HEIDELBERG UNIVERSITY
DEPARTMENT OF ECONOMICS

UNIVERSITÄT
HEIDELBERG
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Environmental Protection and Labor Market Composition

Sreeja Jaiswal

Anca Balietti

Daniel Schäffer

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Sreeja Jaiswal, Anca Balietti, and Daniel Schäffer*

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Abstract

This paper investigates the long-term impacts of protected area management on the labor market participation and composition of the affected population. We study changes spanning two decades in the Western Ghats region of India, one of the key global biodiversity hotspots with the highest population density. Our findings indicate a noteworthy shift toward non-farm employment. Additionally, our research unveils a marked trend towards irregular income patterns: eco-development initiatives appear to have resulted in a significant decline in year-round employment coupled with a corresponding rise in employment for less than six months a year. The primary mechanism we identify is a distinct change in land use patterns, whereby villages under the scope of eco-development initiatives manifest a substantial transition from irrigated to rainfed agricultural land, known to be conducive to seasonal employment. Following these changes, lower consumption levels and higher poverty rates persist in the affected population compared to surrounding areas.

JEL Classification: D04, D10, O10, Q20, Q56.

Keywords: Environmental protection; Labor market participation; Labor composition; Land use changes.

The 2022 Global Biodiversity Framework has set the target of effective conservation and management of at least 30 percent of the Earth's lands, inland waters, coastal zones, and oceans by the year 2030 through protected areas (PAs) and other effective area-based conservation approaches.[1] Although the benefits from biodiversity preservation and the provision of ecosystem services provided by protected areas accrue on a global scale, the costs are borne by the local population residing within and near these areas. This includes displacement, the loss of access to forest resources, agricultural and grazing land, as well as livelihoods. Furthermore, the local communities often grapple with human-wildlife conflicts. Consequently, the impact of protected areas on poverty, human well-being, and other socio-economic outcomes remains a topic of substantial and ongoing debate within the sphere of conservation policy (Ferraro and Hanauer,

*Balietti: Alfred Weber Institute for Economics, Heidelberg University, Bergheimer Str. 20, 69115 Heidelberg, Germany, anca.balietti@awi.uni-heidelberg.de. Jaiswal: Alfred Weber Institute for Economics, Heidelberg University, Bergheimer Str. 20, 69115 Heidelberg, Germany, sreeja.jaiswal@gmail.com. Schäffer: Technical University Berlin, Germany, daniel.schaeffer@mailbox.org. Research was funded by the Alexander von Humboldt Foundation.

[1] Presently, approximately 17 percent of the Earth's terrestrial areas and 10 percent of its marine areas are within protected zones.

2014). Concerns surrounding potential conflicts between the establishment of protected areas and the pursuit of economic development and poverty eradication goals are particularly relevant, especially within the context of developing nations (Ma et al., 2019; Estifanos et al., 2020).

In this paper, we estimate the long-term impact on labor force participation and composition within village communities, prompted by a shift in protected area management policy within the Indian context. During the 1990s, India's approach to protected area management underwent a transformation towards an eco-development paradigm. This paradigm aimed to integrate conservation efforts with rural development initiatives, with the overarching goal of alleviating pressure on forest resources. This was achieved through the creation of alternative employment opportunities and the implementation of participatory management strategies for protected areas. The geographic focus of this study is the Western Ghats in India, which is classified as both a global biodiversity hotspot and a UNESCO World Heritage site.

Our main research question concerns the impact of India's eco-development strategy for managing protected areas on the dynamics of labor force participation and its composition. In theory, we expect that the implementation of the eco-development approach, especially when executed with local participation, can create viable economic opportunities and alternatives to livelihoods reliant on agriculture and forest resources. This, in turn, is anticipated to result in an increase in the share of non-farm employment.

To address the research question, we assess labor market outcomes utilizing data from three successive rounds of Census records. Specifically, we leverage data from the year 1991 as the baseline prior to the initiation of eco-development endeavors, 2001 as an intermediate assessment juncture, and 2011 as the comprehensive long-term endpoint. Our empirical identification consists of estimating a difference-in-differences model with Covariate Balancing Propensity Score weights. The approach aims to address endogenity concerns associated with the non-random placement of protected areas.

The analysis reveals that, although eco-development initiatives did not affect the overall labor force participation among the impacted population, they did lead to a notable decrease in year-round employment accompanied by a concurrent rise in employment for less than half a year. We view this as implicit evidence that eco-development has led to a significant increase in the proportion of the population experiencing irregular incomes throughout the year. Moreover, we find support for the hypothesis that eco-development has led to a shift in labor composition away from agriculture towards non-farm employment. Furthermore, recognizing that specific initiatives within the eco-development framework were tailored towards women, while others were geared more towards men, we investigate heterogeneity in labor market responses by gender. Our findings indicate that labor force participation exhibited a comparable response to eco-development interventions among both men and women. Notably, while the estimated treatment effects are marginally more pronounced for women, they do not exhibit statistically significant differences. Finally, when comparing labor market responses to eco-development in the first versus the second decade since its implementation, our findings establish that the identified effects only accrue over the longer horizon. These outcomes underscore the significance of conducting comprehensive assessments that encompass both short- and long-term perspectives, as the influence of eco-development on the labor market exhibits a dynamic evolution over time.

We complement the main analysis with an investigation of the potential channels through which eco-development affects the labor force participation and its composition. The central mechanism we identify involves changes in land use patterns. More precisely, our analysis provides empirical support indicating that villages subject to eco-development programs experience an increase in the share of forested land, accompanied by a notable shift from irrigated to rainfed agricultural land. These effects resonate with the fundamental aims of eco-development, which revolve around the preservation of forests, soil, and water resources. As seasonal work is known to be in high demand in rainfed agriculture, the changes observed in land use patterns offer a plausible channel through which eco-development has affected the labor force composition. Finally, our investigation brings evidence against the hypothesis that eco-development exerted any discernible impact on local migration patterns.

This paper contributes to a growing literature assessing the impacts of different types of environmental protection on labor market outcomes (Berman and Bui, 2001; Walker, 2013; Ferris, Shadbegian and Wolverton, 2014; Curtis, 2018; Hafstead and Williams III, 2018; Ferris and Frank, 2021; Cheng, Sims and Yi, 2023). Our research makes a valuable contribution by offering strong evidence of significant labor market effects in a developing country context. This is especially relevant given the vulnerability of the affected population, who often experience high levels of poverty and have limited alternative employment opportunities.

A large share of the existing literature aims to identify the causal impact of conservation initiatives on poverty rates and consumption, mostly at the individual or household level. The existing body of evidence yields a diverse range of findings, indicating positive, negative, or no effects on poverty and income levels for households and communities residing in or around protected areas (*e.g.,* Andam et al., 2010; Sims, 2010; Ferraro et al., 2013; Robalino and Villalobos, 2015; Ma et al., 2019; Estifanos et al., 2020). Notably, none of these previous studies focuses on the Indian context. Additionally, with the exception of Beauchamp, Clements and Milner-Gulland (2018), the majority of evidence originates from short-term assessments. Our paper contributes to the existing literature by documenting changes spanning a period of two decades and establishing connections between these shifts and enduring disparities in income and poverty rates between the population directly impacted by protected area management and those residing outside its sphere of influence.

More broadly, this study is part of a growing literature that studies determinants of labor force participation in developing countries (*e.g.*, Bryan, Chowdhury and Mobarak, 2014; Kaur, 2019; Asher and Novosad, 2020; Breza, Kaur and Shamdasani, 2021). The results presented in this study highlight that protected area management can have significant impacts on the workforce composition of the affected population. With these finding, we add to the existing body of evidence that, in developing countries, labor markets are rather flexible and adjust significantly to external shocks (Imbert and Papp, 2015; Akram, Chowdhury and Mobarak, 2017; Breza and Kinnan, 2021). The employment opportunities generated by eco-development lead to a significant shift away from year-round employment to less than six-months in a year employment. This shift can result in less consistent income patterns throughout the year, potentially causing increased variability in consumption. Irregular incomes may exacerbate liquidity constraints, affect eligibility for financial credits, and heighten financial uncertainty among affected households (Beck, Levine and Loayza, 2000; Bauer, Chytilová and Morduch, 2012; Fafchamps, 2013; Hertzberg, Liberman and Paravisini, 2018). In regions with high poverty rates, such income patterns can be particularly concerning, raising questions about their impact on the overall well-being of the affected population (Fink, Jack and Masiye, 2020). Therefore, further research is essential to comprehensively understand the short- and long-term consequences of experiencing irregular incomes. From a policy perspective, it may be necessary to integrate eco-development programs with financial schemes[2] designed to help individuals manage irregular income flows.

I. Background

A. Eco-development

The concept of Integrated Conservation and Development Programs (ICDPs) emerged during the late 1970s and early 1980s as a direct response to the criticism aimed at conventional "fortress conservation" strategies that created protected areas with strict boundaries and limited participation of local communities. Detractors contended that these approaches frequently resulted in conflicts with local populations and fell short in tackling the fundamental drivers of resource exploitation.

In India, a similar shift in conservation paradigm occurred due to challenges such as restricted access to forest resources, instances of human-wildlife conflicts, and conflicts with protected area managers. These circumstances prompted a transition toward more participatory approaches in the management of protected areas, which acknowledged the opportunity costs borne by local communities for the sake of biodiversity preservation, all the while receiving minimal tangible benefits in return (Gubbi and MacMillan, 2008; Chaudhuri, 2013). In India, the ICDP approach was administered through a novel centrally sponsored scheme (CSS) known as the "Eco-development Scheme in and around National Parks and Sanctuaries including Tiger Reserves," which was launched in 1991. Under this scheme, state governments received financial support from the Central government to facilitate the implementation of eco-development initiatives in protected areas. Eco-development had a dual focus: enhancing the well-being

[2] There are notable examples of financial schemes that aim to reduce the impacts of income variability, specifically tailored to a developing country context, aiming at improving financial inclusion (see, *e.g.* Barboni and Agarwal, 2023, and references therein).

of residents within and around protected areas and fostering "ecologically sustainable economic development." With a targeted approach, eco-development centers on a range of context specific activities, including: (1) lessening the reliance of local communities on resources from protected areas through the creation of alternative avenues for income and employment; (2) enhancing the ecological productivity of buffer zones through community engagement; (3) mitigating conflicts between local communities and protection personnel; (4) introducing alternative energy sources; (5) implementing initiatives for soil and water conservation; (6) developing essential infrastructure; and (7) undertaking minor welfare measures (*e.g.*, Ministry of Environment and Forest, Government of India, 1992, 2002).

Although eco-development was launched in 1991, its coverage expanded gradually to encompass more protected areas. Starting from 2002, the endorsement of eco-development became an integral component of the centrally sponsored scheme named "Assistance for Development of National Parks and Sanctuaries," as well of Project Tiger, India's flagship initiative for conservation of tiger species. Subsequently, in 2008, the former initiative underwent expansion and a renaming as 'Integrated Development of Wildlife Habitats'. Between 1991 to 2011, certain eco-development projects also secured funding from multilateral development banks and multilateral funds. Notably, the most significant among these was the India Eco-Development Project, which was operational from 1996 to 2006. This project was executed across five national parks and two tiger reserves, further underlining the growing support and financial commitment towards eco-development initiatives. Table A-1 provides a comprehensive timeline of the implementation of eco-development initiatives in India.

B. The Western Ghats

Among India's ten biogeographic zones, the Western Ghats has the highest percentage of terrestrial area under protection, amounting to ten percent.[3] Acknowledged as a global biodiversity hotspot and designated as a UNESCO World Heritage Site, the Western Ghats is a mountain range that spans six states and runs for 1600 kilometeres parallel to the western coastline of India. Despite covering less than six percent of India's total land area, the Western Ghats is astonishingly rich in biodiversity, harboring over thirty percent of the total plant, fish, amphibian, reptile, bird, and mammal species present in the country. This region serves as the habitat for thirty percent of Asia's elephant population and hosts 18 percent of the wild tigers, both distributed across an extensive network of national parks, wildlife sanctuaries, and tiger reserves (see Bawa et al., 2007).

The Western Ghats is estimated to have the highest population density among all the global

[3]India follows a biogeographic zone classification system for planning and managing a representative network of protected areas.These biogeographic zones are large, distinctive land units classified based on shared ecological attributes, biome representation, as well as the presence of similar communities and species. The Western Ghats biogeographic zone is further subdivided into two distinct biotic provinces: the Western Ghats Mountains and the Western Ghats Malabar Plains (Rodger, Panwar and Mathur, 2002).

biodiversity hotspots worldwide (Cincotta, Wisnewski and Engelman, 2000; Myers et al., 2000). Roughly one-third of the Western Ghats, which spans over 160,000 square kilometers, is comprised of natural habitats. Within this region, there were 50 designated protected areas (national parks and wildlife sanctuaries) that collectively covered an area of 12,716 square kilometers in 1991. The remaining portion of the Western Ghats landscape encompasses a diverse array of land uses. This includes human settlements, artificial reservoirs, and various forms of agricultural activity, such as paddy and vegetable cultivation. Moreover, significant expanses are devoted to extensive plantations including coffee, tea, rubber, and cardamom, alongside crops like pepper, tapioca, and cashew nuts. The plantations span over 10,000 square kilometers and are primarily concentrated in the central and southern regions of the Western Ghats. In tandem, forestry plantations also contribute to the land use mosaic, being more broadly distributed. Collectively, these plantations constitute a substantial proportion of human-utilized land across the Western Ghats landscape (Kale et al., 2016). The protected areas in the Western Ghats often contain other land-uses within, around, or adjoining their borders. According to Anand et al. (2010), "many PAs resemble doughnuts, with human land use within (e.g. hydro-electric projects, tea and coffee plantations) and around them."

II. Empirical Strategy

A. Data

To estimate the long-term impact of eco-development on labor market outcomes we combine socio-economic and geospatial data. As a first step, we create a panel at the village level using the three most recent rounds of the Indian Census (Office of the Registrar General and Census Commissioner, India, 1991, 2001, 2011). The first round corresponds to the year 1991, which we set as the baseline year for the purposes of our analysis. The second and third rounds in 2001 and 2011 respectively, serve as midline and endline periods in our analysis, respectively.[4] The Census provides access to the key labor force outcome measures at the village level used in our analysis. Furthermore, it includes data concerning population counts and literacy rates at the village level, as well as information on different types of land use.

As a second step, we overlaid village and protected area shapefiles. The village shapefiles for the year 2001 were acquired from the Socioeconomic Data and Applications Center (SEDAC), which is under the purview of the U.S. National Aeronautics and Space Administration (NASA) (Meiyappan et al., 2018). The shapefiles of the protected areas originate from the Wildlife Institute of India.[5] This step is essential in identifying treatment and control villages, as detailed

[4]We compile the Census village-level panel dataset for the Western Ghats using the keys provided in the SHRUG database (v.1.5) (Asher et al., 2021). In the case of the district of Surat in Gujarat, the keys were extracted from SHRUG (v.2.0) to correct for errors in the previous version of the dataset.

[5]Access to the PA shapefiles was generously granted by Malaika Mathew Chawla of Nature Conservation Foundation, India (Srivathsa et al., 2020).

in Section B. There were 50 PAs in the Western Ghats during the baseline year of our analysis 1991 (see Appendix Table A-3).

Third, we take several steps to enrich the village-level panel with a comprehensive set of fixed and time-varying characteristics. Foremost, we retrieve climatic variables (annual rainfall, annual average maximum and minimum temperature) and geographical controls (mean slope and mean elevation, distance from nearest water body and town). Next, we merge poverty and consumption estimates for the year 2011 using the Socio-Economic Caste Census data available in the SHRUG database (Asher et al., 2021). Lastly, we extract data on the performance of protected areas from the Management Effectiveness Evaluation (MEE) Reports, as available from the Wildlife Institute of India.[6] Table A-2 contains a comprehensive compilation of data sources and variable definitions.

B. Identification

Treatment definition. In order to assess the effect of eco-development on the composition of the labor force across sectors, we design an empirical identification strategy where the unit of analysis is the village. Figure 1 illustrates the map of the study area, encompassing the Western Ghats in India. Furthermore, it illustrates the geographic demarcation between the treatment and control villages. We designate villages within a range of 0 to 1 kilometers from the protected area boundary as treatment villages. On the other hand, control villages are defined as those situated within a distance of 20 to 50 kilometers from the protected area boundary.[7] In order to mitigate the potential impact of spillover effects between treatment and control villages, we implement a buffer zone, excluding all villages located within a distance of 1 to 20 kilometers from the protected area. Section IIIA shows the robustness of our main results when subjected to varying definitions of treatment and control zones.

Covariate Balancing Propensity Score weighted Difference-in-differences. We rely on a modified difference-in-differences (DID) framework, where the main model estimated is given by:

$$Y_{it} = \beta_1 \text{Post}_t + \beta_2 \text{Post}_t \times \text{Treatment}_i + X_i' \Gamma + \gamma_i + \epsilon_{it} \tag{1}$$

[6]Starting 2006, the Government of India has been commissioning the Management Effectiveness Evaluation Reports of protected areas. The Management Effectiveness Evaluation assessment is conducted by an independent panel of experts, appointed by the Government of India, in accordance with specified criteria. This process involves completing the MEE scorecard for each PA, which encompasses more than 30 key indicators across six essential components: context, planning, inputs, processes, outputs, and outcomes. India's MEE is adopted from the framework of the International Union for Conservation of Nature and Natural Resoucres (IUCN) World Commission on Protected Areas. MEE is progressively being mandated by governments and recommended by international bodies and agreements such as the Convention on Biological Diversity.

[7]We set the threshold for control villages at 50 kilometers, considering our focus on confining control villages to the Western Ghats region. The villages within the Western Ghats are situated at a maximum distance of 76 kilometers from the protected area, with approximately 96 percent of them located within a 50-kilometer of the protected area.

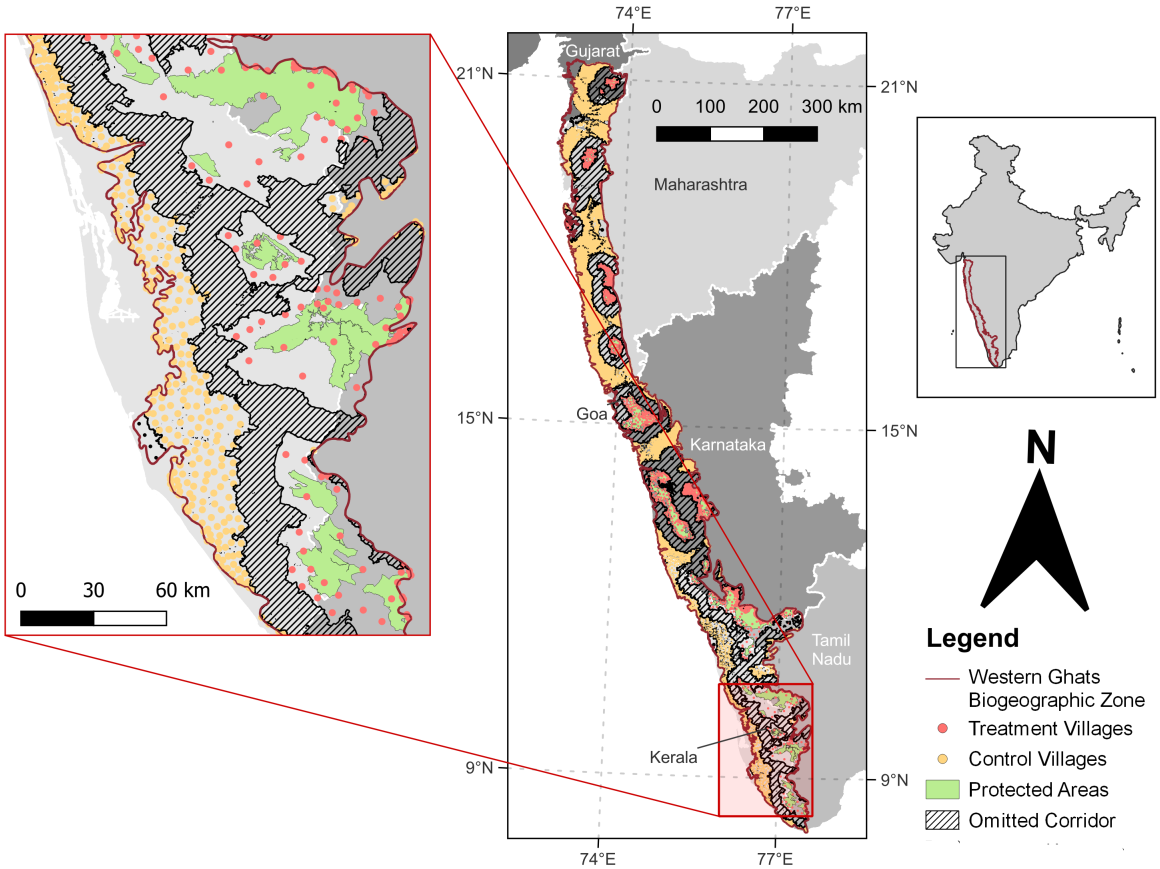

FIGURE 1 – STUDY AREA MAP WITH TREATMENT AND CONTROL VILLAGE IDENTIFICATION.

Notes: This map illustrates the location and boundary of the Western Ghats bio-geographic region in India, encompassing its protected areas (National Parks and Wildlife Sanctuaries). Additionally, it indicates the location of treatment and control villages, as defined for the purpose of this study. The treatment villages (depicted in red) are identified as those located within a 0-1 km distance of the protected area (PA) boundary. The control villages (depicted in yellow) lie between 20-50 km away from the PA boundary. We omit villages in the corridor between 1 to 20 km of the PA (marked as the gray cross-hatched area). Source: Figure generated by the authors.

where Y_{it} is one of the main outcome variables of labor force participation, measured in village i in the year t. The set of main outcome variables includes the workforce participation rate and the share of main workers among total workers. Additionally, we estimate changes within the distribution of main workers across sectors, studying impacts on the share of cultivators, the share of workers involved in agricultural labor, household industry and other work. Post_t is a dummy indicator equal to 0 for the year 1991 and equal to 1 afterwards. Treatment_i is a time-invariant treatment dummy, which takes value 1 for villages within 1 kilometer of the protected area boundary and 0 for control villages, as defined above. We include annual rainfall, minimum and maximum annual temperature and distance from the nearest town in the vector of village-level time-varying controls X_i. γ_i is the village-level fixed effect. Standard errors are clustered at the village level.

A major challenge in designing an identification strategy for the evaluation of protected area impacts is the endogenous placement of villages. Compared to the national average, protected areas are often found in locations that are remote, away from cities, or on lands that are less suitable for agriculture due to factors like higher elevation and steeper slopes (Ferraro, Hanauer and Sims, 2011). We address the non-random assignment of village locations in three main ways. First, we limit the control group villages to the Western Ghats biogeographic zone, which shares comparable attributes such as altitude, climate, topography, and vegetation with the treatment villages. Second, we adapt the conventional difference-in-difference approach by incorporating weights derived from a covariate balancing propensity score (CBPS) method. This adjustment aims to achieve balance in the observable characteristics between treatment and control villages (Imai and Ratkovic, 2014). Third, we estimate a village fixed-effects model to explain away unobservable factors.

Constructing CBPS Weights. To mitigate potential concerns of endogeneity between treatment and control villages, we employ the Covariate Balancing Propensity Score (CBPS) method (Imai and Ratkovic, 2014). CBPS exploits the dual characteristics of the propensity score as a covariate balancing score and the conditional probability of treatment assignment. The estimation of CBPS comprises two primary stages. Firstly, it entails the formulation of a flexible model to compute the propensity score. Subsequently, in the second step, it employs the computed propensity score to equalize the distribution of covariates between the treatment and control groups. In order to reduce bias in the estimation of treatment effects the observations are re-weighted using the estimated CBPS , thereby ensuring equilibrium in the distribution of covariates. The method is increasingly being applied in various research areas to address selection bias.[8] For example, Bensch, Kluve and Stöterau (2021) utilize CBPS weighting to effectively address variations in individual entrepreneur attributes in a study about the dissemination of improved cookstoves and small solar products in Kenya. CBPS has found other applications, such as in evaluating the extent to which conservation investments curbed biodiversity loss across 109 countries (Waldron et al., 2017). Additionally, it has been employed to assess the impact of banks' income gap on the transmission of monetary policy to bank lending (Gomez et al., 2021).

In this study, the process of deriving CBPS weights involves incorporating specific climatic and geographic covariates, along with pre-treatment village attributes, as explanatory variables. These factors are chosen based on their potential to influence treatment assignment, while remaining unaffected by the treatment itself.[9] Existing research has indicated that protected

[8]The CBPS method is believed to be an improvement over traditional propensity score methods which either model treatment assignment or optimize covariate balance. CBPS, on the other hand, does both - it allows for the inclusion of more flexible models for the propensity score, while also controlling for the bias due to model misspecification (Imai and Ratkovic, 2014).

[9]To derive the CBPS weights, we use the Stata command 'psweight' with the *ate* option to estimate the average treatment effect in the population (Kranker, 2019).

areas are commonly located in remote areas and on land less conducive to agriculture, often characterized by steeper slopes and higher elevations (Andam et al., 2010; Ferraro, Hanauer and Sims, 2011). As a result, in the construction of CBPS weights, we incorporate specific village-level characteristics. These include the average slope and elevation, as well as the distance from the nearest statutory town (averaged over Census data from 1991, 2001, and 2011), and the proximity to the nearest water body, serving as a proxy for irrigation accessibility.[10]. We further incorporate specific climatic variables due to their potential impact on agriculture. These variables consist of the mean and standard deviation of annual rainfall during the periods 1991-2001 and 2002-2011, as well as the minimum value derived from the average minimum temperature and the maximum value from the average maximum temperature, both spanning the periods 1991-2001 and 2002-2011.

Covariate Balance. Table 1 provides an overview of village-level characteristics for both treatment and control villages in the year 1991. Furthermore, it presents a comparison of mean differences, both with and without the constructed CBPS weights. In the absence of CBPS weights, notable and statistically significant distinctions between treatment and control villages emerge at the baseline (indicated by a p-value of < 0.01 in the pairwise t-test analyzing the differences in means across all variables). Treatment villages exhibit a consistently higher mean elevation and steeper slope compared to their comparison counterparts. Moreover, they are situated at a greater distance from the nearest town. Additionally, discernible dissimilarities between treatment and comparison villages extend to temperature and rainfall patterns.

Applying the CBPS weights ensures statistical balance across covariates. Upon applying the CBPS weights, p-values exceeding 0.10 are observed for all covariates, except for annual rainfall (p-value of 0.08) at baseline. Furthermore, evidence of successful covariate balance is substantiated by the F-test for joint significance, yielding a p-value of 0.57. It is noteworthy that both the mean absolute standardized difference and the maximum absolute standardized difference exhibit minimal values, specifically -0.02 and 0.05, respectively.[11] The combined evaluation of individual covariate balance and the three summary measures collectively indicates

[10]The variable "distance from the nearest statutory town" is subject to change over time, given that the designation of towns can shift between census years. For instance, a town could transition from a "census town" to a "statutory town." In the Indian census, a Census Town is defined by urban attributes, including a minimum population of 5,000, at least 75% of the male working force engaged in non-agricultural activities, and a population density of at least 400 persons per square kilometer. As of the 2011 Census, there were 3,784 Census Towns, compared to 1,362 in 2001. A Statutory Town, on the other hand, possesses a municipality, corporation, cantonment board, or a designated town area committee. The count of Statutory Towns stood at 4,041 in the 2011 Census, in contrast to 3,799 in 2001.

[11]The mean absolute standardised difference is a measure of the average standardized difference in covariate means between the treated and control groups after applying weights. A lower value indicates better balance and suggests that the treatment and control groups have similar distributions of covariates. The maximum absolute standardized difference is the largest absolute standardized difference among all covariates after applying propensity score weights. It identifies the covariate that contributes the most to the imbalance between the treatment and control groups. A smaller maximum absolute standardized difference indicates better balance and suggests that no individual covariate is strongly driving the imbalance.

Table 1 – Sample characteristics and balance tests for treatment and control villages.

	Village-level characteristics		Difference in means			
	Treatment	Control	Unweighted	CBPS-weighted		
	1991 (1)	1991 (2)	1991 (3)	1991 (4)	2001 (5)	2011 (6)
Elevation (m)	539.98 (8.22)	249.98 (3.38)	290.01***	0.96	0.96	-5.41
Slope (degrees)	10.45 (0.13)	8.33 (0.05)	2.12***	0.00	0.00	-0.11
Annual Rainfall (mm)	2,218.41 (44.63)	3,176.16 (21.69)	-957.74***	-88.17*	12.22	67.48*
Max Temperature (°C)	30.22 (0.04)	31.03 (0.01)	-0.81***	0.02	-0.02	-0.06*
Min Temperature (°C)	20.25 (0.03)	20.72 (0.01)	-0.46***	-0.01	-0.01	0.01
Distance from town (km)	25.99 (0.43)	23.80 (0.23)	2.20***	-0.65	0.80	-0.29
Distance from water body (km)	5.74 (0.17)	6.26 (0.08)	-0.51***	0.00	0.00	-0.05
p-value F-test of joint significance			0.00	0.57	0.99	0.29
Mean absolute standardized diff.				0.01	0.00	0.02
Max absolute standardized diff.				0.05	0.02	0.05
Observations	1,382	6,242	7,624	7,624	7,624	7,370

Notes: This table presents summary statistics of pre-treatment village-level characteristics and balance tests between control and treatment villages. Standard deviations are reported in parentheses. Columns (3) to (6) capture the difference in means between treatment and control characteristics. Column (3) presents the unweighted differences in means for the year 1991. Columns (4) - (6) present the difference in means for the years 1991, 2001, and 2011, respectively, where the CBPS-weights have been applied. See Table A-2 for variable definitions. Significant t-test estimates are denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

that, following the application of weighting, the treatment and control groups exhibit commendable balance. This underscores the effectiveness of the CBPS method in substantially mitigating bias within the covariate distributions across the two groups.

In panel data analysis, it is important to achieve covariate balance across time. This practice is instrumental in addressing the complexities posed by time-varying confounding variables, accommodating variations specific to different time points, managing challenges related to panel attrition and incomplete data, and ultimately augmenting the comparability and robustness of the analytical approach. Table 1 (Columns 4 through 6) shows that the CBPS weights ensure the balance of covariates in the three distinct years 1991, 2001, and 2011.

III. Results

A. Labor force participation

A.1 Full sample estimates

The set of main outcomes of interest concerns the participation of population in the labor force. To assess the impacts of eco-development, we estimate Equation (1) relying on a CBPS weighted difference-in-difference approach. The estimation results capturing differential changes in labor force participation between treatment and control villages over 1991 to 2011 are presented in Table 2. Panel A focuses on average changes observed in the full sample.[12]

The baseline workforce participation rate was slightly above 48% in 1991 in control villages, typical for a developing country setting (Breza, Kaur and Shamdasani, 2021). The results indicate that within the span of two decades, the workforce participation rate of the population in control villages has risen by nearly 3 percentage points (p-value < 0.01). Treatment villages exhibit a comparable trend, showing no significant evidence of divergent development.

Interestingly, even with an overall rise in the workforce participation rate, there is a notable and substantial decrease in the proportion of workers employed for more than six months in a year. In control villages, the share of main workers drops from about 87.4% in 1991 to about 76% in 2011 (an effect of -11.56 percentage points, p-value < 0.01). In treatment villages, the downward trend is significantly more pronounced, with the share of main workers decreasing by an additional 4.6 percentage points (p-value < 0.01).

Columns (3)-(6) provide insights into the dynamics of year round employment, by sector. In control villages, the majority of workers employed for more than six months in the year are cultivators, representing a share of 53% among all occupations in 1991. Over 1991-2011, we observe a drop by about 10% and 15% in control and treatment villages, respectively, suggesting a shift toward other employment opportunities. As the estimation results in Column 4 indicate, the change is not explain by a shift within the agricultural sector. Namely, the share of agricultural workers remains unchanged over 1991-2011, in both treatment and control villages. Instead, the decrease in the share of cultivators appears to be explained by a relatively small move toward employment in household industry and a sizable increase in employment in other occupations.[13] In particular, the share of workers employed in other sectors experiences an increase by about 33% in the control villages during 1991-2011 (an effect of 7.59 percentage points, p-value < 0.01). In the treatment villages, the effect is significantly more pronounced, presenting an additional 4.42 percentage points increase (p-value < 0.01). Data from 2011 suggests that the changes in

[12] Appendix Table A-10 presents the results of estimating Equation (1) without the CBPS weights. These results are aligned in sign and significance with those in Table 2. However, they suggest stronger common time trends for treatment and control villages. Moreover, the DID estimates without weights indicate that the increase in the workforce participation was significantly more pronounced in treatment relative to control villages.

[13] We note that the Indian Census classifies all workers not engaged in cultivation, or working as agricultural labor or engaged in household industry as "other workers".

the sectoral composition of year round employment closely mirror those of employment for less than six months a year (see Appendix Table A-11 and Table A-12).[14]

To summarize, our analysis reveals that over the course of two decades, the overall workforce participation rate of the population has slightly risen, similarly in control and treatment villages. Furthermore, we observe a substantial movement toward employment for less than half a year, along with a shift within the realm of year-round employment from cultivation activities to non-agricultural labor. These dynamics are even more accentuated for villages situated in and around the protected areas, implying that the introduction of eco-development programs within these regions has had a discernible impact on the local labor market. The effects appear aligned with the scope and structure of eco-development initiatives, whereby they specifically generate person-days of non-farm employment.[15]

Impacts between 1991-2001. Our main analysis concerns changes in the labor force participation over two decades. Given that eco-development programs commenced as early as 1991 (for specific details, refer to Appendix Table A-1), it prompts the inquiry into how fast the labor market responded to these initiatives. Utilizing the accessible data on outcomes a decade after the initiation of eco-development, we conduct our primary model estimation incorporating three distinct time points: 1991 as the baseline year, 2001 as the midline reference, and 2011 as the concluding endline assessment. This approach enables us to gauge dynamic treatment effects for the years 2001 and 2011, respectively. Our findings reveal that while the general trends observed in both treatment and control villages closely mirror the documented changes spanning two decades, notable effects in treatment villages, in contrast to control villages, are absent during the initial decade (refer to Appendix Table A-5). Instead, the discernible divergence in labor force participation between treatment and control villages surfaces only over the extended time horizon. This suggests that the influence of eco-development on the labor force primarily materialized over the longer duration, rather than in the short term.

The outcomes observed for the period 1991-2001 come as no surprise, given the slow and gradual implementation of the eco-development approach. A considerable amount of time and resources were devoted to preparatory measures, encompassing an assessment of local needs, the participatory development of site-specific microplans, the establishment of village eco-development committees, the facilitation of alternative employment opportunities through

[14]Due to lack of data availability for 1991, we cannot present the results of the differences-in-differences estimation for the sectoral composition of employment for less than six months a year.

[15]The generated employment encompasses various activities, including habitat improvement and development projects, afforestation programs, fire management, revitalization of indigenous saplings, excavation of trenches for elephant protection, construction and upkeep of solar fences, and the establishment and maintenance of additional infrastructure such as roads. Moreover, community-based ecotourism has been initiated within certain protected areas as a component of the eco-development strategy. This approach offers local residents opportunities for employment as tourist guides, trekking guides, safari vehicle drivers, canteen operators, and involvement in the branding and sale of local products and non-timber forest products collected with authorization from the protected area authorities and sold through eco-shops.

Table 2 – Changes in labour force participation, 1991 - 2011.

	Workforce participation rate	Share main workers	Share of main workers by sector: Cultivators	Agricultural labor	Household industry	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All						
Post	2.97***	-11.56***	-5.42***	-2.80	0.63***	7.59***
	(0.57)	(1.03)	(0.76)	(2.43)	(0.18)	(2.62)
Post × Treatment	0.63	-4.59***	-2.75*	-1.16	-0.51***	4.42***
	(0.65)	(1.47)	(1.64)	(1.55)	(0.20)	(1.65)
Observations	14,594	14,594	14,574	14,574	14,574	14,574
Baseline Mean	48.37	87.41	52.89	22.65	1.12	23.34
R^2	0.70	0.60	0.82	0.68	0.57	0.83
Panel B: Male						
Post	2.41***	-10.05***	-6.88***	-0.84	0.33***	7.38***
	(0.54)	(0.74)	(0.85)	(2.27)	(0.12)	(2.59)
Post × Treatment	0.17	-3.44***	-3.56**	-0.72	-0.08	4.37***
	(0.46)	(1.22)	(1.63)	(1.46)	(0.17)	(1.66)
Observations	14,594	14,594	14,570	14,570	14,570	14,570
Baseline mean	53.36	96.80	52.21	19.13	1.22	27.44
R^2	0.75	0.62	0.82	0.67	0.58	0.83
Panel C: Female						
Post	3.97***	-12.73***	-1.86**	-8.75***	1.08***	9.54***
	(0.82)	(1.47)	(0.88)	(2.91)	(0.35)	(2.82)
Post × Treatment	1.00	-6.66***	-1.17	-2.61	-1.34***	5.11***
	(1.04)	(2.04)	(1.81)	(1.94)	(0.36)	(1.88)
Observations	14,592	14,480	14,304	14,304	14,304	14,304
Baseline mean	43.14	76.48	50.33	31.00	1.15	17.52
R^2	0.70	0.57	0.78	0.67	0.54	0.76

Notes: This table presents CBPS-weighted difference-in-differences estimates of Equation (1) from the main text to measure the impact of eco-development on village-level labour market outcomes. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. *Post* × *Treatment* is the DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2011 relative to 1991. The "Baseline mean" refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects and controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

training, the initiation of microenterprises, and the cultivation of trust and rapport between protected area managers and local communities. This concerted effort aimed to encourage active participation of the local communities in the management and safeguarding of protected areas.

Our results underscore thus the imperative of evaluating cumulative impacts over extended timeframes, as shifts in livelihood strategies prompted by conservation initiatives can unfold gradually over the course of several years (Beauchamp, Clements and Milner-Gulland, 2018; Ferraro and Pressey, 2015).

Robustness. We subject our main findings to a range of robustness tests. The first set of analyses concerns the treatment definition. Here, we broaden the scope of treated villages to encompass all villages located within a maximum distance of either 5 or 10 kilometers from the protected area boundary.[16] For the estimation, we utilize the identical control villages as in the main specification, while incorporating fresh CBPS weights to ensure balance with the expanded treatment groups. In both variations of treatment definitions, the estimated coefficients exhibit consistent signs and levels of significance as those observed in the main specification, although the magnitude of effects is slightly diminished (see Appendix Table A-6 and Table A-7). As an illustration, in the main specification, the proportion of main workers decreases by 5.19 percentage points compared to the control group. However, the estimates indicate a decline of 3.86 percentage points and 3.21 percentage points for treatment definitions of 0-5 kilometers and 0-10 kilometers, respectively (all results have a p-value < 0.01). The evidence indicates that the effects of eco-development on labor force participation extend beyond the immediate boundaries of the protected areas, also impacting neighboring villages, albeit to a lesser extent.

A second set of robustness checks concerns the definition of control villages. We alter the constraint regarding the minimum distance of control villages from the protected area boundary. While the main specification included only villages situated within the 20 to 50-kilometer range from the boundary in the control group, we now explore two additional scenarios: one encompassing villages within the 15 to 50-kilometer range, and the other within the 25 to 50-kilometer range. Both scenarios confirm the robustness of our main results (see Appendix Table A-8 and Table A-9).

Third, we provide evidence that our main results are robust to estimating Equation (1) without time-varying geographical and climatic covariates (see Appendix Table A-4). Finally, we

[16] Some eco-development plans, like the one for Kalakad Mundanthurai National Park, employ a 5-kilometer radius as the zone of influence. In contrast, the Wildlife Board of India, adopted in 2002 the Wildlife Conservation Strategy, proposing that land falling within a 10-kilometer radius of the boundaries of national parks and wildlife sanctuaries should be designated as Eco-Fragile Zones under the Environmental Protection Act. This was aimed at restricting development activities around protected areas. However, due to human population and development pressures, many states opposed this notification. Consequently, a revised decision was made in 2005, suggesting that the delineation of eco-sensitive zones should be tailored to each specific site. Later, in 2022, the Supreme Court of India ruled that each national park and wildlife sanctuary must have a minimum eco-sensitive zone of 1 kilometer.

compare our main results with that of a simple unweighted difference-in-differences model. We find that, while time trends appear more pronounced than estimates with the CBPS-weighted, the DID coefficient has a lower magnitude (see Appendix Table A-10).

A.2 Heterogeneous Effects by Gender

Eco-development initiatives could lead to differential impacts on the labor force participation of women compared to men. This hypothesis is endorsed by the fact that certain eco-development initiatives, like establishing self-help groups and providing micro-credit loans, are specifically directed towards women. This, in turn, could direct women's employment away from the farming sector. In contrast, other types of eco-development initiatives are more likely to have been embraced by men. In particular, the Management Effectiveness Evaluation Reports highlight specific vocational training initiatives organized by the protected area management, with main examples such as carpentry, sewing, masonry, electrical work, plumbing, and training for roles like drivers and tour guides. Moreover, if eco-development influences the workforce participation of one gender, it could potentially lead to spillover effects on the employment patterns of the other gender. For instance, prior research on gender-based labor division provides evidence that a transition of male workers away from agriculture can result in an increase in farming-related tasks undertaken by women (see Jayachandran, 2015, and references theirein).

To address such considerations, we provide estimates of the labor market impacts of eco-development for each gender (see Panels B and C in Table 2). Overall, we document similar time trends for both men and women in the control group, aligned with those observed in the aggregate sample. During the span of two decades, control and treatment villages experience a similar increase in the workforce participation rate for both men and women. Moreover, we observe a stark decrease in the portion of the population engaged in year-round employment across genders in control villages. These trends appear significantly stronger in treatment villages, and slightly more accentuated for women compared to men. For instance, the share of main workers decreases by an additional 6.7 percentage points among women from treated villages relative to women in control villages (p-value < 0.01) in 2011 relative to 1991. In contrast, the corresponding effect is a reduction by about 3.4 percentage points for men (p-value < 0.01). Moreover, regarding the distribution of main employment across sectors, we note that women from treated villages exhibit a greater propensity than men to transition from the farming sector to other types of occupations. While indicating potential variations in average magnitudes, none of these gender-related differences achieve statistical significance at a 95% confidence level (see Appendix Figure A-1 for an illustration of estimated marginal treatment effects by gender).

B. Mechanisms

In this section, we explore potential mechanisms by which eco-development initiatives have led to shifts in the labor force participation of the impacted population. We pursue two avenues of inquiry: firstly, an examination of changes in the socio-demographic characteristics of the population, and secondly, an exploration of shifts in land use patterns.

B.1 Socio-Demographic Changes

When considering socio-demographic attributes, one of the principal factors shaping the labor supply is the migration patterns of the population (*e.g.*, Bryan, Chowdhury and Mobarak, 2014; Kleemans and Magruder, 2018). In India, male dominated out-migration for work tends to be concentrated within specific regional clusters (Tumbe, 2015). An illustrative example is the cluster situated along the west coast, between the Arabian Sea and the Western Ghats. A considerable portion of our study area falls within this particular cluster.

The eco-development approach, if executed with local participation, may stimulate local economic activities and attract in-migration. Alternatively, the various restrictions imposed on agriculture and collection of natural resources around protected areas, may draw people away from agriculture, and without an alternative employment generation, it may push people to out-migrate in search of economic opportunities. Such migration trends, could manifest directly in alterations to the population's workforce participation and composition.

To evaluate shifts in male-dominated migration patterns, the female-to-male sex ratio – *i.e.*, the number of women per thousand men – serves as a commonly used proxy (Angrist, 2002). Male-dominated outmigration for work can result in an inflated regional female-to-male sex ratio surpassing 1000 females per 1000 males. We estimate the CBPS-weighted difference-in-differences model from Equation (1) using the female-to-male sex ratio as an outcome variable in order to assess differential migration patterns in treatment and control villages. Moreover, we assess changes in the population count of males and females separately to allow for the possibility of in- and out-migration of both sexes.[17]

Table 3 presents the results of this estimation. We note that in the general population, the baseline average female-to-male sex ratio in the control villages exceeds 1000. This implies the presence of prevailing male out-migration patterns within the study area. During 1991-2011, the ratio increases further as male out-migration continues (an average increase of 56 women per 1000 men, p-value < 0.01). Yet, the patterns remain consistent in treatment villages, suggesting that eco-development initiatives have not influenced the pace of out-migration, either by slowing it down or accelerating it. Moreover, these findings apply similarly to the population counts of both males and females.

Furthermore, we evaluate changes in the literacy rate of the village population. We observe a significant increase in literacy over 1991-2011 for both men and women (p-values < 0.01 for each) from control villages. These trends appear no different for both genders in the treated villages, with a slightly higher increase in the literacy rate of men (an effect of 1.52 percentage

[17] To capture a more accurate portrayal of population dynamics influencing the available workforce, we exclude individuals aged 6 years or younger from this analysis.

TABLE 3 – Changes in Population Count and Literacy, 1991 - 2011.

	Population count		Sex Ratio	Literacy Rate	
	Male	Female		Male	Female
	(1)	(2)	(3)	(4)	(5)
Post	619.89***	841.63***	55.67***	13.14***	17.80***
	(81.66)	(97.64)	(5.88)	(0.77)	(0.74)
Post x Treatment	16.48	26.31	6.97	1.52*	1.50
	(34.73)	(45.24)	(8.78)	(0.80)	(0.93)
Observations	14,740	14,740	14,594	14,594	14,592
Baseline mean	1,191	1,248	1,087	68	46
R^2	0.99	0.99	0.81	0.88	0.92

Notes: This table presents CBPS-weighted difference-in-differences estimates of Equation (1), where the dependent variable is either the population count, the sex ratio, or the literacy rate. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. $Post \times Treatment$ is the DID estimate of interest, capturing the estimate difference in outcomes between treatment and control villages in 2011. The Baseline mean refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects and controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

points, p-value = 0.057). The more pronounced effect on males could be explained by the organization within the scope of eco-development initiatives of vocational trainings targeting typical male occupations, as mentioned in Section III.A.2.

In conclusion, our analysis does not yield evidence that eco-development has triggered substantial alterations in migration patterns or literacy rates during our study period in the overall population. We thus believe that neither migration nor literacy have acted as driving mechanisms through which eco-development has impacted the local labor force participation.

B.2 Changes in Land Use Patterns

A primary objective of eco-development initiatives is to safeguard the natural habitat of the protected area. This endeavor encompasses efforts to guide local economic activities in ways that mitigate their adverse environmental effects. The established guidelines may impose restrictions on specific land use practices, potentially triggering shifts in the dynamics of the labor supply as a consequence. We investigate this hypothesis and estimate changes in the share of land use across various land use categories. Table 4 presents the estimation results, focusing on five distinct land use types: forest land, irrigated land, rainfed land, non-agriculture, and culturable wasteland.

Relative to control villages, treated villages experience an increase in forest land by almost 2 percentage points (p-value < 0.01) over the two-decade horizon. The outcome is in line with expectations, considering the explicit objectives of eco-development initiatives to protect forest

Table 4 – Changes in Land Use, 1991-2011.

	Share of land use, by type				
	Forest	Irrigated	Rainfed	Non-Agriculture	Culturable Waste
	(1)	(2)	(3)	(4)	(5)
Post	-0.71	10.04***	-3.07**	-1.16	-4.93***
	(0.66)	(1.24)	(1.43)	(1.16)	(0.91)
Post × Treatment	1.98***	-5.20***	8.27***	-1.18	-0.91
	(0.68)	(1.33)	(1.36)	(0.87)	(0.99)
Observations	14,364	12,676	14,366	14,366	14,364
Baseline Mean	19.59	5.35	41.61	18.51	15.62
R^2	0.95	0.73	0.75	0.72	0.66

Notes: This table presents CBPS-weighted difference-in-differences estimates of Equation (1), where the dependent variable share of land use, by type. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. $Post \times Treatment$ is the DID estimate of interest, capturing the estimate difference in outcomes between treatment and control villages in 2011. The "Baseline mean" refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects and controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

land. Furthermore, our analysis reveals that while the share of irrigated land in control villages triples (increasing from 5.35% in 1991 to over 15% in 2011, p-value < 0.01), the corresponding share in treatment villages only doubles (p-value < 0.01 for the differential effect). These trends contrast those observed for the share of rainfed land. While this share diminishes in control villages, it experiences a notable upsurge in treatment villages. Furthermore, we observe no changes in the share of non-agricultural land. Finally, the share of culturable wasteland decreases over the two-decade period, in a similar manner in treatment and control villages.

Taken together, our results provide evidence that eco-development altered the proportion of land used for different economic activities. These shifts align with the overarching objectives of eco-development, which center on preserving the natural habitat. This alignment is evident as the proportion of forested land expands in villages in and around protected areas. Moreover, in line with water conservation goals and likely restrictions on irrigation projects, villages located in protected areas exhibit a reduction in the proportion of irrigated land, coupled with a sizable increase in the share of rainfed land.

The effects appear aligned with the sizable increase observed in employment for less than six months a year to the detriment of year round employment. In particular, practicing rainfed agriculture is more likely to generate seasonal employment compared to farm practices on irrigated land. Planting and harvesting seasons in rainfed agriculture are closely tied to the availability of rain, which is itself subject to seasonal variations in timing and quantity. This can lead to concentrated periods of activity during the rainy season, creating seasonal employment opportunities.

Table 5 – Poverty and Consumption Estimates, 2011.

	Per capita consumption (annual Rs)	Share households under 2 dollar PPP per capita per day	Share households whose main income cultivation	Share of agricul-tural workers	Average household size
	(1)	(2)	(3)	(4)	(5)
Treatment	-835.15**	0.04***	-0.07***	-0.02	-0.01
	(356.02)	(0.01)	(0.01)	(0.01)	(0.03)
Observations	7,226	7,226	6,804	7,046	6,920
Control Mean	18,614.88	0.32	0.40	0.50	5.30
R^2	0.23	0.31	0.12	0.15	0.15

Notes: This table presents CBPS-weighted estimates of the difference in poverty rates and consumption levels between villages in close proximity to protected areas and those located further away, as measured in the year 2011. Each column corresponds to a different dependent variable. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. All regressions include controls for slope, elevation, rainfall, minimum and maximum temperature, distance from the nearest town and from the nearest water body. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

C. Poverty and Consumption Estimates

The changes induced by eco-development in the regional labor market prompt inquiries concerning the broader well-being outcomes for the affected population. Although eco-development strives for sustainable economic development, its principal objective remains the preservation of the natural environment within and around the protected area. However, in pursuit of this objective, the initiatives channel financial resources directly to mitigate stresses on the protected area, potentially affecting the economic standards of the local population.

In this section, we investigate existing differences in the economic standards between the villages within the protected areas and the control villages.Historically,the population residing around protected areas have been usually poorer and far less economically developed as compared to other regions (Ferraro, Hanauer and Sims, 2011). Here, our investigation focuses on determining whether substantial disparities continue to exist between the treatment and control villages at the end of the study horizon. Relying on the poverty and consumption data provided at the village-level by the SHRUG database – available only for the year 2011 – we estimate a weighted linear regression with CBPS weights.

Table 5 presents the estimation results for five outcome measures designed to reflect the socio-economic status of treatment villages as compared to control villages. First, our findings reveal that in 2011, the per capita consumption of the population residing in treatment villages is 4% lower than that of their counterparts in control villages, translating to an average annual disparity of 835 INR (p-value = 0.013). Similarly, the share of the population with an income below the poverty line – as defined by the World Bank – is 4 percentage points higher in treatment villages compared to control ones (p-value $<$ 0.01). Additionally, households in treatment villages are less likely to derive their main income from cultivation activities, with a

7 percentage points difference to households in the control group (p-value < 0.01). The results align with the DID estimates presented in Table 2 for the share of cultivators. Finally, we find no differences regarding the share of agricultural workers and the average household size.

In summary, we find evidence of higher poverty rates and lower consumption levels among the population residing in close proximity to protected areas, two decades following the commencement of eco-development initiatives. While previous literature notes that these areas were generally less economically developed at the outset, our results suggest that, even with potential advancements, a considerable disparity persists in comparison to the surrounding regions.

IV. Discussion and Conclusions

Protected area systems are considered to be effective policy measures for safeguarding biodiversity from a wide range of threats. More recently, there has been increased pressure on biodiversity rich developing countries to implement various land use management strategies not only for biodiversity conservation, but also to combat greenhouse gas emissions (IPCC, 2022). In this context, the role of protected areas in achieving the twin objectives of biodiversity conservation and as tools for carbon storage and sequestration has led to calls for the implementation of protected area systems as a core component of national strategies (Dinerstein et al., 2019; Duncanson et al., 2023).

The expansion of protected areas or other effective area-based conservation measures necessitates a delicate balance between the developmental aspirations of rural communities and conservation imperatives. This issue is particularly important for developing countries. In India, the conservation of the Western Ghats region has been a matter of intense public debate, with the most divisive issue being how to reconcile development and conservation goals. Balancing this twin objective, though, is far from straightforward because of the multiple and contradictory mechanisms at work. Understanding the impact protected areas have on labor force participation is a first step for generating policy-relevant insights on how protected areas can be managed to deliver multiple goals.

In this paper, we study the role of eco-development in shaping local labor markets. With an application in the Western Ghats of India, one of the richest bio-diversity zones on the planet, we estimate long-term changes induced by eco-development programs. Our results indicate that, while the rate of workforce participation remains comparable between villages engaged in eco-development programs and control villages, the proportion of the population engaged in year-round employment experiences a noteworthy decrease two decades following the commencement of the eco-development programs, coupled with a proportional increase in the share of population employed for less than six months a year. The evidence thus points to an increase in the share of population with irregular incomes. Such instability may exacerbate financial challenges, impacting access to credit and household security. We find that two-decades after the initiation of eco-development initiatives, the affected population still lags behind in terms of poverty and consumption relates relative to close-by areas. We furthermore find evidence of a shift away from cultivation labor toward household industry and other non-farm related employment. Overall, the estimated changes appear to be similarly present among women and men.

We analyze several potential key mechanisms that could elucidate the manner in which eco-development influences local employment dynamics. Importantly, we find no evidence that eco-development affected the local migration patterns, as measured by both the population count and the female-to-male ratio. The primary mechanism we identity entails shifts in land use patterns. Specifically, our findings furnish evidence indicating that villages located in close proximity to protected areas undergo an increase in the proportion of forested land, coupled with a sizable transition from irrigated to rainfed agricultural land. These effects align with the core objectives of eco-development, which are centered around the safeguarding of forests, soil, and water resources. This alignment is manifest in a dual manner: while protected area management imposes limitations on the expansion of irrigated land, activities endorsed by eco-development explicitly target the enhancement of water and soil quality. The transition away from irrigated land to rainfed agriculture appears a valid candidate to explain the notable increase in the share of the population employed for less than six months a year. As rainfed agriculture is subject to the inherent variability of rainfall, it increases the demand for seasonal work.

Our findings are in line with the comprehensive scope and methodology of the eco-development approach adopted in the Western Ghats region. This approach is characterized by participatory management of protected areas and the promotion of alternative employment opportunities, all aimed at reducing the dependency of local communities on forest resources. The observed increase in non-farm related employment appears to be consistent with the new opportunities introduced by the eco-development initiatives. The management effectiveness evaluation reports reveal that numerous protected areas contribute significantly to the creation of several person-days of employment for local residents, primarily through daily wage non-farm labor opportunities.

We believe it is thus crucial that future research further investigates the short- and long-term effects of a shift toward irregular incomes in protected areas. A valuable insight for eco-development policy would then be to integrate tailored financial strategies to assist individuals in managing income variability and its consequences, as well as generate jobs providing stable incomes.

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Appendix

Table A-1 – Eco-development Implementation Timeline 1991-2011.

Year	Implementation
1991 - 1992	Centrally Sponsored Scheme (CSS) "Eco-development in and around National Parks and Sanctuaries including Tiger Reserves" (henceforth Eco-development Scheme) launched. Eco-development plan for 11 out of 18 Tiger Reserves processed in the year.
1992 - 1993	Ecodevelopment plan for 12 out of 19 Tiger Reserves processed. The National Afforestation and Eco-Development Board (NAEB) set up for promoting afforestation, tree planting, ecological restoration and eco-development activities in the country. Special focus on regeneration of degraded forest areas and lands adjoining forest areas, protected areas as well as the ecologically fragile areas including the Western Ghats.
1993 - 1994	Participatory eco-development programs initiated in all 21 Project Tiger Reserves. Management Action Plan for Nilgiri Biosphere Reserve prepared by State Governments sanctioned for undertaking ecodevelopment among other activities.
1994 - 1995	Assistance was provided to the States for under Eco-development scheme. A launch workshop for starting eco-development activities under assistance of IDA Forestry Research, Education and Extension Project (FREEP), for two protected areas were organised at Kullu (Himachal Pradesh) and Kalakad (Tamil Nadu). Several grass-root level workshops were organised for initiating and encouraging people's participation in eco-development activities in different Tiger Reserves.
1996 - 1997	Financial assistance was provided to 12 out of 83 National Parks and 24 out of 447 Wildlife Sanctuaries under the Eco-development scheme and Rs 230 lakhs to Tiger Reserve areas. India Eco-development Project launched in seven Protected Areas in seven different States as the externally aided component of CSS Eco-development scheme. It covers two National Parks and five Tiger Reserves, including two in the Western Ghats.
1997 - 1999	Financial assistance was provided to 6 National Parks and 37 Wildlife Sanctuaries in 1997-98 and 12 National Parks and 40 Wildlife Sanctuaries in 1998-99 under the eco-development scheme. Five PAs were identified for intensive eco-development.
1999 - 2002	The first National Wildlife Action Plan (NWAP) of 1983 was revised and the new Wildlife Action Plan (2002-2016) adopted. The plan outlines the strategies, action points and the priority projects for conservation of wild fauna and flora in the country emphasizing the peoples' participation and their support for wildlife conservation. Rs. 217.19 lakh released to various States under the Eco-development scheme in 1999-00, Rs.8.98 crores in 2000-01 and 15.15 crores in 2001-02. Rs. 18.70 crore has released to the Project-states under the India Eco-development Project in 1999-00.
2002 - 2003	During the tenth Five Year Plan (2002-2007), the Eco-development scheme was merged with Project Tiger for tiger reserve areas and with the "Development of National Parks and Sanctuaries" scheme for wildlife sanctuaries and national parks. The latter scheme provides financial assistance to the States and UTs to develop and extend protected areas (National Parks and Sanctuaries). The objective of the expanded scheme is to create infrastructural facilities for better protection and management of these protected areas; to provide financial assistance for ecodevelopment, training, capacity building and research studies, relocation of villages falling within the Protected Areas to outside areas and settlement of rights. Under the scheme, an assistance of Rs 72.28 crores was provided to the States during the Ninth Five Year Plan. The outlay for the Tenth Five Year Plan is Rs 350 crores, which includes the merged schemes for eco-development and tribal rehabilitation. During the year, financial assistance of Rs. 31.64 was provided under Development of National Parks and Sanctuaries scheme to 210 National Parks and Sanctuaries in 25 States."
2003 - 2007	Financial assistance of Rs. 43.19 crores released under Development of National Parks and Sanctuaries for 269 National Parks and Sanctuaries in 28 states (2003-04). In 2004-05, financial assistance under the scheme was provided to 278 National Parks and Sanctuaries in 26 states (2004-05), in 2005-06 to 316 Protected Areas and in 2006-07 to 340 Protected Areas. Eco-development activities were also supported through Project Tiger in tiger reserves.

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Table A-1 – continued from previous page

Year	Implementation
2008 - 2009	During December 2008, the 'Development of National Parks and Sanctuaries' scheme was modified by expanding the scope and adding a few more components and activities. The total outlay for the modified Scheme - titled as 'Integrated Development of Wildlife Habitats' is Rs.800 crores for the Eleventh Year Plan period. Apart from providing support to Protected Areas, that includes habitat improvement practices, infrastructure development, eco-development activities, anti-poaching activities, research, training, capacity building, census of wildlife, the modified Scheme has also the following components – protection of wildlife outside the protected areas and recovery programs for critically endangered species.
2009 - 2011	Eco-development activities implemented through Integrated Development of Wildlife Habitats and Project Tiger schemes.
since 2011	Eco-development activities implemented through Integrated Development of Wildlife Habitats and Project Tiger schemes.

Notes: This table presents the timeline of eco-development activities in the Western Ghats.
The information was compiled by the authors using the MoEFCC Annual Reports.

TABLE A-2 – VARIABLE DEFINITIONS.

Variable	Definition	Year
	Panel A: Geographic and Climatic Control Variables	
Mean Elevation	The mean elevation of a village in meters, using DEM data provided by Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) (NASA). The data has a spatial resolution of one arc-second and is provided using the World Geodetic System 1984 (WGS 1984). The data comes in several tiles, which we first merge to a single file and then convert using EPSG code 7755, which uses WGS 84 as the horizontal datum and meters as units of measurement. The mean elevation values for each village was then constructed using QGIS' (QGIS Development Team, 2009) zonal statistics plugin.	1991
Mean Slope	The mean slope for each village in degrees. It is constructed using the QGIS Ver. 3.28.0 zonal statistics plugin. Slopes are generated from ASTER DEM data using the GDAL Ver. 3.6.0 `gdaldem slope` algorithm with computed edges.	1991
Annual Rainfall	The mean annual rainfall of a village in millimeters, using yearly climate data provided by the India Meteorological Department (IMD) (Pai et al., 2014). The data has a spatial resolution of $0.25^\circ \times 0.25^\circ$. We downloaded the data for 1991-2011 using `imdlib` (Nandi, Patel and Swain, 2022) and calculated the sum of daily rainfall for the years. The data is then converted using EPSG code 7755. Annual rainfall values per village are constructed using QGIS's (QGIS Development Team, 2009) zonal statistics plugin.	1991-2011
Average Max. Temperature	The annual average maximum temperature of a village in Celsius, using yearly climate data provided by IMD Srivastava, Rajeevan and Kshirsagar (2009). The data has a spatial resolution of $1^\circ \times 1^\circ$.We downloaded the data for 1991-2011 using `imdlib` (Nandi, Patel and Swain, 2022) and calculated the mean of daily maximum temperature for the year. The data is then converted using EPSG code 7755. Annual average maximum temperature values per village are constructed using QGIS's (QGIS Development Team, 2009) zonal statistics plugin.	1991-2011
Average Min. Temperature	The annual average minimum temperature of a village in Celsius, using yearly climate data provided by IMD (Srivastava, Rajeevan and Kshirsagar, 2009). The data has a spatial resolution of $1^\circ \times 1^\circ$. We downloaded the data for 1991-2011 using `imdlib` (Nandi, Patel and Swain, 2022) and calculated the mean of daily minimum temperature for each year. The data is then converted using EPSG code 7755. Minimum temperature values per village per year are constructed using QGIS's (QGIS Development Team, 2009) zonal statistics plugin.	1991-2011

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Table A-2 – Variable definitions (continued)

Variable	Definition	Year
Distance to nearest Water Body	The distance to the closest water body (oceans, lakes and rivers) in meters, using water body shapefiles provided by SRTM (U.S. Geological Survey, 2018). The data comes in several tiles, which we first merge to a single file and then convert using EPSG code 7755. The closest distance values for each village are constructed using QGIS' (QGIS Development Team, 2009) NNJoin plugin, which calculates closest distances on a nearest neighbor relationship.	1991
Distance to nearest town	The distance of the village to the nearest statutory town in km. The data comes from the Census of India. According to the census a statutory town is one with a municipality, corporation, cantonment board or notified town area committee	1991 2001 2011
	Panel B: Labor force variables from Census of India	
Workforce participation rate (WPR)	Refers to the crude workforce participation rate (WPR) in each village calculated as the share of total workers to total population multiplied by 100. The data for all labor force outcome variables is from the Census of India.	1991 2001 2011
Share of Main workers	Share of main workers to total workers for each village in percentage. According to the Census, main workers are those workers who had worked for the major part of the reference period (i.e. 6 months or more).	1991 2001 2011
Share of Cultivators	Share of main cultivators to total main workers in each village in percentage. For purposes of the census a person is classified as cultivator if he or she is engaged in cultivation of land owned or held from government or held from private persons or institutions for payment in money, kind or share. Cultivation includes effective supervision or direction in cultivation. A person who has given out her/his land to another person or persons or institution(s) for cultivation for money, kind or share of crop and who does not even supervise or direct cultivation of land, is not treated as cultivator. Similarly, a person working on another person's land for wages in cash or kind or a combination of both (agricultural laborer) is not treated as cultivator	1991 2001 2011
Share of agricultural labor	Share of main agricultural labor to total main workers for a village in percentage. A person who works on another person's land for wages in money or kind or share is regarded as an agricultural laborer. She or he has no risk in the cultivation, but merely works on another person's land for wages. An agricultural laborer has no right of lease or contract on land on which she/he works	1991 2001 2011
Share of Household Industry Workers	The share of main household industry (HHI) workers to total main workers for each village in percentage. Household Industry is defined as an industry conducted by one or more members of the household at home or within the village in rural areas. The larger proportion of workers in the household industry consists of members of the household. The industry is not run on the scale of a registered factory which would qualify or has to be registered under the Indian Factories Act. Some of the typical industries that can be conducted on a household industry basis are: production of foodstuffs, beverages, tobacco products, wool or silk manufacture, manufacture of wood and wood Products, paper and paper products.	1991 2001 2011
Share of Other Workers	The share of main other workers to total main workers in percentage. All workers, i.e., those who have been engaged in some economic activity during the last one year, but are not cultivators or agricultural laborers or in Household Industry, are 'Other Workers'. The type of workers that come under this category include all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport banking, mining, construction, political or social work, priests, entertainment artists, etc	1991 2001 2011
	Panel C: Socio-Demographic Variables from Census of India	

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Table A-2 – Variable definitions (continued)

Variable	**Definition**	**Year**
Population, Male and Female Population	Total population or total male or female population in the village.	1991 2001 2011
Literacy Rate	Share of literate population to total population above 6 years of age in percentage.	1991 2001 2011
Female to male Sex Ratio	The number of females per 1000 males.	1991 2001 2011
	Panel D: Land Use Change variables from Census of India	
Share of Forest Land	Share of forest land to total land in percentage.This includes all land classified either as forest under any legal enactment, or administered as forest, whether State owned or private, and whether wooded or maintained as potential forest land. The area of crops raised in the forest and grazing lands or areas open for grazing within the forests remain included under the "forest area".	1991 2001 2011
Unirrigated Land	Share of unirrigated land to total land in percentage.	1991 2001 2011
Irrigated Land	Share of irrigated land to total land in percentage.The area is assumed to be irrigated for cultivation through such sources as canals (government and private), tanks, tube -wells, other wells and other sources.	1991 2001 2011
Culturable Wasteland	Share of culturable wasteland to total land in percentage This includes land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years or more in succession including the current year for some reason or the other. Such land may be either fallow or covered with shrubs and jungles, which are not put to any use. They may be accessible or inaccessible and may lie in isolated blocks or within cultivated holdings.	1991 2001 2011
Non-Agricultural Land	Share of non-agricultural land to total land in percentage.This includes all land occupied by buildings, roads and railways or under water, e.g. rivers and canals, and other land put to uses other than agriculture.	1991 2001 2011
	Panel D: Poverty and Consumption Variables	
Per capita Consumption (annual Rs.)	Estimated rural per capita monthly consumption. All data for the analysis in Section III.C was downloaded from the SHRUG database (SHRUG v.1.5). Data for Surat district in Gujarat was downloaded from SHRUG v.2.0 due to errors in the earlier version. Consumption is estimated in the SHRUG database using the Socioeconomic Caste Census (SECC) data and 2011-12 India Human Development Survey (IHDS-II). For details on the methodology for construction of this dataset, refer to (Asher et al., 2021) and SHRUG website.	2011
Share of Households under 2 dollar PPP per capita per day	Share of households living under the World Bank poverty rate of less than 2 dollar per capita per day.	2011

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Table A-2 – Variable definitions (continued)

Variable	Definition	Year
Share of Households whose main income is cultivation	Share of households whose main source of income is from cultivation.	2011
Share of Workers employed in agriculture	Share of workers who are employed in agriculture.	2011

Table A-3 – Protected Areas in the Western Ghats as of 1990.

No.	Name	PA type	State	Notification Year	Area in sq km.
1	Idukki	Wildlife Sanctuary	Kerala	1976	70
2	Eravikulam	National Park	Kerala	1978	97
3	Thattekadu	Wildlife Sanctuary	Kerala	1983	25.16
4	Parambikulam	Wildlife Sanctuary	Kerala	1973	285
5	Chimmony	Wildlife Sanctuary	Kerala	1984	90
6	Peechi-Vazhani	Wildlife Sanctuary	Kerala	1958	125
7	Silent Valley	National Park	Kerala	1984	89.52
8	Aralam	Wildlife Sanctuary	Kerala	1984	55
9	Srivilliputhur (Grzd.Sqrl)	Wildlife Sanctuary	Tamil Nadu	1988	485.2
10	Bandipur	National Park	Karnataka	1974	874.2
11	Nugu	Wildlife Sanctuary	Karnataka	1974	30.32
12	Brahmagiri	Wildlife Sanctuary	Karnataka	1974	181.29
13	Pushpagiri	Wildlife Sanctuary	Karnataka	1987	102.92
14	Talakaveri	Wildlife Sanctuary	Karnataka	1987	105.01
15	Kudremukh	National Park	Karnataka	1987	600.32
16	Bhadra	Wildlife Sanctuary	Karnataka	1974	492.46
17	Shettihally	Wildlife Sanctuary	Karnataka	1974	395.6
18	Mookambika	Wildlife Sanctuary	Karnataka	1974	247
19	Sharavathi Valley	Wildlife Sanctuary	Karnataka	1974	431.23
20	Gudavi	Wildlife Sanctuary	Karnataka	1989	0.74
21	Anshi	National Park	Karnataka	1987	250
22	Cotigaon	Wildlife Sanctuary	Goa	1968	85.65
23	Bhagwan Mahavir	Wildlife Sanctuary	Goa	1967	133
24	Mollem	National Park	Goa	1978	107
25	Bondla	Wildlife Sanctuary	Goa	1969	8
26	Radhanagari	Wildlife Sanctuary	Maharashtra	1958	351.16
27	Chandoli	National Park	Maharashtra	1985	308.97
28	Koyana	Wildlife Sanctuary	Maharashtra	1985	423.55
29	Bhimashankar	Wildlife Sanctuary	Maharashtra	1985	130.78
30	Purna	Wildlife Sanctuary	Gujarat	1990	160.84
31	Neyyar	Wildlife Sanctuary	Kerala	1958	128
32	Peppara	Wildlife Sanctuary	Kerala	1983	53
33	Shendurney	Wildlife Sanctuary	Kerala	1984	100.32
34	Tansa	Wildlife Sanctuary	Maharashtra	1970	304.81
35	Bansda	National Park	Gujarat	1979	23.99
36	Periyar	National Park	Kerala	1982	350
37	Chinnar	Wildlife Sanctuary	Kerala	1984	90.44
38	Mukurthi	National Park	Tamil Nadu	1990	78.46
39	Mudumalai	National Park	Tamil Nadu	1990	103.23
40	Wayanad	Wildlife Sanctuary	Kerala	1973	344.44
41	Nagarahole (Rajiv Gandhi)	National Park	Karnataka	1988	643.39
42	Dandeli	Wildlife Sanctuary	Karnataka	1975	475.02
43	Phansad	Wildlife Sanctuary	Maharashtra	1986	69.79
44	Karnala	Wildlife Sanctuary	Maharashtra	1968	4.48
45	Biligiri Rangaswamy Temple	Wildlife Sanctuary	Karnataka	1987	539.52
46	Someshwara	Wildlife Sanctuary	Karnataka	1974	88.4
47	Mundanthurai	Wildlife Sanctuary	Tamil Nadu	1977	567.38
48	Kalakad	Wildlife Sanctuary	Tamil Nadu	1976	223.58
49	Indira Gandhi (Annamalai)	National Park	Tamil Nadu	1989	117.1
50	Indira Gandhi (Annamalai)	Wildlife Sanctuary	Tamil Nadu	1989	117.1

Table A-4 – Changes in labor force participation, 1991 - 2011. Models without time-varying controls.

	Workforce participation rate	Share main workers	Share of main workers by sector: Cultivators	Agricultural labor	Household industry	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All						
Post	-0.27	-9.73***	-15.51***	3.26***	1.24***	11.02***
	(0.19)	(0.40)	(0.40)	(0.42)	(0.08)	(0.43)
Post x Treatment	0.85	-4.61***	-1.91	-1.45	-0.58***	3.94**
	(0.64)	(1.48)	(1.68)	(1.52)	(0.20)	(1.64)
Observations	14,594	14,594	14,574	14,574	14,574	14,574
Baseline Mean	48.37	87.41	52.89	22.65	1.12	23.34
R^2	0.69	0.59	0.82	0.67	0.57	0.83
Panel B: Male						
Post	3.76***	-12.97***	-14.01***	3.68***	0.51***	9.82***
	(0.13)	(0.33)	(0.38)	(0.39)	(0.06)	(0.41)
Post x Treatment	-0.02	-3.17**	-2.88*	-0.92	-0.10	3.90**
	(0.44)	(1.27)	(1.66)	(1.43)	(0.17)	(1.65)
Observations	14,594	14,594	14,570	14,570	14,570	14,570
Baseline mean	53.36	96.80	52.21	19.13	1.22	27.44
R^2	0.74	0.61	0.82	0.66	0.58	0.83
Panel C: Female						
Post	-3.95***	-8.09***	-17.15***	1.74***	2.33***	13.08***
	(0.31)	(0.58)	(0.48)	(0.54)	(0.15)	(0.51)
Post x Treatment	1.62	-6.76***	-0.01	-3.18*	-1.50***	4.69**
	(1.05)	(2.02)	(1.86)	(1.91)	(0.37)	(1.85)
Observations	14,592	14,480	14,304	14,304	14,304	14,304
Baseline mean	43.14	76.48	50.33	31.00	1.15	17.52
R^2	0.69	0.57	0.77	0.67	0.54	0.76

Notes: This table presents CBPS-weighted difference-in-differences estimates of Equation (1) from the main text to measure the impact of eco-development on village-level labor market outcomes, without the includion of time-varying controls. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. $Post \times Treatment$ is the DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2011. The "Baseline mean" refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

Table A-5 – Changes in labor force participation, 1991 - 2001 - 2011.

	Workforce participation rate	Share main workers	Share of main workers by sector: Cultivators	Agricultural labor	Household industry	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All						
2001	2.24	-11.08	-5.40***	-6.35***	1.36***	10.38***
	(0.31)	(0.60)	(0.56)	(0.77)	(0.12)	(0.92)
2001 x Treatment	-1.22**	-1.99	-1.25	-1.80	0.14	2.91*
	(0.55)	(1.45)	(1.58)	(1.10)	(0.25)	(1.54)
2011	1.33***	-9.82***	-12.05***	1.12	1.22***	9.71***
	(0.45)	(0.83)	(0.83)	(1.29)	(0.16)	(1.55)
2011 x Treatment	0.76	-4.90***	-2.37	-1.24	-0.62***	4.23***
	(0.63)	(1.44)	(1.64)	(1.51)	(0.20)	(1.61)
Observations	22,527	22,527	22,505	22,505	22,505	22,505
R^2	0.65	0.48	0.79	0.62	0.55	0.80
Panel B: Male						
2001	1.46***	-9.36***	-6.26***	-4.25***	0.64***	9.87***
	(0.24)	(0.49)	(0.55)	(0.71)	(0.08)	(0.88)
2001 x Treatment	-0.56	-2.13*	-1.65	-1.70*	0.15	3.20**
	(0.35)	(1.09)	(1.53)	(0.99)	(0.19)	(1.54)
2011	3.34***	-10.07***	-10.93***	2.28*	0.58***	8.07***
	(0.34)	(0.67)	(0.81)	(1.21)	(0.12)	(1.49)
2011 x Treatment	0.03	-3.52***	-3.36**	-0.80	-0.11	4.26***
	(0.44)	(1.21)	(1.61)	(1.42)	(0.17)	(1.62)
Observations	22,527	22,527	22,501	22,501	22,501	22,501
R^2	0.70	0.50	0.79	0.61	0.49	0.81
Panel C: Female						
2001	3.29***	-13.14***	-2.77***	-11.97***	2.55***	12.19***
	(0.46)	(0.86)	(0.64)	(0.96)	(0.24)	(1.05)
2001 x Treatment	-1.96**	-2.57	0.45	-2.56*	-0.03	2.15
	(0.92)	(2.10)	(1.82)	(1.52)	(0.46)	(1.63)
2011	-0.15	-10.10***	-12.32***	-3.01*	2.10***	13.22***
	(0.66)	(1.16)	(0.96)	(1.54)	(0.30)	(1.76)
2011 x Treatment	1.38	-7.06***	-0.51	-2.53	-1.59***	4.63**
	(1.03)	(1.99)	(1.82)	(1.89)	(0.36)	(1.84)
Observations	22,524	22,424	22,206	22,206	22,206	22,206
R^2	0.65	0.46	0.73	0.61	0.56	0.72

Notes: This table presents CBPS-weighted difference-in-differences estimates to measure the impact of eco-development on village-level labor market outcomes. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are located 20-50km away. The baseline year is 1991. 2001 is a dummy indicator equal to 1 for observations in year 2001 and 0 otherwise. 2011 is a dummy indicator equal to 1 for observations in year 2011 and 0 otherwise. $2001 \times Treatment$ is the midline DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2001 relative to 1991. $2011 \times Treatment$ is the endline DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2011 relative to 1991. All regressions include village fixed effects and controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

TABLE A-6 – CHANGES IN LABOR FORCE PARTICIPATION, 1991 - 2011. MODELS WHERE THE TREATMENT VILLAGES ARE SITUATED 0-5 KM AWAY FROM THE PROTECTED AREA BORDER.

			Share of main workers by sector			
	Workforce participation rate	Share main workers	Cultivators	Agricultural labor	Household industry	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All						
Post	2.75***	-11.76***	-7.09***	-4.24***	0.74***	10.58***
	(0.39)	(0.73)	(0.69)	(1.62)	(0.15)	(1.71)
Post x Treatment	-0.19	-3.66***	-0.83	-0.99	-0.58***	2.40***
	(0.43)	(0.84)	(0.85)	(0.91)	(0.15)	(0.77)
Observations	16,896	16,896	16,876	16,876	16,876	16,876
Baseline Mean	48.37	87.41	52.89	22.65	1.12	23.34
R^2	0.70	0.59	0.82	0.68	0.57	0.83
Panel B: Male						
Post	2.16***	-10.36***	-8.73***	-2.15	0.36***	10.52***
	(0.32)	(0.58)	(0.71)	(1.52)	(0.11)	(1.69)
Post x Treatment	-0.07	-2.62***	-0.91	-0.43	-0.16	1.50*
	(0.29)	(0.73)	(0.80)	(0.84)	(0.12)	(0.79)
Observations	16,896	16,896	16,872	16,872	16,872	16,872
Baseline mean	53.36	96.80	52.21	19.13	1.22	27.44
R^2	0.74	0.62	0.82	0.67	0.58	0.83
Panel C: Female						
Post	3.82***	-13.13***	-2.72***	-10.89***	1.17***	12.44***
	(0.63)	(1.10)	(0.86)	(1.92)	(0.31)	(1.86)
Post x Treatment	-0.35	-4.88***	-0.84	-2.59**	-1.11***	4.55***
	(0.70)	(1.23)	(1.14)	(1.18)	(0.29)	(1.01)
Observations	16,892	16,740	16,534	16,534	16,534	16,534
Baseline mean	43.14	76.48	50.33	31.00	1.15	17.52
R^2	0.70	0.57	0.77	0.68	0.55	0.76

Notes: This table presents CBPS-weighted difference-in-differences estimates of Equation (1) from the main text to measure the impact of eco-development on village-level labor market outcomes. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. **Treatment villages are located 0-5km away from the protected area border.** The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. $Post \times Treatment$ is the DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2011 relative to 1991. The "Baseline mean" refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects and controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

Table A-7 – Changes in labor force participation, 1991 - 2011. Models where the treatment villages are situated 0-10 km away from the protected area border.

	Workforce participation rate	Share main workers	Share of main workers by sector: Cultivators	Agricultural labor	Household industry	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All						
Post	3.31***	-12.17***	-7.22***	-3.90***	0.72***	10.40***
	(0.35)	(0.65)	(0.63)	(1.23)	(0.14)	(1.28)
Post x Treatment	-0.76**	-3.12***	-1.74***	-0.94	-0.55***	3.23***
	(0.32)	(0.68)	(0.65)	(0.65)	(0.13)	(0.63)
Observations	20,000	20,000	19,978	19,978	19,978	19,978
Baseline Mean	48.37	87.41	52.89	22.65	1.12	23.34
R^2	0.69	0.59	0.82	0.68	0.56	0.83
Panel B: Male						
Post	2.26***	-10.99***	-9.01***	-1.68	0.29***	10.40***
	(0.26)	(0.51)	(0.64)	(1.16)	(0.09)	(1.25)
Post x Treatment	-0.18	-2.52***	-1.23**	-0.85	-0.15	2.24***
	(0.24)	(0.58)	(0.60)	(0.60)	(0.10)	(0.62)
Observations	20,000	20,000	19,974	19,974	19,974	19,974
Baseline mean	53.36	96.80	52.21	19.13	1.22	27.44
R^2	0.74	0.62	0.82	0.67	0.57	0.83
Panel C: Female						
Post	4.87***	-13.07***	-2.71***	-11.01***	1.26***	12.46***
	(0.58)	(0.99)	(0.79)	(1.47)	(0.30)	(1.42)
Post x Treatment	-1.45***	-3.96***	-2.00**	-1.17	-1.16***	4.34***
	(0.51)	(0.97)	(0.86)	(0.86)	(0.26)	(0.80)
Observations	19,996	19,816	19,572	19,572	19,572	19,572
Baseline mean	43.14	76.48	50.33	31.00	1.15	17.52
R^2	0.70	0.57	0.77	0.67	0.54	0.75

Notes: This table presents CBPS-weighted difference-in-differences estimates of Equation (1) from the main text to measure the impact of eco-development on village-level labor market outcomes. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. **Treatment villages are located 0-10km away from the protected area border.** The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. $Post \times Treatment$ is the DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2011 relative to 1991. The "Baseline mean" refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects and controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

Table A-8 – Changes in labor force participation, 1991 - 2011. Models where the control villages are situated 15-50 km away from the protected area border.

	Workforce participation rate	Share main workers	Share of main workers by sector: Cultivators	Agricultural labor	Household industry	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All						
Post	2.75***	-11.20***	-6.18***	-1.01	0.73***	6.46**
	(0.45)	(0.80)	(0.64)	(2.73)	(0.18)	(2.85)
Post x Treatment	0.90	-4.57***	-2.32	-1.14	-0.48**	3.94**
	(0.63)	(1.40)	(1.58)	(1.51)	(0.19)	(1.60)
Observations	17,806	17,806	17,782	17,782	17,782	17,782
Baseline Mean	48.51	87.56	52.38	22.85	1.15	23.62
R^2	0.70	0.59	0.83	0.67	0.57	0.83
Panel B: Male						
Post	2.51***	-9.89***	-7.58***	0.92	0.35**	6.32**
	(0.39)	(0.59)	(0.70)	(2.61)	(0.15)	(2.82)
Post x Treatment	0.26	-3.22***	-3.01*	-0.80	-0.11	3.92**
	(0.45)	(1.16)	(1.58)	(1.42)	(0.17)	(1.61)
Observations	17,806	17,806	17,776	17,776	17,776	17,776
Baseline mean	53.70	96.94	51.76	19.27	1.27	27.70
R^2	0.75	0.63	0.83	0.66	0.58	0.83
Panel C: Female						
Post	3.43***	-12.06***	-2.77***	-6.88**	1.26***	8.39***
	(0.70)	(1.14)	(0.75)	(3.09)	(0.32)	(3.01)
Post x Treatment	1.51	-6.89***	-1.03	-2.32	-1.22***	4.57**
	(1.00)	(1.95)	(1.74)	(1.90)	(0.35)	(1.83)
Observations	17,802	17,670	17,454	17,454	17,454	17,454
Baseline mean	43.10	76.49	49.70	31.40	1.14	17.77
R^2	0.70	0.57	0.78	0.67	0.54	0.76

Notes: This table presents CBPS-weighted difference-in-differences estimates of Equation (1) from the main text to measure the impact of eco-development on village-level labor market outcomes. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. **Control villages are located 15-50km away.** The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. *Post* × *Treatment* is the DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2011 relative to 1991. The "Baseline mean" refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects and controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

Table A-9 – Changes in labor force participation, 1991 - 2011. Models where the control villages are situated 25-50 km away from the protected area border.

	Workforce participation rate	Share main workers	Share of main workers by sector: Cultivators	Agricultural labor	Household industry	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All						
Post	1.62**	-14.64***	-6.26***	-8.04***	0.69***	13.61***
	(0.79)	(1.15)	(1.06)	(1.80)	(0.24)	(2.02)
Post x Treatment	0.46	-4.86***	-3.46*	-0.75	-0.49**	4.71**
	(0.72)	(1.57)	(1.97)	(1.60)	(0.20)	(1.92)
Observations	11,652	11,652	11,634	11,634	11,634	11,634
Baseline Mean	48.38	86.88	53.25	22.88	1.11	22.76
R^2	0.70	0.59	0.81	0.68	0.57	0.81
Panel B: Male						
Post	1.05**	-12.25***	-8.17***	-5.26***	0.38**	13.05***
	(0.48)	(0.86)	(1.02)	(1.71)	(0.17)	(1.87)
Post x Treatment	0.27	-3.63***	-4.13**	-0.51	0.02	4.62**
	(0.50)	(1.33)	(1.95)	(1.52)	(0.18)	(1.93)
Observations	11,652	11,652	11,630	11,630	11,630	11,630
Baseline mean	53.13	96.63	52.47	19.38	1.19	26.96
R^2	0.74	0.62	0.81	0.67	0.60	0.81
Panel C: Female						
Post	2.60**	-16.71***	-1.69	-16.30***	1.15**	16.84***
	(1.29)	(1.72)	(1.45)	(1.80)	(0.49)	(2.06)
Post x Treatment	0.57	-7.06***	-2.06	-1.84	-1.47***	5.36**
	(1.14)	(2.17)	(2.12)	(1.99)	(0.36)	(2.11)
Observations	11,652	11,564	11,416	11,416	11,416	11,416
Baseline mean	43.37	75.77	50.78	31.14	1.21	16.87
R^2	0.70	0.57	0.77	0.68	0.54	0.73

Notes: This table presents CBPS-weighted difference-in-differences estimates of Equation (1) from the main text to measure the impact of eco-development on village-level labor market outcomes. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. **Control villages are located 25-50km away.** The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. *Post* × *Treatment* is the DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2011 relative to 1991. The "Baseline mean" refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects and controls for rainfall, as well as minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

Table A-10 – Changes in labour force participation, 1991 - 2011. Difference-in-differences model without CBPS weights.

	Workforce participation rate	Share main workers	Share of main workers by sector: Cultivators	Agricultural labor	Household industry	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All						
Post	2.51***	-11.50***	-8.11***	-4.91***	0.69***	12.32***
	(0.40)	(0.76)	(0.77)	(0.97)	(0.15)	(0.86)
Post x Treatment	1.30***	-1.08	0.31	1.26	-0.66***	-0.92
	(0.41)	(0.83)	(0.81)	(0.88)	(0.17)	(0.80)
Observations	14,594	14,594	14,574	14,574	14,574	14,574
Baseline Mean	48.33	87.43	52.82	22.67	1.12	23.38
R^2	0.69	0.59	0.82	0.69	0.56	0.83
Panel B: Male						
Post	2.49***	-11.86***	-10.13***	-2.00**	0.36***	11.78***
	(0.26)	(0.61)	(0.78)	(0.93)	(0.10)	(0.85)
Post x Treatment	-0.35	0.55	0.24	1.17	-0.33***	-1.07
	(0.29)	(0.65)	(0.80)	(0.81)	(0.11)	(0.81)
Observations	14,594	14,594	14,570	14,570	14,570	14,570
Baseline mean	53.36	96.81	52.14	19.17	1.22	27.47
R^2	0.76	0.61	0.82	0.68	0.58	0.83
Panel C: Female						
Post	2.92***	-10.52***	-2.83***	-14.13***	1.16***	15.80***
	(0.68)	(1.16)	(0.95)	(1.24)	(0.33)	(1.05)
Post x Treatment	2.80***	-2.28*	1.21	1.00	-1.31***	-0.89
	(0.68)	(1.27)	(1.06)	(1.16)	(0.38)	(1.04)
Observations	14,592	14,480	14,304	14,304	14,304	14,304
Baseline mean	43.07	76.50	50.24	30.96	1.17	17.62
R^2	0.69	0.57	0.77	0.69	0.53	0.76

Notes: This table presents unweighted difference-in-differences estimates of Equation (1) from the main text to measure the impact of eco-development on village-level labour market outcomes. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. $Post \times Treatment$ is the DID estimate of interest, capturing the difference in outcomes between treatment and control villages in 2011 relative to 1991. The "Baseline mean" refers to the mean value of each outcome variable in the control villages in 1991. All regressions include village fixed effects and controls for annual rainfall, minimum and maximum temperature, distance from the nearest town. Standard errors are clustered at the village level. Significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table A-11 – Differences in workforce composition of year round employment, 2011.

	Share of Main Workers	Share of Main Workers by Category			
		Cultivators	Agricultural Labour	Household Industry	Other
	(1)	(2)	(3)	(4)	(5)
Treatment	-4.07***	-3.83***	5.21***	-0.40*	-0.98
	(1.30)	(1.34)	(1.35)	(0.23)	(1.57)
Observations	7,324	7,313	7,313	7,313	7,313
Baseline Mean	77.47	37.99	25.92	2.37	33.72
R^2	0.07	0.06	0.13	0.03	0.20

Notes: This table presents CBPS-weighted estimates of the difference in workforce composition of year round employment between villages in close proximity to protected areas and those located further away, as measured in the year 2011. Each column corresponds to a different dependent variable. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. All regressions include controls for rainfall, minimum and maximum temperature, distance from the nearest town. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

Table A-12 – Differences in workforce composition in employment for less than six months a year, 2011.

	Share of Marginal Workers	Share of Marginal Workers by Category			
		Cultivators	Agricultural Labour	Household Industry	Other
	(1)	(2)	(3)	(4)	(5)
Treatment	4.07***	-2.79**	5.97***	-0.44	-2.74*
	(1.30)	(1.25)	(1.55)	(0.43)	(1.44)
Observations	7,324	6,873	6,873	6,873	6,873
Baseline Mean	22.53	24.82	39.81	3.85	31.52
R^2	0.07	0.03	0.11	0.01	0.13

Notes: This table presents CBPS-weighted estimates of the difference in workforce composition of workers employed for less than six months a year in villages in close proximity to protected areas relative to those located further away, as measured in the year 2011. Each column corresponds to a different dependent variable. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. All regressions include controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.

Marginal effects by gender

In order to assess the heterogeneity of the treatment effect by gender, we estimate a triple interaction model, as follows:

$$Y_{it} = \beta_1 \text{Post}_t + \beta_2 \text{H}_i + \beta_3 \text{Post}_t \times \text{Treatment}_i + \beta_4 \text{Post}_t \times \text{H}_i + \\ + \beta_5 \text{G}_i \times \text{Treatment}_i + \beta_6 \text{Post}_t \times \text{Treatment}_i \times \text{H}_i + X_i' \Gamma + \gamma_i + \epsilon_{it} \quad (2)$$

where G_i is a categorical variable for the female population. All other variables follow the definitions of Equation (1) from the main text.

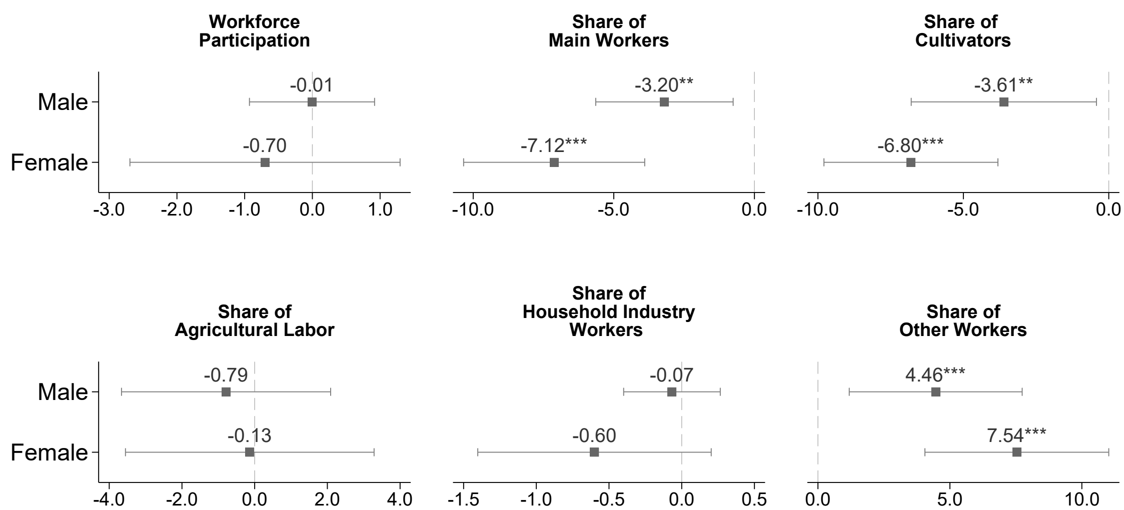

Figure A-1 – Estimated Marginal Effects of Eco-development on Labor Force Participation, by Gender.

Notes: This figure presents the estimated marginal treatment effects on labor force participation outcomes at the village level (Equation (2)), by gender. See Table A-2 for variable definitions. Treatment villages are defined as those that lie between 0-1km of the protected area. Control villages are villages located 20-50km away. The baseline year is 1991. *Post* is a dummy indicator equal to 1 for observations in year 2011 and 0 for observations from 1991. *Post* × *Treatment* is the DID estimate of interest, capturing the estimated difference in outcomes between treatment and control villages in 2011 relative to 1991. All regressions include village fixed effects and controls for rainfall, minimum and maximum temperature, and distance from the nearest town. Standard errors are clustered at the village level. The usual set of CBPS weights has been utilized in the DID estimation. Significance is denoted as follows: *** p<0.01, ** p<0.05, and * p<0.1.