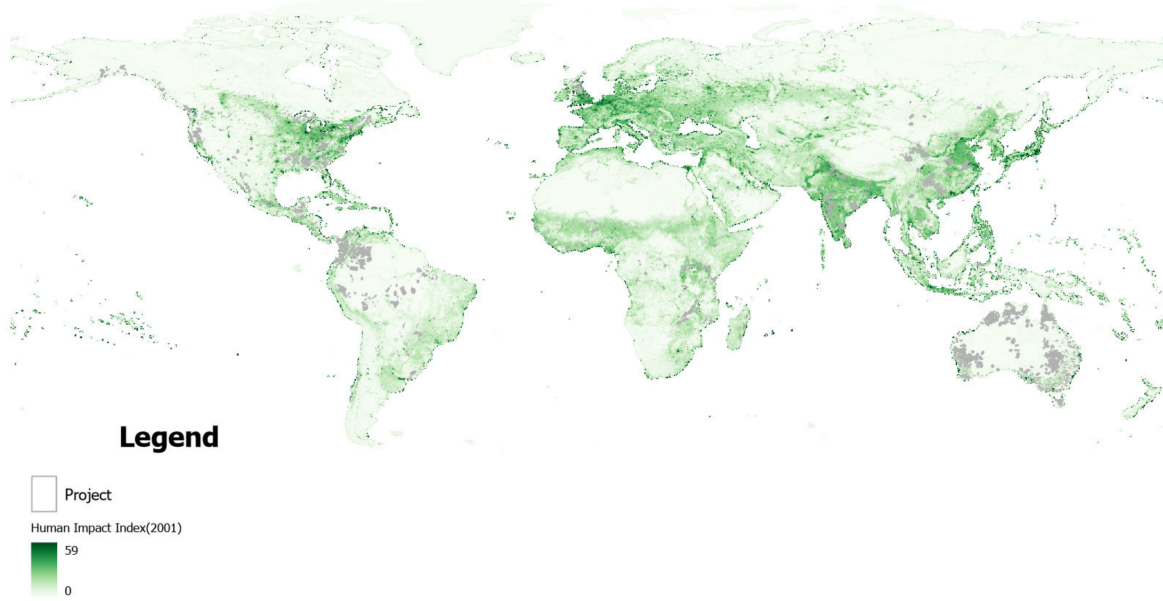


Figure 3: Carbon Offset Projects and Human Impact Index (HII)

This figure shows the relationship between carbon offset projects and the Human Influence Index (HII). Greener areas indicate regions with higher HII, representing greater human impact. The outlined polygons represent the locations of carbon offset projects. Panel A shows the map for the year 2001, and Panel B shows the map for 2020, allowing for a comparison of changes in HII and carbon offset project locations over time.

Panel A Human Influence Index and Carbon Offset Projects, 2001



Panel B Human Influence Index and Carbon Offset Projects, 2020

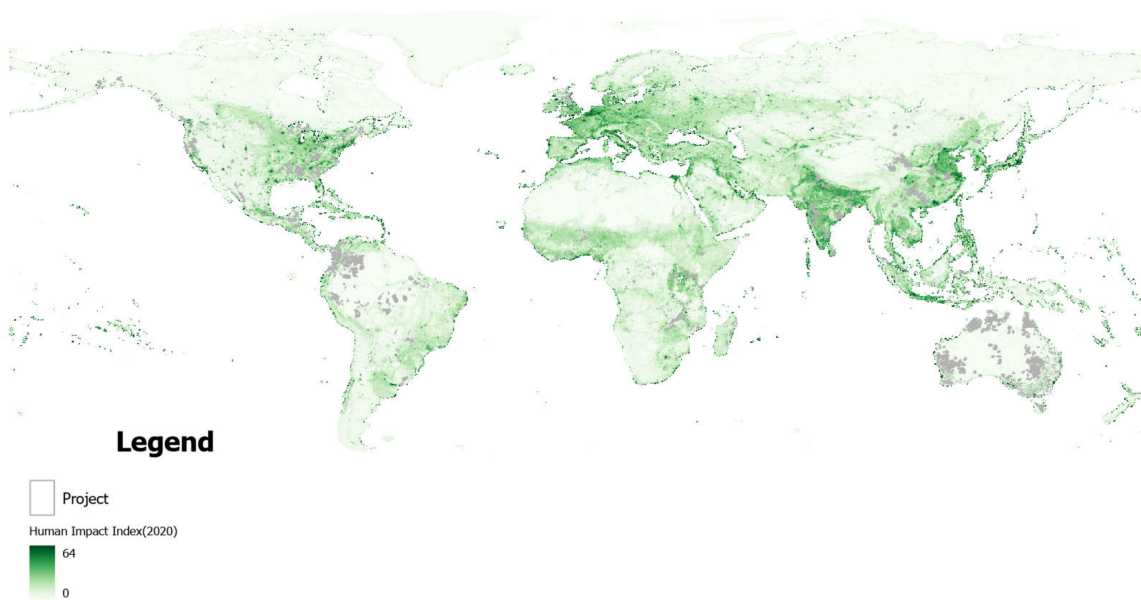


Figure 4: Biodiversity Impact of Carbon Offsetting Projects

This figure shows the impact of carbon offsetting projects on biodiversity using the Human Impact Index (HII). Panel A shows the average treatment effect on the HII for all carbon offsetting projects in the study. Panel B shows the average treatment effect on HII for projects located in areas with initially low human impact, determined by using the median HII value from the year before project establishment. The x-axis represents years relative to project establishment, spanning from  $t-5$  to  $t+5$ . The y-axis shows the mean HII values. Shaded areas depict the 10th to 90th percentile range of HII values for each project type. The vertical dashed line at  $t=0$  marks the project establishment year. Higher HII values indicate greater human impact on local ecosystems.

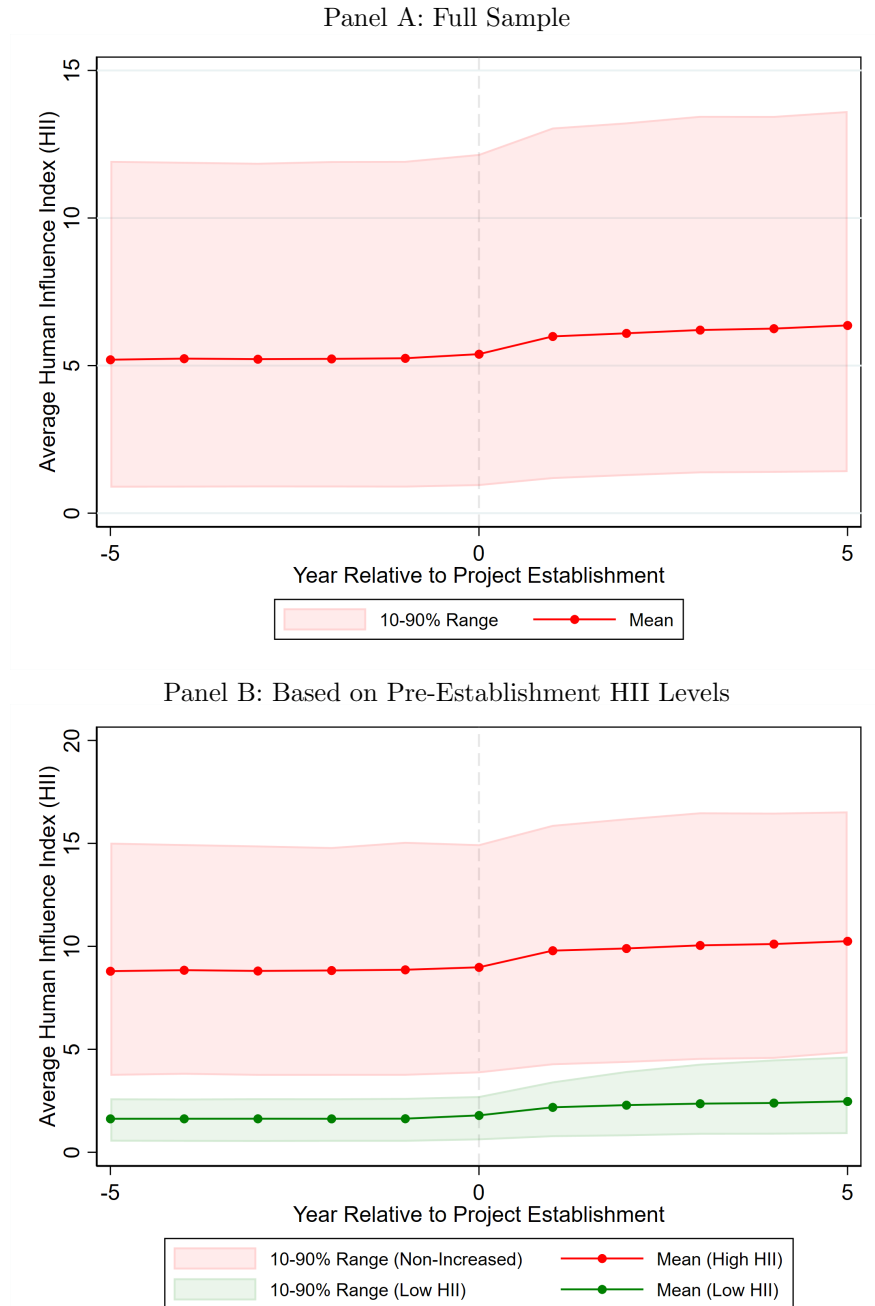
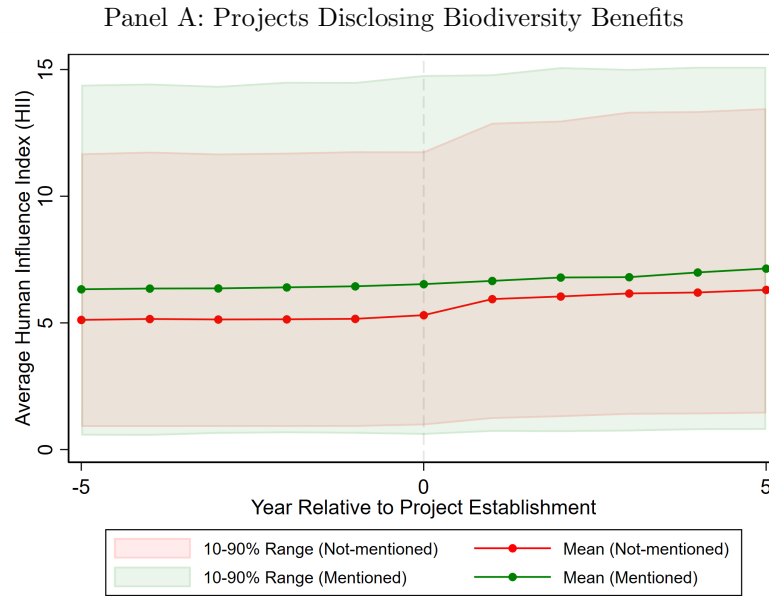


Figure 5: Biodiversity Impact of Carbon Offsetting Projects Based on Project Self-disclosure and Registry Requirements

This figure illustrates the biodiversity impact of carbon offsetting projects, categorized by project characteristics. Panel A presents the average treatment effect on the HII for projects that self-disclose biodiversity benefits in their documentation. Panel B presents the average treatment effect on the HII for projects that are subject to specific biodiversity and conservation requirements set by carbon offset registries. The x-axis represents years relative to project establishment, spanning from  $t-5$  to  $t+5$ . The y-axis shows the mean HII values. Shaded areas depict the 10th to 90th percentile range of HII values for each project type. The vertical dashed line at  $t=0$  marks the project establishment year. Higher HII values indicate greater human impact on local ecosystems.



Panel B: Projects with Biodiversity and Conservation Requirements

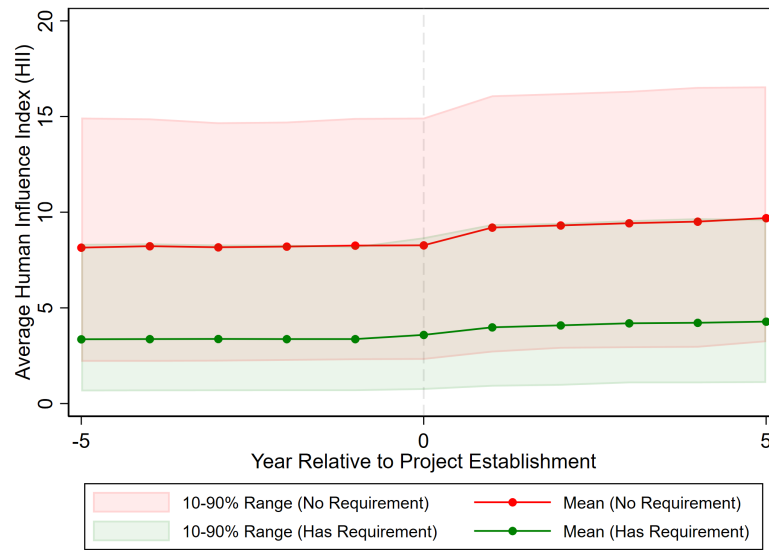


Figure 6: Biodiversity Impact of Carbon Offsetting Projects Based on Protected Area Location

This figure indicates how the location of carbon offsetting projects in relation to protected areas influences their impact on biodiversity, as measured by changes in the HII. Protected areas are defined according to the World Database on Protected Areas (WDPA) classification as the "Strict Nature Reserve". The x-axis represents years relative to project establishment, spanning from  $t-5$  to  $t+5$ . The y-axis shows the mean HII values. Shaded areas depict the 10th to 90th percentile range of HII values for each project type. The vertical dashed line at  $t=0$  marks the project establishment year. Higher HII values indicate greater human impact on local ecosystems.

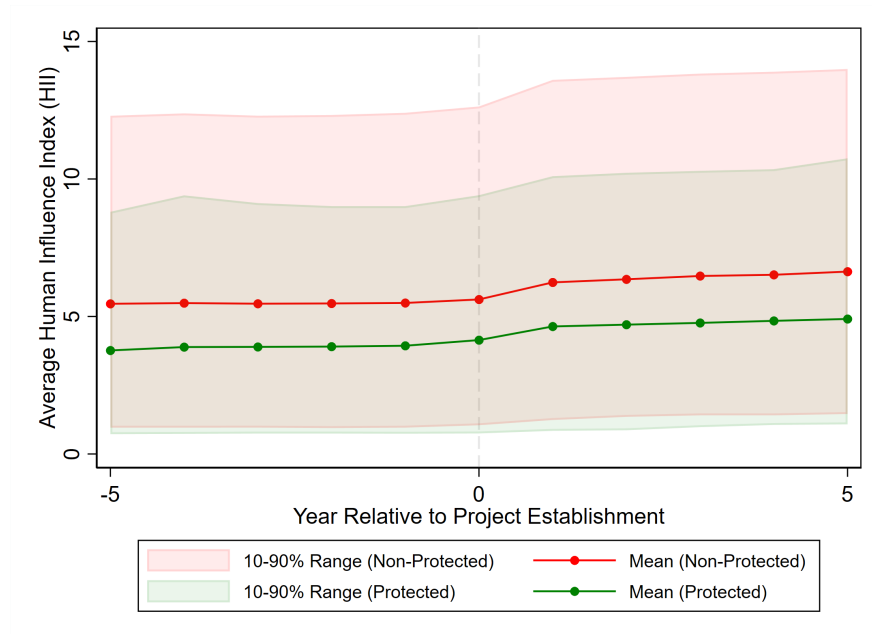


Figure 7: Biodiversity Impact of Carbon Offsetting Projects Based on Land Use and Land Cover Types

This figure illustrates the changes in Human Impact Index (HII) for carbon offsetting projects involving forest expansion, differentiated by the type of land converted. The sample includes projects converting pasture or shrubland to forest (green line), other land use types to forest (red line), and projects without forest expansion (black line). The x-axis represents years relative to project establishment, spanning from t-5 to t+5. The y-axis shows the mean HII values. Shaded areas depict the 10th to 90th percentile range of HII values for each project type. The vertical dashed line at t=0 marks the project establishment year. Higher HII values indicate greater human impact on local ecosystems.

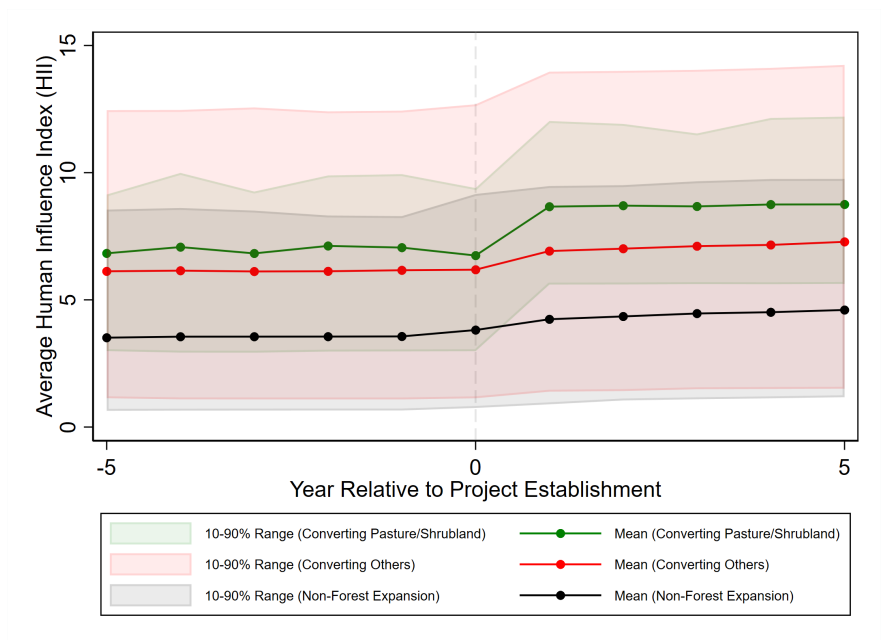


Table 1: Summary of Top Buyers and their Credit Volumes

## Panel A: All the credit volumes

Buyer	Industry	Sum of Credit Volume
Delta	Aviation	40,537,111
Shell	Energy	30,492,007
Toucan Token	Technology and Telecommunication	22,119,936
PRIMAX COLOMBIA	Energy	20,654,016
Eni	Energy	13,406,656
Chevron	Energy	11,945,963
Takeda	Healthcare	11,116,338
easyJet	Aviation	11,088,274
Volkswagen	Industrials	10,957,763
Hu-Chems Fine Corp	Materials	10,167,493
Biofix Consultoría	Professional Services Firms	9,984,218
Banco Votorantim	Financial Services	9,899,219
Biomax Biocombustibles	Energy	9,520,524
LSB Industries	Industrials	7,951,096
Telstra	Technology and Telecommunication	7,625,653
AUDI	Ground and Maritime Transportation	7,091,586
Terpel	Energy	6,966,156
Disney	Consumer Services	6,210,483
Interface	Industrials	5,972,412
Petróleos del Milenio	Energy	5,832,221

## Panel B: Credits Related to Biodiversity

Buyer	Industry	Sum of Credit Volume
Shell	Energy	25,550,670
PRIMAX COLOMBIA	Energy	16,469,884
Delta	Aviation	15,128,050
Eni	Energy	11,809,160
Biofix Consultoría	Professional Services Firms	9,984,218
Chevron	Energy	7,880,886
easyJet	Aviation	7,202,146
Volkswagen	Industrials	7,107,138
Disney	Consumer Services	5,274,148
ENTEGA	Energy	4,877,217
Greenchoice	Energy	4,714,574
Gucci	Fashion	4,385,010
AUDI	Ground and Maritime Transportation	4,063,253
Terpel	Energy	3,892,003
PetroChina	Energy	3,772,096
Takeda	Healthcare	3,338,971
Petróleos del Milenio	Energy	3,103,821
Zeuss Petroleum	Energy	2,680,090
Tokyo Gas	Energy	2,446,956
Toucan Token	Technology and Telecommunication	2,308,886

Table 2: Summary Statistics

This table presents summary statistics for the Human Impact Index (HII) across individual carbon offsetting projects. For each project, we calculate zonal summaries of the HII by overlaying the project boundaries with the HII data, producing key statistics—mean, minimum, maximum, and standard deviation—of HII values within each project’s area. Panel A shows these summary statistics for the full sample, while Panel B presents the statistics for a balanced subsample, restricted to projects observed consistently from five years before to five years after their establishment.

Panel A: Original Sample								
	count	mean	sd	min	p25	p50	p75	max
Average of HII	40,480	5.989	5.632	0.000	1.840	3.894	8.829	48.184
Minimum of HII	40,480	2.744	4.308	0.000	0.110	0.875	3.300	47.190
Maximum of HII	40,480	15.184	9.968	0.000	8.070	13.245	18.550	63.000
Standard Deviation of HII	40,480	2.380	1.481	0.000	1.548	2.107	3.118	13.258
Panel B: Balanced Sample								
	count	mean	sd	min	p25	p50	p75	max
Average of HII	19,022	5.676	5.223	0.000	1.872	3.516	8.464	48.184
Minimum of HII	19,022	2.635	4.194	0.000	0.120	0.860	3.110	47.190
Maximum of HII	19,022	14.396	8.722	0.000	8.080	13.140	17.950	61.650
Standard Deviation of HII	19,022	2.327	1.388	0.000	1.607	2.093	3.018	13.258

Table 3: Biodiversity Impact of Carbon Offsetting Projects

This table reports the effects of carbon offsetting projects on biodiversity outcomes, as measured by the Human Impact Index (HII). The dependent variable across all specifications is the average HII. Columns (1)–(2) present the average treatment effects for the full sample of carbon offsetting projects, while Columns (3)–(7) restrict the analysis to a balanced subsample, limited to observations from five years before to five years after project establishment. In Columns (1)–(4) and (6), the key independent variable is PostEstablishment, a dummy variable that takes the value of 1 if the project has been established. In Columns (5) and (7), the independent variables include a set of time-period dummy variables. Standard errors, clustered at the project level, are reported in parentheses. Statistical significance is denoted by \*\*\*, \*\*, and \* for the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: <i>Average HII</i>						
PostEstablishment	1.297*** (0.093)	0.648*** (0.232)	0.822*** (0.032)	0.663* (0.386)		0.187*** (0.050)	
5YearBeforeEstablishment					-0.499 (0.483)		-0.114* (0.067)
4YearBeforeEstablishment					-0.413 (0.360)		-0.063 (0.046)
3YearBeforeEstablishment					-0.295 (0.236)		-0.033 (0.034)
2YearBeforeEstablishment					-0.133 (0.112)		-0.024 (0.021)
EstablishmentYear					0.414*** (0.120)		0.243*** (0.041)
1YearAfterEstablishment					0.351 (0.232)		0.017 (0.058)
2YearAfterEstablishment					0.543 (0.346)		0.072 (0.057)
3YearAfterEstablishment					0.868* (0.468)		0.159*** (0.053)
4YearAfterEstablishment					0.863 (0.590)		0.089** (0.040)
5YearAfterEstablishment					0.696 (0.706)		
Observations	40,480	40,480	19,022	19,022	19,022	19,022	19,022
Adjusted R-squared	0.012	0.337	0.006	0.220	0.220	0.973	0.973
Country FE	N	Y	N	Y	Y	Y	Y
Year FE	N	Y	N	Y	Y	Y	Y
Registry FE	N	Y	N	Y	Y	Y	Y
Project FE	N	N	N	N	N	Y	Y

Table 4: Robustness: Biodiversity Impact of Carbon Offsetting Projects

This table reports the effects of carbon offsetting projects on biodiversity outcomes, as measured by the Human Impact Index (HII). The dependent variable across all specifications is the log of the average HII. Columns (1)–(2) present the average treatment effects for the full sample of carbon offsetting projects, while Columns (3)–(7) restrict the analysis to a balanced subsample, limited to observations from five years before to five years after project establishment. In Columns (1)–(4) and (6), the key independent variable is PostEstablishment, a dummy variable that takes the value of 1 if the project has been established. In Columns (5) and (7), the independent variables include a set of time-period dummy variables. Standard errors, clustered at the project level, are reported in parentheses. Statistical significance is denoted by \*\*\*, \*\*, and \* for the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: $\log(\text{Average HII})$						
PostEstablishment	0.323*** (0.019)	0.175*** (0.047)	0.222*** (0.011)	0.091 (0.069)		0.050*** (0.019)	
5YearBeforeEstablishment					-0.060 (0.083)		-0.040 (0.024)
4YearBeforeEstablishment					-0.050 (0.062)		-0.020 (0.016)
3YearBeforeEstablishment					-0.032 (0.042)		-0.010 (0.011)
2YearBeforeEstablishment					-0.017 (0.022)		-0.009 (0.007)
EstablishmentYear					0.094*** (0.027)		0.071*** (0.018)
1YearAfterEstablishment					0.033 (0.044)		0.000 (0.020)
2YearAfterEstablishment					0.058 (0.062)		0.010 (0.020)
3YearAfterEstablishment					0.088 (0.081)		0.025 (0.017)
4YearAfterEstablishment					0.078 (0.101)		0.020 (0.013)
5YearAfterEstablishment					0.022 (0.120)		
Observations	40,430	40,430	19,002	19,002	19,002	19,002	19,002
Adjusted R-squared	0.017	0.242	0.010	0.146	0.146	0.932	0.932
Country FE	N	Y	N	Y	Y	Y	Y
Year FE	N	Y	N	Y	Y	Y	Y
Registry FE	N	Y	N	Y	Y	Y	Y
Project FE	N	N	N	N	N	Y	Y

Table 5: Heterogeneity: Biodiversity Impact of Carbon Offsetting Projects

This table reports the cross-sectional effects of carbon offsetting projects on biodiversity outcomes, as measured by the Human Impact Index (HII). The dependent variable across all specifications is the average HII. Panels A–D present results from split-sample analyses: Panel A examines projects with low versus high HII prior to establishment; Panel B focuses on projects that disclose biodiversity benefits versus those that do not; Panel C evaluates projects with biodiversity requirements versus those without; and Panel D considers projects located in protected areas versus those not located in such areas. In Columns (1)–(4) and (7)–(8), the key independent variable is *PostEstablishment*, a dummy variable that takes the value of 1 if the project has been established. In Columns (5)–(6) and (9)–(10), the independent variables include a set of time-period dummy variables. Panel E tests all the above variables separately in the pooled sample. The analysis is conducted in a balanced subsample, limited to observations from five years before to five years after project establishment. Standard errors, clustered at the project level, are reported in parentheses. Statistical significance is denoted by \*\*\*, \*\*, and \* for the 1%, 5%, and 10% levels, respectively.

Panel A: Low HII Before Establishment										
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LowHIIBeforeEstablishment:	Y	N	Y	N	Y	N	Y	N	Y	N
Dependent variable: <i>Average HII</i>										
<i>PostEstablishment</i>	0.620*** (0.037)	1.020*** (0.051)	-0.261** (0.122)	0.854* (0.474)			0.140 (0.112)	0.223*** (0.055)		
<i>5YearBeforeEstablishment</i>					0.252* (0.148)	-0.572 (0.589)			-0.302* (0.164)	-0.060 (0.072)
<i>4YearBeforeEstablishment</i>					0.271** (0.108)	-0.455 (0.442)			-0.134 (0.112)	-0.055 (0.052)
<i>3YearBeforeEstablishment</i>					0.172** (0.075)	-0.325 (0.290)			-0.098 (0.078)	-0.029 (0.040)
<i>2YearBeforeEstablishment</i>					0.067 (0.041)	-0.166 (0.140)			-0.070 (0.046)	-0.015 (0.025)
<i>EstablishmentYear</i>					0.251*** (0.074)	0.358** (0.145)			0.378*** (0.090)	0.150*** (0.045)
<i>1YearAfterEstablishment</i>					-0.525*** (0.112)	0.623** (0.280)			-0.266** (0.133)	0.196*** (0.062)
<i>2YearAfterEstablishment</i>					-0.586*** (0.129)	0.850** (0.418)			-0.215* (0.122)	0.231*** (0.063)
<i>3YearAfterEstablishment</i>					-0.563*** (0.145)	1.267** (0.570)			-0.063 (0.094)	0.276*** (0.065)
<i>4YearAfterEstablishment</i>					-0.602*** (0.186)	1.226* (0.719)			0.057 (0.068)	0.094* (0.050)
<i>5YearAfterEstablishment</i>					-0.823*** (0.258)	1.233 (0.855)				
Observations	9,514	9,508	9,514	9,508	9,514	9,508	9,514	9,508	9,514	9,508
Adjusted R-squared	0.068	0.010	0.240	0.205	0.249	0.205	0.682	0.962	0.688	0.962
Country FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Registry FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Project FE	N	N	N	N	N	N	Y	Y	Y	Y

Panel B: Disclose Biodiversity Benefit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Dependent variable: <i>Average HII</i>									
DiscloseBiodiversityBenefit:	Y	N	Y	N	Y	N	Y	N	Y	N
PostEstablishment	0.441*** (0.075)	0.850*** (0.033)	-0.700 (0.524)	1.229** (0.485)			0.115* (0.060)	0.189*** (0.066)		
5YearBeforeEstablishment					1.029 (0.695)	-1.153* (0.619)			-0.109* (0.063)	-0.139 (0.093)
4YearBeforeEstablishment					0.765 (0.525)	-0.889* (0.461)			-0.078* (0.046)	-0.074 (0.064)
3YearBeforeEstablishment					0.482 (0.353)	-0.593** (0.301)			-0.069** (0.033)	-0.032 (0.047)
2YearBeforeEstablishment					0.238 (0.182)	-0.280** (0.143)			-0.032 (0.022)	-0.033 (0.028)
EstablishmentYear					-0.262 (0.184)	0.620*** (0.148)			0.039 (0.030)	0.305*** (0.053)
1YearAfterEstablishment					-0.485 (0.383)	0.602** (0.292)			0.112 (0.072)	-0.078 (0.076)
2YearAfterEstablishment					-0.733 (0.553)	1.018** (0.435)			0.167** (0.074)	-0.024 (0.074)
3YearAfterEstablishment					-1.175 (0.737)	1.657*** (0.589)			0.058 (0.064)	0.135* (0.069)
4YearAfterEstablishment					-1.603* (0.930)	1.854** (0.739)			0.049 (0.045)	0.078 (0.049)
5YearAfterEstablishment					-2.097* (1.137)	1.881** (0.875)				
Observations	1,295	17,727	1,295	17,727	1,295	17,727	1,295	17,727	1,295	17,727
Adjusted R-squared	0.001	0.007	0.710	0.200	0.713	0.201	0.989	0.972	0.989	0.972
Country FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Registry FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Project FE	N	N	N	N	N	N	Y	Y	Y	Y

Panel C: Has Biodiversity Requirement

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Dependent variable: <i>Average HII</i>									
HasBiodiversityRequirement:	Y	N	Y	N	Y	N	Y	N	Y	N
PostEstablishment	0.690*** (0.038)	1.033*** (0.054)	-0.642* (0.329)	0.088 (0.445)			0.265*** (0.077)	0.141** (0.061)		
5YearBeforeEstablishment					0.869** (0.434)	0.075 (0.646)			-0.305** (0.122)	-0.035 (0.079)
4YearBeforeEstablishment					0.594* (0.323)	0.048 (0.478)			-0.207** (0.086)	-0.004 (0.060)
3YearBeforeEstablishment					0.377* (0.206)	-0.001 (0.322)			-0.122* (0.063)	-0.015 (0.046)
2YearBeforeEstablishment					0.167* (0.095)	0.010 (0.162)			-0.078** (0.037)	-0.000 (0.029)
EstablishmentYear					0.125 (0.109)	0.029 (0.195)			0.381*** (0.066)	0.046 (0.040)
1YearAfterEstablishment					-0.557*** (0.194)	0.071 (0.363)			-0.025 (0.087)	0.140* (0.081)
2YearAfterEstablishment					-0.808*** (0.288)	0.093 (0.519)			0.010 (0.084)	0.222*** (0.080)
3YearAfterEstablishment					-0.947** (0.382)	0.210 (0.719)			0.169** (0.075)	0.176** (0.079)
4YearAfterEstablishment					-1.339*** (0.482)	-0.026 (0.898)			0.148*** (0.050)	0.022 (0.073)
5YearAfterEstablishment					-1.905*** (0.592)	-0.227 (1.089)				
Observations	11,711	7,311	11,711	7,311	11,711	7,311	11,711	7,311	11,711	7,311
Adjusted R-squared	0.007	0.009	0.387	0.283	0.390	0.282	0.963	0.970	0.964	0.970
Country FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Registry FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Project FE	N	N	N	N	N	N	Y	Y	Y	Y

Panel D: Located In Protective Area

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LocatedInProtectiveArea:	Y	N	Y	N	Y	N	Y	N	Y	N
Dependent variable: <i>Average HII</i>										
PostEstablishment	0.869*** (0.064)	0.807*** (0.036)	-0.698* (0.379)	1.366** (0.591)			0.236*** (0.072)	0.167** (0.074)		
5YearBeforeEstablishment					0.993** (0.439)	-1.175 (0.780)			-0.234*** (0.088)	-0.002 (0.097)
4YearBeforeEstablishment					0.710** (0.330)	-0.942 (0.574)			-0.158** (0.063)	0.023 (0.066)
3YearBeforeEstablishment					0.460** (0.215)	-0.673* (0.375)			-0.089* (0.046)	0.018 (0.049)
2YearBeforeEstablishment					0.176* (0.105)	-0.328* (0.182)			-0.072** (0.029)	0.024 (0.028)
EstablishmentYear					0.025 (0.128)	0.650*** (0.188)			0.256*** (0.059)	0.247*** (0.061)
1YearAfterEstablishment					-0.419* (0.235)	0.832** (0.367)			0.098 (0.079)	-0.018 (0.085)
2YearAfterEstablishment					-0.682** (0.343)	1.241** (0.541)			0.138* (0.074)	0.043 (0.083)
3YearAfterEstablishment					-0.951** (0.452)	1.929*** (0.734)			0.192*** (0.069)	0.152* (0.079)
4YearAfterEstablishment					-1.376** (0.567)	2.190** (0.931)			0.135*** (0.052)	0.068 (0.061)
5YearAfterEstablishment					-1.954*** (0.694)	2.307** (1.113)				
Observations	4,790	14,232	4,790	14,232	4,790	14,232	4,790	14,232	4,790	14,232
Adjusted R-squared	0.009	0.005	0.361	0.228	0.365	0.229	0.965	0.975	0.965	0.975
Country FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Registry FE	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Project FE	N	N	N	N	N	N	Y	Y	Y	Y

Panel E: All				
VARIABLES	(1)	(2)	(3)	(4)
	Dependent variable: <i>Average HII</i>			
PostEstablishment	0.388*** (0.057)	0.204*** (0.053)	0.444*** (0.062)	0.149*** (0.056)
LowHIIBeforeEstablishment x PostEstablishment	-0.479*** (0.063)			
DiscloseBiodiversityBenefit x PostEstablishment		-0.121 (0.082)		
HasBiodiversityRequirement x PostEstablishment			-0.430*** (0.065)	
LocatedInProtectedArea x PostEstablishment				0.110 (0.072)
Observations	19,022	19,022	19,022	19,022
Adjusted R-squared	0.974	0.973	0.974	0.973
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Registry FE	Y	Y	Y	Y
Project FE	Y	Y	Y	Y

Table 6: Robustness: Biodiversity Impact of Carbon Offsetting Projects

This table reports the effects of carbon offsetting projects on biodiversity outcomes, as measured by the Biodiversity Habitat Index (BHI) and Bioclimatic Ecosystem Resilience Index (BERI). Similar to our main specification, we conduct our analysis in a balanced subsample, limited to observations from five years before to five years after project establishment. BHI estimates the level of species diversity expected to be retained within any given spatial reporting unit as a function of the unit's area, connectivity and integrity of natural ecosystems across it. BHI can be measured in both portion of species and portion of habitats. BERI measures the capacity of natural ecosystems to retain species diversity in the face of climate change, as a function of ecosystem area, connectivity and integrity - it assesses the extent to which any given spatial configuration of natural habitat across a landscape would promote or hinder climate-induced shifts in biological distributions. The key independent variable is PostEstablishment, a dummy variable that takes the value of 1 if the project has been established. Standard errors, clustered at the project level, are reported in parentheses. Statistical significance is denoted by \*\*\*, \*\*, and \* for the 1%, 5%, and 10% levels, respectively.

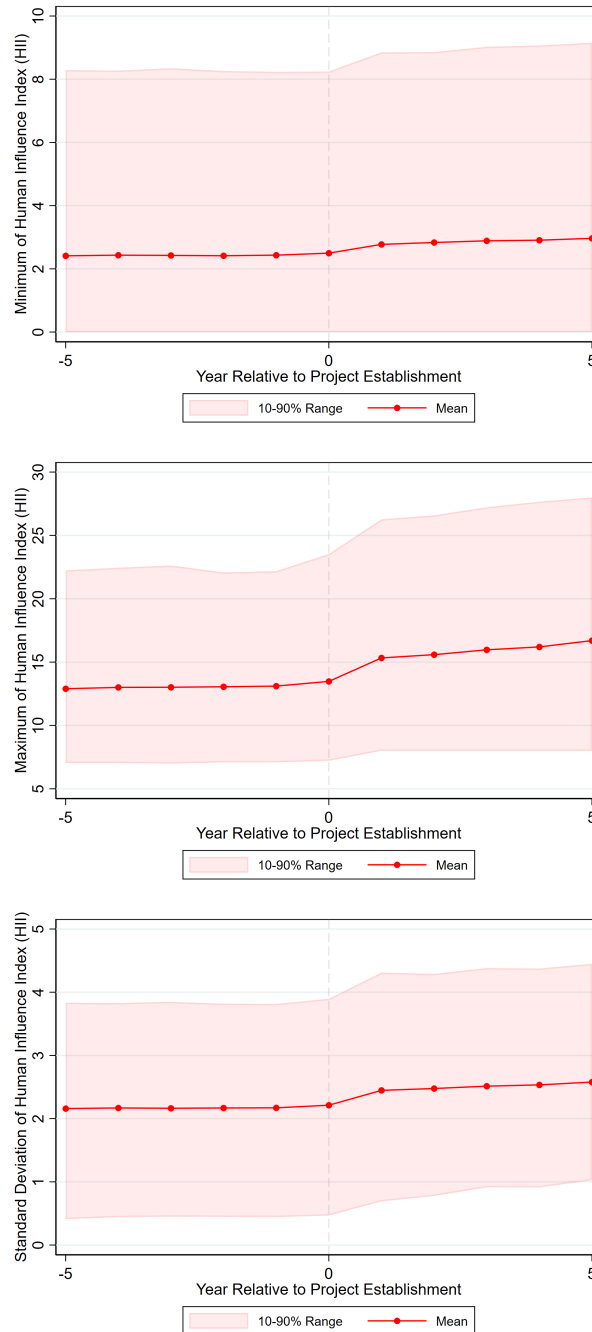
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	Average BERI					log(Average BERI)					Average BHI					log(Average BHI)				
PostEstablishment	-0.011*** (0.001)	-0.035** (0.016)		0.000 (0.001)		-0.033*** (0.003)	-0.170** (0.078)		0.003 (0.004)		-0.014*** (0.001)	-0.020 (0.014)		-0.000 (0.001)		-0.027*** (0.002)	-0.032 (0.024)		-0.000 (0.001)	
6To10yearsBeforeEstablishment			0.001 (0.002)	0.000 (0.001)			0.001 (0.009)		-0.003 (0.003)				0.001 (0.001)	0.000 (0.001)				0.001 (0.002)	0.000 (0.001)	
0to5yearsAfterEstablishment			-0.037** (0.018)	0.002 (0.001)			-0.186** (0.085)		0.005 (0.005)				-0.021 (0.015)	-0.000 (0.001)				-0.034 (0.027)	-0.001 (0.002)	
6to10yearsAfterEstablishment			-0.075** (0.035)	0.004 (0.004)			-0.371** (0.171)		0.013 (0.012)				-0.043 (0.031)	-0.001 (0.003)				-0.070 (0.054)	-0.004 (0.005)	
Observations	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596	596
Adjusted R-squared	0.000	0.535	0.538	0.993	0.993	0.001	0.490	0.493	0.997	0.997	0.001	0.619	0.619	0.997	0.997	0.001	0.616	0.616	0.997	0.997
Country FE	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Year FE	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Registry FE	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Project FE	N	N	N	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y

## Appendix

Figure A1: Robustness of Figure 4: Biodiversity Impact of Carbon Offsetting Projects

This figure shows the impact of carbon offsetting projects on biodiversity using the Human Impact Index (HII). Panel A shows the minimum, maximum, and standard deviation of HII for all carbon offsetting projects across time in the study. Panel B shows the minimum, maximum, and standard deviation of HII for projects located in areas with initially low human impact, determined by using the median of HII value from the year before project establishment. The x-axis represents years relative to project establishment, spanning from  $t-5$  to  $t+5$ . The y-axis shows the maximum HII values. Shaded areas depict the 10th to 90th percentile range of maximum HII values for each project type. The vertical dashed line at  $t=0$  marks the project establishment year. Higher HII values indicate greater human impact on local ecosystems.

Panel A: Full Sample



Panel B: Based on Pre-Establishment HII Levels

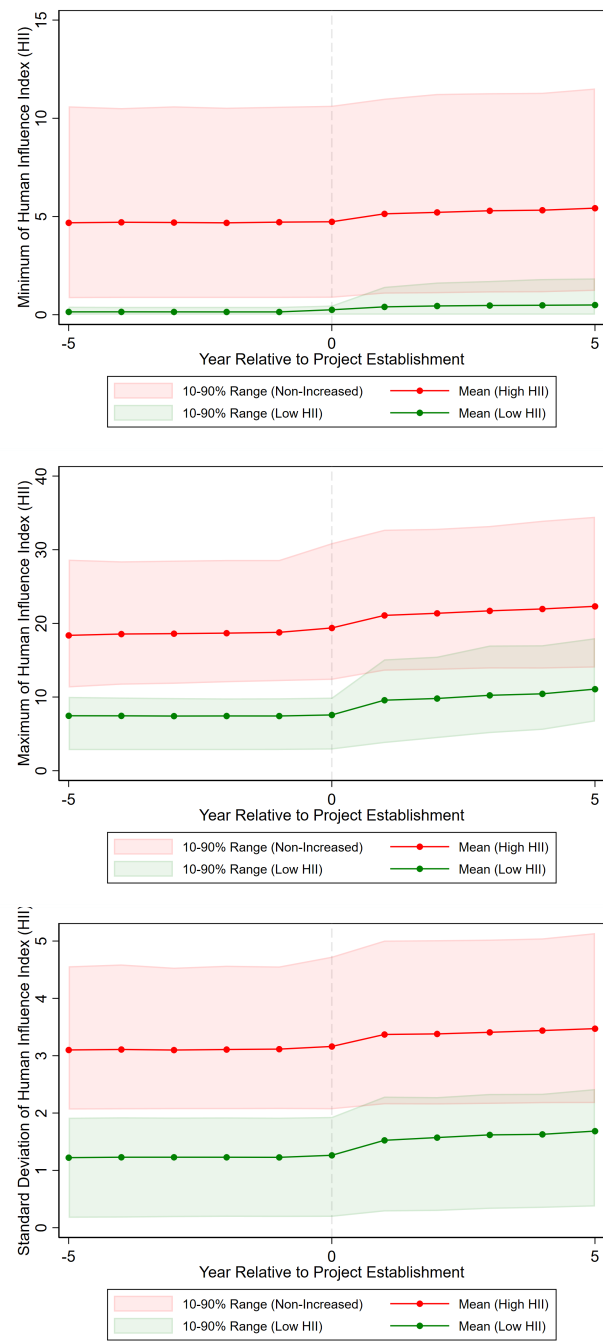
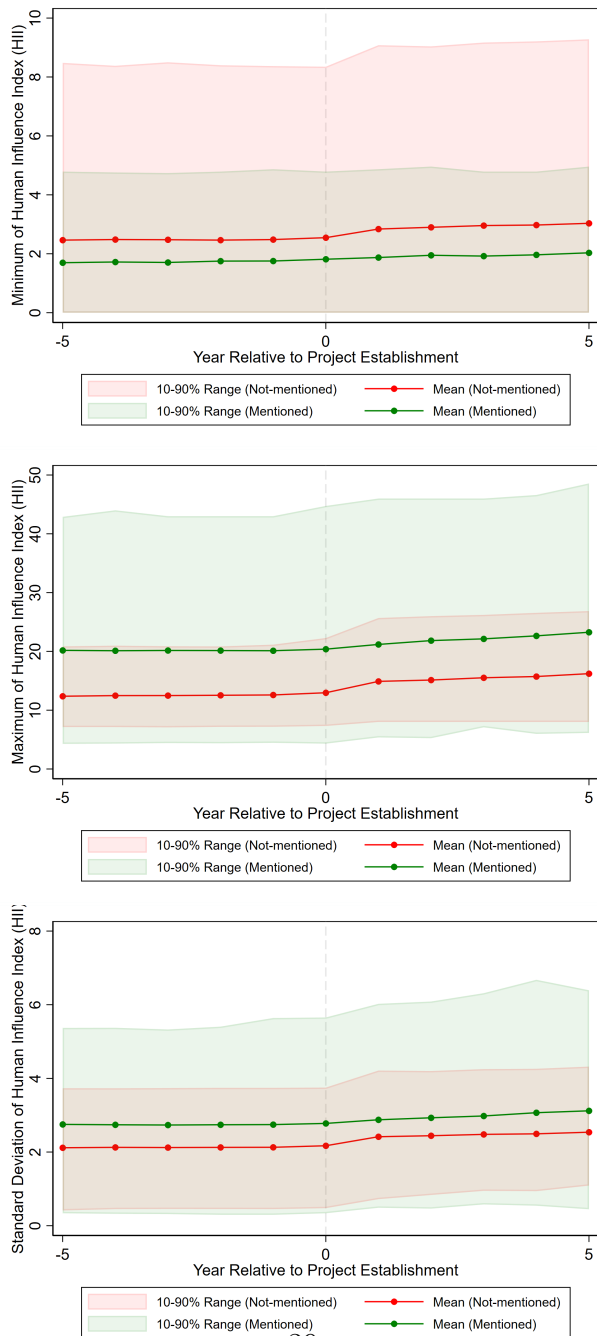


Figure A2: Robustness of Figure 5: Biodiversity Impact of Carbon Offsetting Projects Based on Project Self-disclosure and Registry Requirements

This figure illustrates the biodiversity impact of carbon offsetting projects, categorized by project characteristics. Panel A presents the minimum, maximum, and standard deviation of HII for projects that self-disclose biodiversity benefits in their documentation. Panel B presents the minimum, maximum, and standard deviation of HII for projects that are subject to specific biodiversity and conservation requirements set by carbon offset registries. The x-axis represents years relative to project establishment, spanning from t-5 to t+5. The y-axis shows the maximum HII values. Shaded areas depict the 10th to 90th percentile range of maximum HII values for each project type. The vertical dashed line at t=0 marks the project establishment year. Higher HII values indicate greater human impact on local ecosystems.

Panel A: Projects Disclosing Biodiversity Benefits



Panel B: Projects with Biodiversity and Conservation Requirements

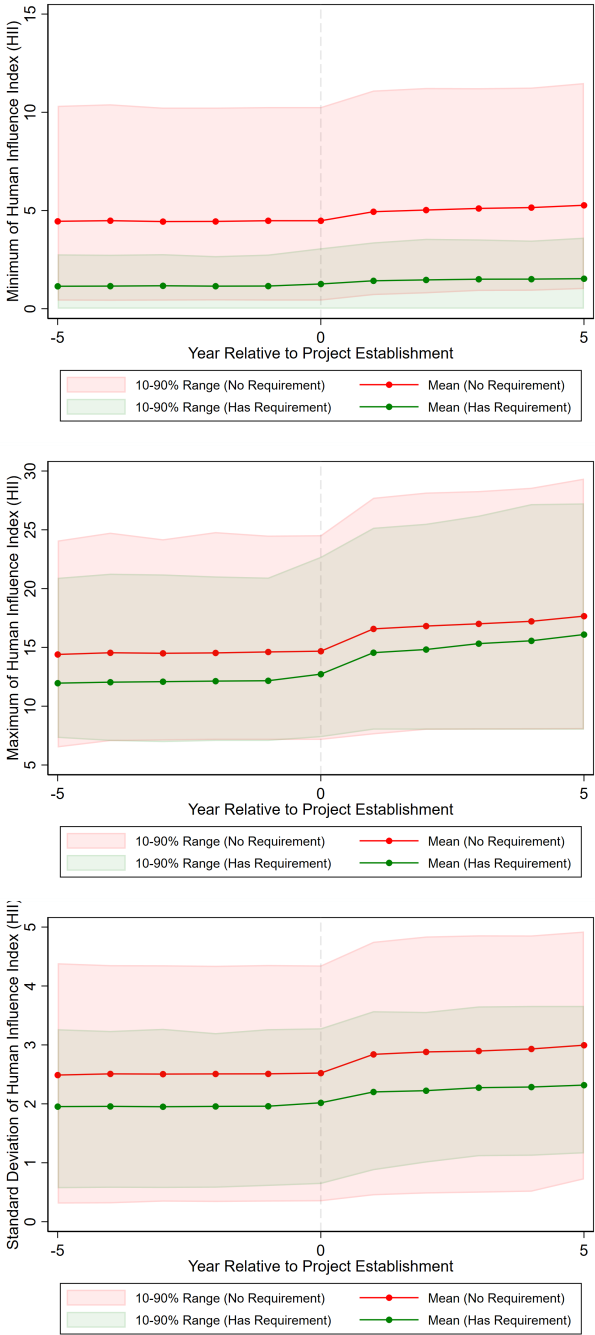


Figure A3: Robustness of Figure 6: Biodiversity Impact of Carbon Offsetting Projects Based on Protected Area Location

This figure indicates how the location of carbon offsetting projects in relation to protected areas influences their impact on biodiversity, as measured by changes in the HII. Protected areas are defined according to the World Database on Protected Areas (WDPA) classification as the "Strict Nature Reserve". The x-axis represents years relative to project establishment, spanning from  $t-5$  to  $t+5$ . The y-axis shows the minimum, maximum, and standard deviation of HII values. Shaded areas depict the 10th to 90th percentile range for each project type. The vertical dashed line at  $t=0$  marks the project establishment year. Higher HII values indicate greater human impact on local ecosystems.

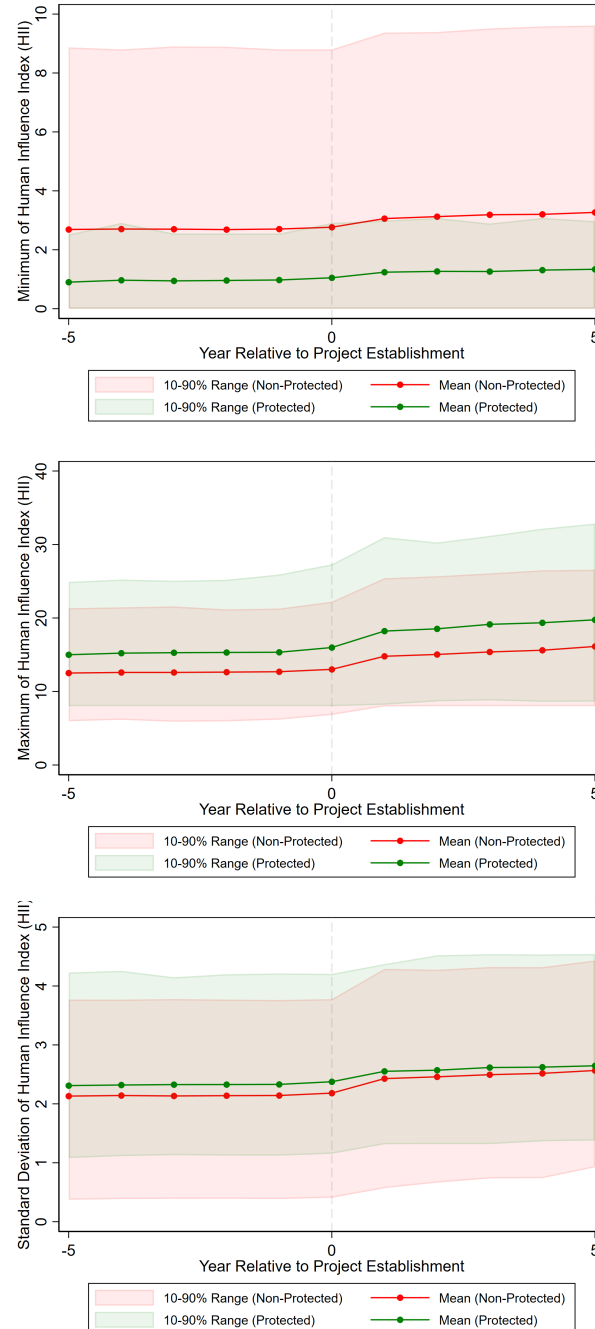


Figure A4: Robustness of Figure 7: Biodiversity Impact of Carbon Offsetting Projects Based on Land Use and Land Cover Types

This figure illustrates the changes in Human Impact Index (HII) for carbon offsetting projects involving forest expansion, differentiated by the type of land converted. The sample includes projects converting pasture or shrubland to forest (green line), other land use types to forest (red line), and projects without forest expansion (black line). The x-axis represents years relative to project establishment, spanning from t-5 to t+5. The y-axis shows the minimum, maximum, and standard deviation of HII values. Shaded areas depict the 10th to 90th percentile range for each project type. The vertical dashed line at t=0 marks the project establishment year. Higher HII values indicate greater human impact on local ecosystems.

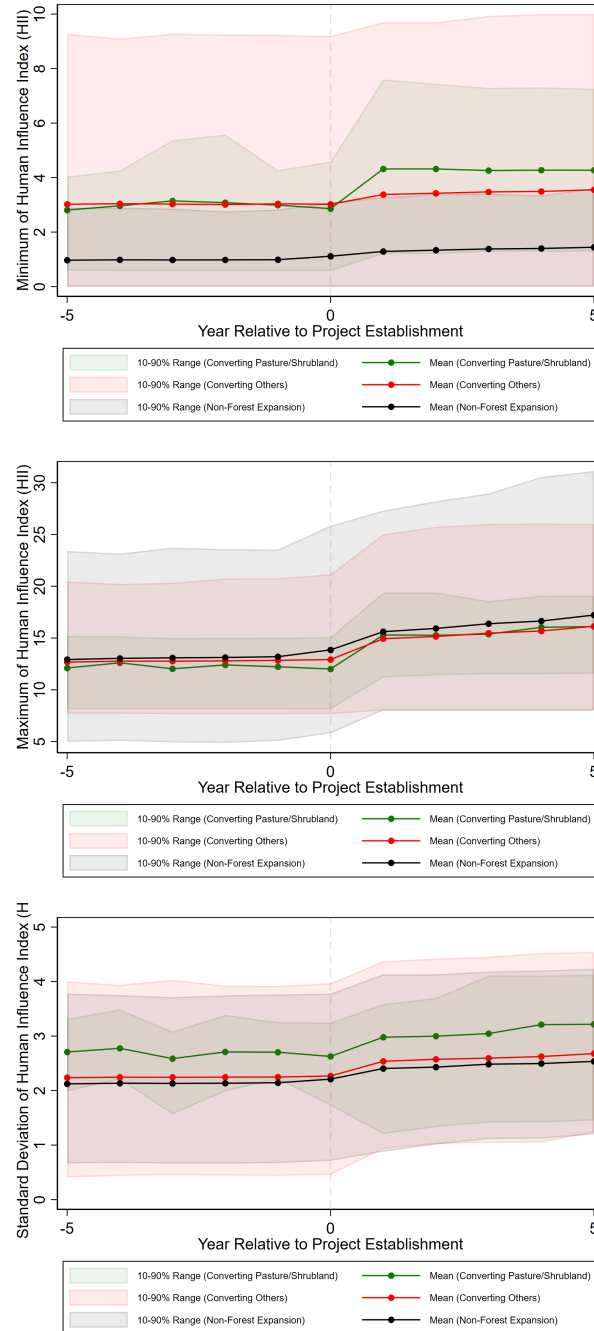


Table A1: Robustness of Table 3: Biodiversity Impact of Carbon Offsetting Projects

This table reports the effects of carbon offsetting projects on biodiversity outcomes, as measured by the Human Impact Index (HII). The dependent variables in Panels A, B, and C are the minimum, maximum, and standard deviation of HII values, respectively. Columns (1)–(2) present results for the full sample of carbon offsetting projects, while Columns (3)–(7) restrict the analysis to a balanced subsample, limited to observations from five years before to five years after project establishment. In Columns (1)–(4) and (6), the key independent variable is PostEstablishment, a dummy variable that takes the value of 1 if the project has been established. In Columns (5) and (7), the independent variables include a set of time-period dummy variables. Standard errors, clustered at the project level, are reported in parentheses. Statistical significance is denoted by \*\*\*, \*\*, and \* for the 1%, 5%, and 10% levels, respectively.

VARIABLES	Panel A: Minimum of HII						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: <i>Minimum of HII</i>						
PostEstablishment	0.702*** (0.069)	0.708*** (0.208)	0.387*** (0.026)	0.828** (0.343)		0.079** (0.039)	
5YearBeforeEstablishment					-0.821* (0.437)		-0.029 (0.067)
4YearBeforeEstablishment					-0.585* (0.326)		0.017 (0.047)
3YearBeforeEstablishment					-0.404* (0.213)		0.016 (0.035)
2YearBeforeEstablishment					-0.182* (0.101)		0.010 (0.023)
EstablishmentYear					0.356*** (0.105)		0.115*** (0.032)
1YearAfterEstablishment					0.475** (0.206)		-0.003 (0.047)
2YearAfterEstablishment					0.724** (0.306)		0.026 (0.044)
3YearAfterEstablishment					1.113*** (0.415)		0.064 (0.042)
4YearAfterEstablishment					1.324** (0.524)		0.018 (0.029)
5YearAfterEstablishment					1.498** (0.617)		
5YearAfterEstablishment = 0,							-
Observations	40,480	40,480	19,022	19,022	19,022	19,022	19,022
Adjusted R-squared	0.006	0.258	0.002	0.208	0.210	0.970	0.970
Country FE	N	Y	N	Y	Y	Y	Y
Year FE	N	Y	N	Y	Y	Y	Y
Registry FE	N	Y	N	Y	Y	Y	Y
Project FE	N	N	N	N	N	Y	Y

Panel B: Maximum of HII							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: <i>Maximum of HII</i>						
PostEstablishment	3.157*** (0.166)	-0.509 (0.450)	2.527*** (0.081)	-0.626 (0.683)		0.472*** (0.110)	
5YearBeforeEstablishment					1.208 (0.771)		-0.398** (0.160)
4YearBeforeEstablishment					0.790 (0.579)		-0.196* (0.114)
3YearBeforeEstablishment					0.517 (0.391)		-0.093 (0.081)
2YearBeforeEstablishment					0.255 (0.200)		-0.072 (0.051)
EstablishmentYear					0.255 (0.224)		0.551*** (0.095)
1YearAfterEstablishment					-0.404 (0.433)		0.188 (0.123)
2YearAfterEstablishment					-0.625 (0.646)		0.302** (0.124)
3YearAfterEstablishment					-0.872 (0.863)		0.435*** (0.122)
4YearAfterEstablishment					-1.704 (1.088)		0.271*** (0.100)
5YearAfterEstablishment					-2.914** (1.341)		
Observations	40,480	40,480	19,022	19,022	19,022	19,022	19,022
Adjusted R-squared	0.023	0.422	0.021	0.311	0.313	0.935	0.935
Country FE	N	Y	N	Y	Y	Y	Y
Year FE	N	Y	N	Y	Y	Y	Y
Registry FE	N	Y	N	Y	Y	Y	Y
Project FE	N	N	N	N	N	Y	Y

Panel C: Standard Deviation of HII							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable: <i>Standard Deviation of HII</i>						
PostEstablishment	0.383*** (0.023)	0.044 (0.068)	0.294*** (0.014)	-0.032 (0.100)		0.059*** (0.019)	
5YearBeforeEstablishment					0.088 (0.116)		-0.042 (0.029)
4YearBeforeEstablishment					0.044 (0.087)		-0.020 (0.021)
3YearBeforeEstablishment					0.024 (0.058)		-0.015 (0.016)
2YearBeforeEstablishment					0.017 (0.029)		-0.010 (0.010)
EstablishmentYear					0.033 (0.033)		0.060*** (0.016)
1YearAfterEstablishment					-0.023 (0.064)		0.034 (0.024)
2YearAfterEstablishment					-0.040 (0.094)		0.045* (0.023)
3YearAfterEstablishment					-0.044 (0.126)		0.065*** (0.021)
4YearAfterEstablishment					-0.137 (0.159)		0.047*** (0.018)
5YearAfterEstablishment					-0.318 (0.198)		
Observations	40,480	40,480	19,022	19,022	19,022	19,022	19,022
Adjusted R-squared	0.016	0.204	0.011	0.136	0.136	0.922	0.922
Country FE	N	Y	N	Y	Y	Y	Y
Year FE	N	Y	N	Y	Y	Y	Y
Registry FE	N	Y	N	Y	Y	Y	Y
Project FE	N	N	N	N	N	Y	Y

Table A2: Robustness of Table 5: Heterogeneity: Biodiversity Impact of Carbon Offsetting Projects

This table reports the cross-sectional effects of carbon offsetting projects on biodiversity outcomes, as measured by the Human Impact Index (HII). The dependent variables in Panels A, B, and C are the minimum, maximum, and standard deviation of HII, respectively. LowHIIBeforeEstablishment is a dummy variable equal to 1 for projects with low HII prior to establishment and 0 for those with high HII. DiscloseBiodiversityBenefit is a dummy variable equal to 1 for projects that disclose biodiversity benefits and 0 otherwise. HasBiodiversityRequirement is a dummy variable equal to 1 for projects with biodiversity requirements and 0 for those without. LocatedInProtectedArea is a dummy variable equal to 1 for projects located in protected areas and 0 for those outside such areas. Standard errors, clustered at the project level, are reported in parentheses. Statistical significance is indicated by \*\*\*, \*\*, and \* for the 1%, 5%, and 10% levels, respectively.

Panel A: Minimum of HII				
VARIABLES	(1)	(2)	(3)	(4)
	Dependent variable: <i>Minimum of HII</i>			
PostEstablishment	0.234*** (0.047)	0.090** (0.041)	0.248*** (0.051)	0.075* (0.043)
LowHIIBeforeEstablishment x PostEstablishment	-0.369*** (0.053)			
DiscloseBiodiversityBenefit x PostEstablishment		-0.075 (0.063)		
HasBiodiversityRequirement x PostEstablishment			-0.284*** (0.056)	
LocatedInProtectiveArea x PostEstablishment				0.010 (0.057)
Observations	19,022	19,022	19,022	19,022
Adjusted R-squared	0.970	0.970	0.970	0.970
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Registry FE	Y	Y	Y	Y
Project FE	Y	Y	Y	Y

Panel B: Maximum of HII				
VARIABLES	(1)	(2)	(3)	(4)
	Dependent variable: <i>Maximum of HII</i>			
PostEstablishment	0.429*** (0.132)	0.430*** (0.124)	0.245* (0.130)	-0.027 (0.128)
LowHIIBeforeEstablishment x PostEstablishment	0.103 (0.158)			
DiscloseBiodiversityBenefit x PostEstablishment		0.287 (0.283)		
HasBiodiversityRequirement x PostEstablishment			0.379** (0.151)	
LocatedInProtectiveArea x PostEstablishment				1.464*** (0.196)
Observations	19,022	19,022	19,022	19,022
Adjusted R-squared	0.935	0.935	0.935	0.936
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Registry FE	Y	Y	Y	Y
Project FE	Y	Y	Y	Y

Panel C: Standard Deviation of HII				
VARIABLES	(1)	(2)	(3)	(4)
	Dependent variable: <i>Standard Deviation of HII</i>			
PostEstablishment	0.104*** (0.024)	0.052** (0.021)	0.124*** (0.025)	0.059*** (0.021)
LowHIIBeforeEstablishment x PostEstablishment	-0.107*** (0.029)			
DiscloseBiodiversityBenefit x PostEstablishment		0.046 (0.046)		
HasBiodiversityRequirement x PostEstablishment			-0.109*** (0.031)	
LocatedInProtectiveArea x PostEstablishment				0.000 (0.030)
Observations	19,022	19,022	19,022	19,022
Adjusted R-squared	0.922	0.922	0.922	0.922
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Registry FE	Y	Y	Y	Y
Project FE	Y	Y	Y	Y

Table A3: Carbon Offset Project Types and Categories

Project Category	Project Type
Agriculture	Fertilizer - N20 Grassland/rangeland management Livestock methane No-till/low-till agriculture Rice cultivation/management Sustainable agricultural land management Other - Agriculture
Chemical Processes/Industrial Manufacturing	Nitric Acid  Ozone-depleting substances Carbon capture and storage Coal mine methane Other - Chemical Processes/Industrial Manufacturing
Energy Efficiency/Fuel Switching	Energy efficiency - community-focused (targeting individuals, communities, etc.) Energy efficiency - industrial-focused (targeting corporations) Fuel switching Waste heat recovery Other - Energy Efficiency/Fuel Switching
Forestry and Land Use	Afforestation/reforestation Agro-forestry Avoided conversion Improved forest management REDD - Avoided planned deforestation REDD - Avoided unplanned deforestation Soil carbon Urban forestry Wetland restoration/management Other - Forestry and land use
Household Devices	Clean cookstove distribution Water purification device distribution Other - Household Devices
Renewable Energy	Biogas Biomass/biochar Geothermal Large hydro Run-of-river hydro Solar

### Carbon Offset Project Types and Categories (continued)

Project Category	Project Type
	Wind
	Other - Renewable Energy
Transportation	Transportation - private (cars/trucks)
	Transportation - public (bikes/public transit)
	Other - Transportation
Waste Disposal	Landfill methane
	Waste water methane
	Other - Waste Disposal