Iosr Journal Of Economics And Finance (Iosr-Jef)
E-Issn: 2321-5933,P-Issn: 2321-5925.Volume 15, Issue 3 Ser.5 (May. – June. 2024),Pp 07-26
www.Iosrjournals.Org

Navigating The Biodiversity-Economic Growth Nexus And Shared Socioeconomic Pathways: Insights From Asia And Others

Amal Varghese
Ramjas College, University of Delhi, India

Abstract
The conservation of natural ecosystems is an urgent global concern, and it often involves navigating complex trade-offs between economic growth and ecological preservation. However, biodiversity conservation has at times taken a back seat in the broader discussion as climate change receives more attention. Yet, both biodiversity and climate change are inextricably linked. This paper aims to empirically examine the relationship between economic growth and biodiversity wellness through panel data analysis along with the preparation of a Shared Socioeconomic Pathways Index and the categorisation of the data based on the same. It also involves testing the existence of the Kuznets relationship if any with a special focus on Asia. The estimates from the panel data give conventional results with South America and North America facing the worst and best biodiversity scenario respectively. The SSP index prepared and subsequent categorisation of the same further substantiate the results. The Kuznets curve however is a flat U-shaped curve in terms of environmental degradation and economic growth nexus.

Keywords: *Biodiversity; Living Planet Index; Shared Socioeconomic Pathways*

Date of Submission: 07-06-2024 Date of acceptance: 17-06-2024

I. Introduction

WWF's Living Planet Report states- "Biodiversity is the variety of life and the interactions between living things at all levels on land, in water and in the sea and air – genes, populations, species and ecosystems. Each of these species and organisms work together in ecosystems, like an intricate web, to maintain balance and support life." However though ignored relative to climate change, biodiversity loss is a crucial and pestering issue that has been on the rise. Economic growth coupled with extensive industrialisation and skewed utilisation and over-commercialisation of resources has led to ecosystem fragmentation, the introduction of invasive species, and environmental degradation in general (Figure 1.1). While industrialised countries are responsible for most environmental degradation, it is poor countries and poor people who are the most vulnerable. Recent estimates reveal that the planet is experiencing an unprecedented loss of species at a rate between 1,000 and 10,000 times higher than natural extinction levels.[1] This rampant biodiversity decline not only jeopardises the intricate ecological balance but also poses severe risks to human well-being, as ecosystems provide essential services such as clean water, pollination of crops, and disease regulation.

Figure 1.1: *Economic Growth induced Biodiversity loss*

Source: Otero et al. (2020)

Ecological indicators are relatively explored less compared to indicators like per capita carbon emissions which are used as proxies for environmental degradation or climate change in particular for studying the biodiversity-economic growth nexus. Living Planet Index (hereby LPI) is one such ecological indicator that measures bio-diversity wellness. "LPI is a measure of the state of the world's biological diversity based on

1 Global Assessment Report (2019) by the Intergovernmental Platform on Biodiversity and Ecosystem Services

population trends of vertebrate species from terrestrial, freshwater and marine habitats. The LPI shows region-specific data based on trends of over 4,000 species and thousands of population time series collected from monitored sites around the world."(WWF). A rise in LPI indicates improvement in the state of biodiversity and vice versa. The regions in the dataset are classified based on the extent of similarity of biodiversity into five categories which are North America, South America and Caribbean, Central Asia (except the Middle East) and Europe, Asia and Pacific (except North Korea), and Africa.[2]

Moving away from analysis-oriented studies and talking about solution-oriented studies, paved the path to scenario-based strategies to understand where the world would stand given the current situation using projections, the most recent and prominent one being Shared Socio-economic Pathways (hereby SSPs). The IPCC Sixth Assessment Report on Climate Change in 2021 defines SSPs as "climate change scenarios of projected socioeconomic global changes up to 2100." They are developed to explore different possible future trajectories of global socio-economic conditions. These pathways were created to serve as a basis for Integrated Assessment Models (IAMs), which are designed to capture a range of plausible futures based on different combinations of socio-economic and environmental drivers which include population growth, economic development, technological innovation, and policy choices.

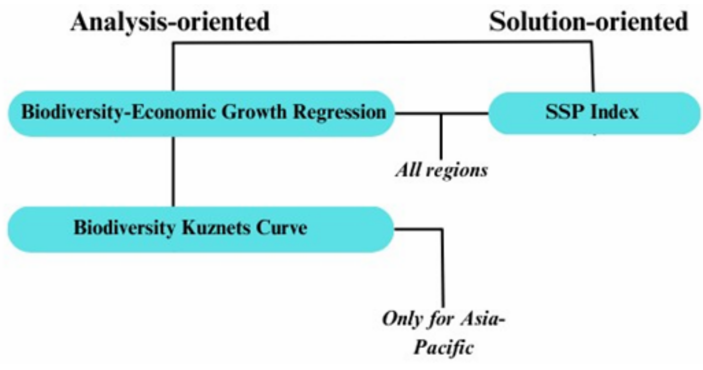
Similar to panel data studies, relative negligence could be seen for ecological indicators when it comes to studies on the Kuznets relation. The concept of the Biodiversity Kuznets curve is less explored compared to the popular Environmental Kuznets Curve (EKC) which shows the trade-off between environmental degradation and economic growth often represented by carbon emissions and per capita GDP respectively.

Background And Rationale

Environment-Economy nexus came under the radar of scholars from the last decade of the 20th century with ecological economics being a relatively newer concept. Panel data analysis and the exploration of the Kuznets relationship have been integral to these investigations. Concurrently, discussions on scenario-based projections have become prevalent, lately with a focus on SSPs. These SSPs delineate challenges and opportunities for both adaptation and mitigation. Notably, some scholars have extended this discourse into the realm of biodiversity and economic growth.

Limited attention has been directed toward region-specific panel data analysis incorporating comprehensive biodiversity indicators such as the LPI, indicating the need for further investigation as one cannot treat biodiversity loss and climate change as two separate concepts anymore. LPI is a comprehensive index that could reflect the particular nuances of the ecosystems due to the inclusion of as many as 4000 species. LPI distinguishes itself by adhering to the FAIR (Findable, Accessible, Interoperable, and Reusable) norms to a considerable extent, hence the choice of the same. The region-specific analysis must be done because bloc-level solutions incorporating corporation from different countries is crucial for successful solutions as one nation cannot work to improve the biodiversity as many ecosystems of similar nature are spanned across multiple nations. Also, SSPs must be applied in areas other than projections and forecasts. The author found the choice of an additional study for the Asia-Pacific[3] region in particular, crucial based on various factors including its current contribution to world GDP, biodiversity richness, size and population. Hence, the Biodiversity Kuznets Curve Analysis for Asia-Pacific must be discussed. This is what is being done in this paper (See Figure 1.1.1).

Figure 1.1.1 *Structure of the study*



Source: Author's explanation

2 The exclusion of Middle East and North Korea is owing to data constraints.

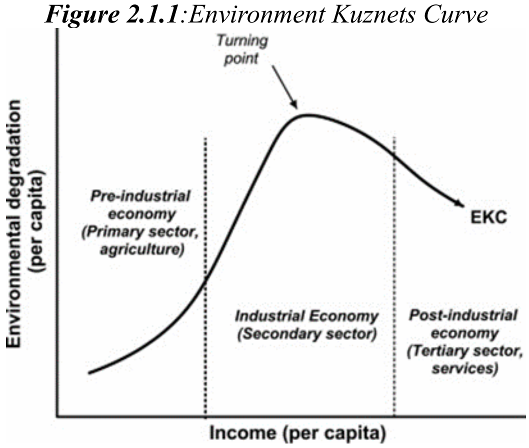
3 All the countries in Asia and the pacific region are classified and clubbed together as Asia and Pacific (not to be confused with Asia and Pacific-APAC) in the LPI database. Both the terms 'Asia and Pacific' and 'Asia-Pacific' are used interchangeably to avoid confusion.

II. Literature Review

Theoretical Literature

The relationship between environmental pollution and economic development has been studied extensively over the past few decades with Grossman & Krueger (1991) being the pioneering work done on that front. Kuznets curve was first translated into environmental economics by Panayotou (1993). The fundamental idea underlying the EKC is that during the initial stages of economic growth, a country depletes its natural resources, leading to a direct positive relationship between growth and environmental pollution. Subsequently, as technological advancements progress, environmental pollution starts to diminish beyond a certain turning point, marking a threshold level of economic growth where environmental degradation begins to decrease. Historically, environmental degradation intensified during the transition from agriculture-based to industrial-oriented economies (Cialani & Catia, 2007). As income levels rise, people tend to prioritise better environmental quality, particularly in post-industrial economies, leading to a decline in environmental degradation (See Figure 2.1.1). Within the EKC framework, growth's environmental impacts are channeled into three paths: the scale effect during initial growth, where production expansion may heighten environmental damage; the composition effect as the economy shifts to the cleaner service sector; and the technique effect, involving the adoption of eco-friendly production methods. The application of explicit policy tools on the EKC relation was tested by Panayotou (1997). Since then, many studies have been done incorporating various institutional, social, and demographic indicators to derive the EKC relationships for various countries and groups of countries to frame effective policies using the same for mitigating the issues.

Figure 2.1.1:*Environment Kuznets Curve*



Source: Kaika et al. (2013)

Economic growth is important for human well-being even at the cost of environmental damage opined Aşıcı (2013). Holtz Eakin and Selden (1995) showcased the case of relative decoupling from global panel data in terms of the marginal propensity to emit carbon dioxide, one of the earliest to pave the way for later literature into the ideology of degrowth. Biodiversity policies reflect the shared assumption by policymakers that economic growth is needed to alleviate poverty and achieve prosperity However, citing various kinds of literature on OECD nations, Otero et al. (2020) show "how an emerging literature explores whether and how it may be possible to find a 'prosperous way down' and manage without growth."

On the prospects of solutions, along with the typical fiscal and institutional policies, scenario-based strategies emerged within the past few decades, the widely used one being SSPs. There are five SSPs labelled SSP1 through SSP5, each representing a different storyline or narrative about the future. These narratives describe different ways in which societies might evolve, leading to distinct patterns of population, economic development, and resource use. Table 2.1.1 provides a summary of what each SSP accounts for.

Table 2.1.1: *Description of various SSPs*

Factor	SSP1 Sustainable Development	SSP2 Middle of the Road	SSP3 Regional Rivalry	SSP4 Inequality	SSP5 Fossil-Fueled Development
Population Growth	Low to very low	Moderate	High to very high	Moderate	High to very high
Economic Development	Low to moderate	Moderate and balanced	Development with regional disparities	Growth concentrated among a small elite.	High economic growth and industrialisation

Resource Use	Shift toward renewable energy sources and efficient technologies	Resource utilization, with moderate investments in sustainable practices.	Variability in resource utilization, reflecting regional competition	Driven by economic interests	Heavy reliance on fossil fuels and high GHG emissions
Inequality	Reduced inequality with strong sense towards human capital	Moderate	High	High	May vary
Environmental Sustainability	High priority on environmental conservation and protection	Priority exist, but may vary in effectiveness.	Priority secondary to economic and political interests.	Priority secondary to economic interests	Limited focus

Source: Author

Empirical Literature

The Kuznets Curve concept was introduced in Environmental Economics by Panayotou (1993), building upon the pioneering work of Grossman & Krueger (1991) on the nexus between the environment and economic growth. Subsequently, researchers have extensively examined the EKC relationship across various countries and groups. Zaman (2017) citing many previous works showed the most common reasons for observed EKC results, including shiftable externalities, industry composition, environmental regulation, technology, net migration, and differences in trade policy regimes.

Mozumder et al. (2006) were among the first to shift focus to ecological footprint and biodiversity specifically in EKC analysis. Ecological footprint analysis, an emerging field in ecological economics, has gained prominence in recent studies (Aydin, Esen, & Aydin, 2019; Destek & Sarkodie, 2019; Sarkodie & Strezov, 2018; Wang & Dong, 2019; Aşici & Acar, 2015; Wang et al., 2013). The utilisation of the Living Planet Index (hereby LPI) as an ecological indicator[4] has witnessed a significant upsurge in recent times, as depicted in Figure A.1 (refer to the Appendix). In addition to LPI, other prominent proxies for assessing biodiversity health, such as the IUCN Red List Index and Biodiversity Intactness Index, exist. Notably, LPI has emerged as a widely employed indicator for studying biodiversity wellness over the past two decades. Dasgupta (2021) offers a comprehensive analysis of the utility of LPI, viz a viz other indicators. Its non-static nature stands out as a notable strength, rendering LPI particularly advantageous for research purposes (Ledger et al., 2022). Various studies have focused on projections using various scenarios[5] with Shared Socioeconomic Pathways (SSPs) being the latest and most prominent one. However, the usage of SSPs for alternative objectives has been a relatively unexplored domain. Otero et al. (2020), however, innovatively adapted the basic SSP framework to the realm of biodiversity, thereby substantiating their arguments on degrowth and decoupling.

III. Research question and Objectives

The research question addressed in this study is: What is the biodiversity-economic growth nexus between various regions and concerning the SSP scenarios, where does each region stand? What is the stance of Asia-Pacific in particular for the Kuznets relationship with biodiversity indicators other than environmental indicators like carbon emissions?

The objective of this paper is threefold:

1. To study the region-wise empirical relationship between economic growth and biodiversity for all regions aforementioned.
2. To derive an SSP index and categorise the regions on its basis.
3. To derive a Biodiversity Kuznets Curve using LPI as the ecological indicator for Asia-Pacific.

Appropriate policy recommendations and scope of the study will be made.

IV. Biodiversity- Economic Growth Regression

4 For simplicity, the terms 'ecological indicator' and 'biodiversity indicator' are used interchangeably.

5 See Table A.2 in the Appendix for various other scenarios along with SSP

Data And Methodology

The paper uses region-wise secondary data available from various reliable international sources. The period of study is 2000-2017, a choice made based on the availability of data. The regions of study are: North America, South America and Caribbean, Central Asia and Europe, Asia and Pacific and Africa.

The econometric model is specified as follows:

[6] (1)

where is the LPI measured for region in the year

is the per capita GDP (current US$) measured for region in the year

is the Harmonised Learning Outcome measured for region in the year

is the Carbon dioxide emissions per capita annum measured for region in the year

is the categorical variable for regions for the year t

The detailed description of the variables used for the same is shown in Table 4.1.1 as follows:

***Table 4.1.1**: Description of variables in Biodiversity Economic Growth Regression*

Notation	Type of Variable	Type of Indicator	Proxy chosen	Source of data
	Dependent	Biodiversity	LPI	ZSL[7] and WWF[8]
	Independent	Economic	GDP per capita (current US$)	World Bank
	Independent (Control)	Human Capital	Harmonised Learning Outcome	World Bank
	Independent (Control)	Environmental Quality	Carbon dioxide emissions per capita annum (in metric tons)	ICOS[9]

Source: Author

The choice of functional form for this panel data analysis is in lines with the previous empirical studies done on similar aspects. It is also done to address the stationarity of the data. The estimation method used is Fixed Effects. Hausmann test was done to reach this decision (See appendix). The inclusion of fixed effects enhances the precision of estimates by effectively isolating the impact of time-varying economic indicators on LPI, while accounting for region-specific idiosyncrasies.

Harmonised Learning Outcome is incorporated in the model as "education is a quintessential factor for the masses to understand ecological threats" (Chankrajang & Muttarak, 2017; Ulucak & Bilgili, 2018). In lines with the inclusion of environmental indicators in the model constructed by S. T. Hassan, Baloch, Mahmood, and Zhang (2019) and how WWF's Living Planet Report states how Climate change (for which carbon emissions are popularly taken as a proxy) and Biodiversity loss are two sides of the same coin, the paper included carbon emissions per capita as a control variable.

The depicted figure numbered 4.1.1, illustrates the trajectory of the principal variable under consideration, namely LPI across different regions. It is to be noted that the state of biodiversity wellness, measured by the LPI, is notably unfavourable in South America, showcasing a recent decline. While Europe and Central Asia have historically led among the regions, there is now an observable downward trend, anticipated to be surpassed by North America. In contrast, Asia and the Pacific maintained a stable trend until 2007, followed by a convergence with Africa, subsequently leading to a decline in LPI. Nevertheless, recent years show signs of improvement in this index for Africa.

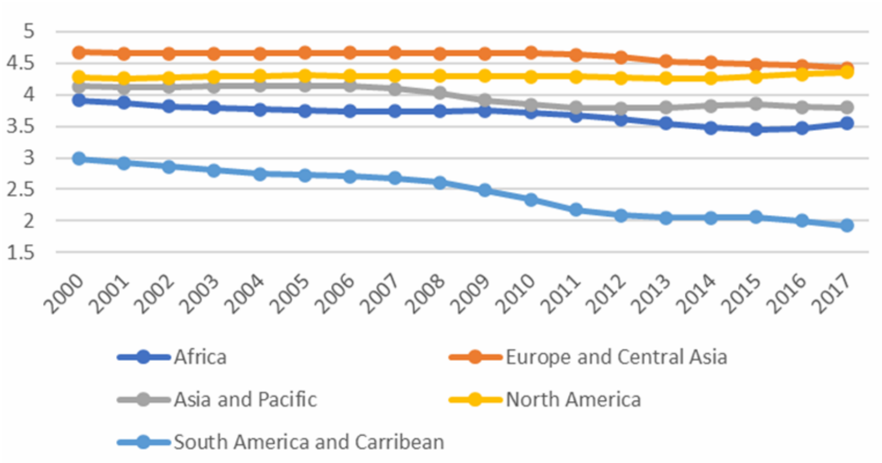
Figure 4.1.1: LPI trends for regions (2000-2017)

6 All β coefficients and possess conventional meanings

7 Zoological Society of London

8 World-Wide Fund

9 Integrated Carbon Observation System



Source: Author's calculations

The summary of the variables under study has been provided in Table 4.1.2 below.

***Table 4.1.2**: Descriptive statistics- Biodiversity Economic Growth Regression*

Region	log LPI	log HLO	log GDP	log CO
South America and Caribbean	2.456 (0.365)	6.029 (0.197)	0.888 (0.151)	0.955 (0.089)
North America	4.288 (0.024)	6.029 (0.197)	10.523 (0.155)	2.634 (0.168)
Asia and Pacific	3.969 (0.155)	6.172 (0.073)	1.378 (0.039)	3.083 (0.027)
Europe and Central Asia	4.602 (0.083)	6.091 (0.156)	1.526 (0.018)	2.171 (0.229)
Africa	3.684 (0.139)	6.177 (0.059)	1.303 (0.038)	0.255 (0.445)
Note: The table gives the mean of each region along with the standard deviations stated in the parenthesis				

Source: Author's calculations

Results And Analysis

The results obtained by running the regression is shown in Table 4.2.1 below.

***Table 4.2.1**: Regression Results - Biodiversity- Economic Growth Regression*

Variable	Estimate	Std Error	t-value
Intercept	2.771***	0.411	6.742
log GDP	1.156***	0.075	15.408
log HLO	0.057 .	0.063	0.894
log CO	-0.073*	0.037	-1.99
Factor(Region) Asia and Pacific	0.405***	0.107	3.795
Factor(Region) Europe and Central Asia	0.797***	0.077	10.396
Factor(Region) North America	9.892***	0.702	14.088
Factor(Region) South America and Caribbean	-0.705***	0.047	-15.162

Source: Author's calculations

In addition to Hausmann test for choice of estimation methods, various other tests to check for robustness were also conducted.[10] The results reflected in Table 4.2.1 indicates that a change in GDP per capita is associated with an increase in the biodiversity wellness measured by LPI. This aligns with existing literature that underscores the post-industrial phase's correlation between environmental degradation and economic growth. Notably, carbon emissions, highlighted in sources such as the Living Planet Report and studies by S. T. Hassan et al. (2019), demonstrate a substantial negative impact on LPI, affirming their statistical significance. Conversely, concerning human capital formation measured by HLO, a positive association with LPI is observed, though without high statistical significance.

10 See Appendix for associated calculations, figures and results of the tests.

Utilising Africa as the reference region, the outcomes suggest distinct variations across regions in comparison to the reference. Notably, North America, Europe, and Central Asia exhibit a positive shift towards LPI, with North America displaying a particularly noteworthy change. In contrast, South America experiences a negative change. This trend aligns with the observed LPI patterns among regions as seen in Figure 4.1.1, further substantiating the statistical significance of these relationships.

From the analysis-oriented panel data study, we have obtained the results on the various relationships within the bio-diversity economic growth nexus. But to form region-specific solutions, we must know where each region stands when it comes to all the socio-economic factors affecting this nexus. This is what is done in the next section.

V. Shared Socio-Economic Pathways Index

Based on various socio-economic factors like population, inequality, resource use, environmental quality, and economic development, different storylines or narratives about the future can be derived for each region of study. These scenarios as mentioned in Section 2 are SSP1- Sustainable Development, SSP2- Middle of the Road, SSP3- Regional Rivalry, SSP4- Inequality, and SSP5- Fossil-Fueled Development. These SSP scenarios, other than for projection studies can be transformed into the realm of biodiversity loss and economic growth (as discussed in Section 2.2,) as provided in the figure. This along with the discussion on the various factors within each SSP discussed in Table 2.1.1 will be incorporated in the preparation of an SSP Index to understand where each region stands as per these scenarios.

Data And Methodology

The paper uses secondary data available from various reliable international sources. The period of study is 2000-2017, a choice made based on the availability of data. The regions of study are: North America, South America and Caribbean, Central Asia and Europe, Asia and Pacific and Africa. The detailed description of various variables used for the study is provided in Table 5.1.1.

***Table 5.1.1**: Description of variables- SSP Index*

Notation	Type of Indicator	Proxy chosen	Source
	Biodiversity	Living Planet Index	ZSL and WWF
	Economic	GDP per capita (current US$)	World Bank
	Demographic	Population Growth (annual %)	United Nations
	Industrial Activity	Energy use per capita	(EIA)[11]
	Inequality	Poverty Gap[12]	World Bank

Source: Author

Natural logs of all the variables of interest is taken so as to normlaize it. The SSP index prepared is a weighted index. Based on the concepts discussed in the previous section, appropriate weightage will be assigned for all the variables with more weightage assigned to LPI and GDP.

The equation for weighted SSP Index is as follows

(3)

where is the SSP index for region i at a given year j.

is the weight assigned to the k-th variable.

is the value of the k-th variable for region i at year j.

Take k=1 for LPI and so on[13] and assigning weights to the variables with respect to concepts laid out in Table 2.1.1,

we have[14] , and

Substituting this in equation (3), we have

(4)

The next step is to classify these values into different SSPs. To streamline the analysis, SSP2, SSP4, and SSP5 are grouped together as a single SSP. This simplification is deemed necessary as a straightforward weighted index may not effectively categorise regions where ecological and economic indicators fall within intermediate ranges. The resulting amalgamated SSP signifies scenarios characterised by either fossil-fueled

11 Energy Information Administration(EIA)

12at $3.65 a day (2017 PPP) (%)

13 k=2 for GDP, k=3 for POP, k=4 for ENE and k=5 for PGR

14 The absolute value of the weights is taken randomly; however, the relative weightage for each variable was based on theoretical concepts behind SSPs.

development or inequality-induced trajectories. Hence the classification used to categorise the region will be: Sustainable Development (SSP1) as SSP+, Fossil-fueled Development (SSP5), Middle of the Road (SSP2) and Inequality (SSP4) clubbed as SSP0 and finally, Regional Rivalry (SSP3) as SSP-. The next step is to have an apropriate interval division of the range of the values. Standard deviation of the values is taken to determine the thresholds.

The derivation of the same is follows:

Let be the minimum Index value,

be the maximum Index value,

$\bar{x}$ be the mean, and

s be the standard deviation

Given: =2.441, = 6.402, $\bar{x}$=3.957 and s =1.25

Interval using standard deviation will be as follows

Below one standard deviation below the mean that is   for SSP-

Within one standard deviation of the mean that is for SSP0

Above one standard deviation above the mean that is   for SSP+

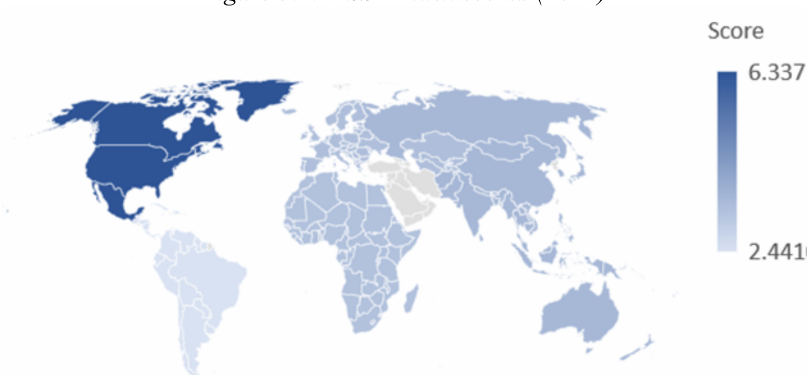
Thus, substituting values into the intervals, we have (2.441, 2.707) for SSP- , (2.707, 5.207) for SSP0 and (5.207, 6.402) for SSP+.

Results And Analysis

All regions have been classified into three distinct categories over the study period, and detailed results are available in Table B.7 in the appendix. Figure 5.2.1 illustrates the SSP scores for the year 2017. Notably, North America emerges as the sole region exhibiting indications of sustainable development, consistently maintaining an index score falling under SSP+ throughout the years. Similarly, Asia and Pacific, Africa, and Europe and Central Asia maintain a consistent categorisation within SSP0, suggesting tendencies toward fossil-fueled development, inequality-driven growth, or an intermediate position.

South America, however, demonstrates a concerning shift from SSP0 to SSP-, aligning with the downward trends in biodiversity and environmental quality highlighted in the Living Planet Report. In summary, it is evident that North America needs to sustain its commendable efforts for environmental conservation, regions categorised as SSP0 require improvements, and South America urgently needs reformed policies in this regard. The world map showing average global categorisation of SSPs over the last 5 years is depicted in Figure B.1 in the appendix.

Figure 5.2.1: SSP Index scores (2017)



Source: Author's calculations

The Asia-Pacific region stands out in terms of trends across economic development, resource use, and population-the factors for which weights were assigned for the preparation of this index. Thus, understanding and addressing ecological conditions in this region is especially vital. The next section of the paper is devoted to examining this specific focus.

VI. Biodiversity Kuznets Curve For Asia-Pacific

As mentioned above, the region of Asia-Pacific is of utmost importance. Various studies on the Environmental Kuznets Curve have been done for the same. However, one must see how the results and analysis change when we take ecological indicators rather than the usual carbon emissions. This section delves into the Kuznets relation taking both carbon emissions and LPI as the dependent variable to understand side-by-side, the associated differences (if any) in the results and subsequent approach.

Data And Methodology

The paper uses secondary data available from various reliable international sources. The period of study is 1980-2018, a choice made based on the availability of data. The region of study is Asia-Pacific. Time series analysis is being done. The reduced form econometric model is specified as follows:

[15] (5)

The detailed description of various variables used for the study is provided in Table 6.1.1

Table 6.1.1: Description of variables- Biodiversity Kuznets curve for Asia-Pacific

Notation	Type of variable	Type of Indicator	Proxy chosen	Source
LPI	Dependent	Biodiversity	Living Planet Index	ZSL and WWF
GDP	Independent	Economic	GDP per capita (current US$)	World Bank
URB	Independent(Control)	Demographic	Urban Population (% of total population)	World Bank
FDI	Independent(Control)	Trade	FDI net inflows (% of GDP)	World Bank
DEM	Independent(Control)	Institutional Quality	Democracy Index	Economist Intelligence Unit, Economist Group

Source: Author

The selection of the functional form, as outlined in equation (5), aligns with prior empirical studies conducted on the same subject with the choice being motivated not only by the objective of mitigating issues related to data stationarity but also mainly to reduce complexity and provide simple interpretation. In addition, the regression model described above was extended to incorporate the natural logarithm of per capita annual carbon dioxide emissions as the dependent variable. The aim of this extension as already mentioned was to investigate how a shift in the focus of discussion from carbon dioxide emissions to biodiversity loss indicators might influence the results and subsequent analysis.

The reason for the choice of LPI and GDP for the regression is obvious and needs no further explanation. The structure of FDI and the layout of trade provide insight into an economy's energy consumption patterns. An economy with a higher industrial export rate typically uses more energy (Mahmood, Furqan, Hassan, & Rej, 2023). This is to be reflected by the inclusion of FDI in the model. Urbanization can lead to environmental damage through increased pollution, habitat loss, resource consumption, and the expansion of infrastructure, which can degrade ecosystems and contribute to climate change (Abdallh & Abugamos, 2017). Hence the usage of urbanisation as a percent of the total population in the model is justified. Political institutions are relevant for biodiversity conservation since the national management of biodiversity can be understood as a case of decision-making in the political system. Thus, variations in the political institutions should be expected to impact the success of biodiversity conservation across countries (Rydén, Zizka, Jagers, Lindberg, & Antonelli, 2019), thereby the inclusion of the same. The summary of the variables under study has been provided in Table 6.1.2 below.

15 t represents each time period, (here year)

	log LPI	log CO2	log GDP	log urban	log FDI	log Dem

Mean	4.205	0.547	7.899	4.226	0.547	-1.251
Std Dev.	0.283	0.895	0.612	0.187	0.895	0.257

***Table 6.1.2**: Descriptive statistics - Biodiversity Kuznets curve for Asia* -Pacific

Source: Author's calculations

Results And Analysis

Following result was obtained on running the regression with log LPI as the dependent variable.[16] [17]

***Table 6.2.1**: Regression Results - Biodiversity Kuznets curve for Asia - Pacific*

Variable	Estimate	Std Error	t value
Intercept	-7.461*	3.297	-2.263
log GDP	3.367***	0.618	5.446
(log	-0.213***	0.039	-5.461
log URB	-0.539*	0.263	-2.054
log FDI	-0.041	0.030	-1.379
log DEM	-0.608***	0.146	-4.172

Residual standard error: 0.04435 on 33 dof	
R-Squared: 0.979	Adj. R-Squared: 0.976
F-statistic: 304.5	p-value: 0.000

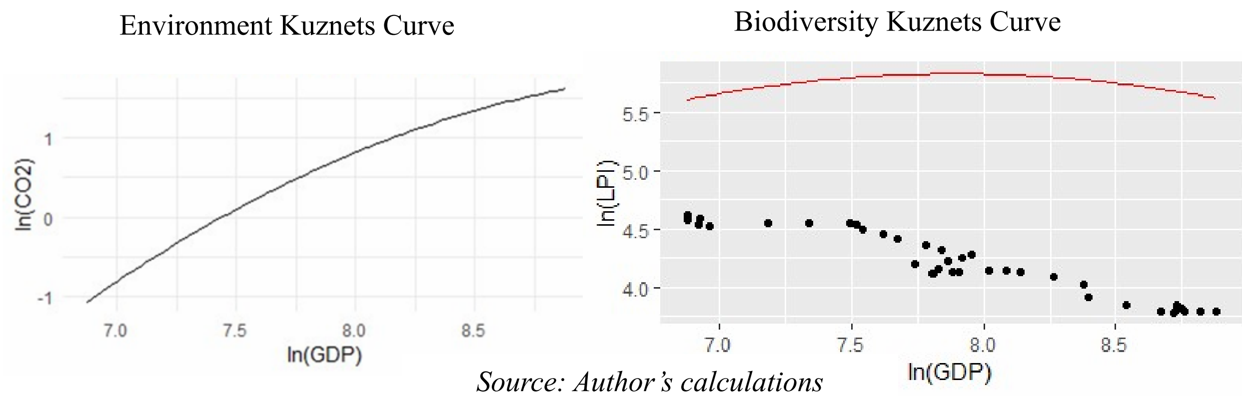
*'***':Significance level less than 0.001*
*'**': Significance level between 0.001 and 0.01*
'': Significance level between 0.01 and 0.05*
'.': Significance level between 0.05 and 0.1

Source:Author's calculations

The results derived from running the regression are quite different and interesting from those of a typical EKC with carbon emissions. With log CO as the dependent variable, the resultant EKC as shown in Figure 6.2.1 showcases a positive relationship between carbon emissions and economic growth indicating that the Asia-Pacific region is in the pre-industrial phase of development.

The results associated with LPI give alternate signs for the coefficients of log GDP (log thus portraying an inverted U kind of relationship. Though the shape is the typical one, it is to be noted that LPI and environmental degradation have inverse relationship. The results thus showcase an inverted U shape between LPI and GDP which when translated in terms of environmental degradation[18] and economic growth is a U shape. Specifically, as depicted in Figure 6.2.1, the resulting Biodiversity Kuznets Curve takes the form of a flat inverted U, which, in the context of the environmental degradation-economic growth nexus, translates to a flat U-shaped curve.

***Figure 6.2.1**: Kuznets Curve with Carbon emissions (left) and LPI(right)*

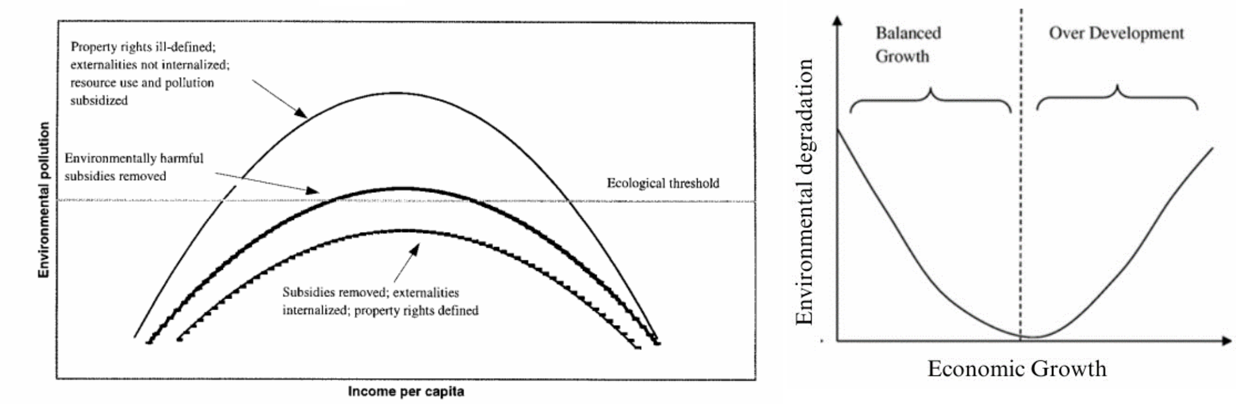


Source: Author's calculations

It means that as an economy grows, the condition of biodiversity improves (degradation decreases) reaches a turning point and further gets worse (degradation increases) as economy grows further. The flatness of the curve (see Figure 6.2.2 panel a) irrespective of the shape can be understood as a result of removal of subsidies, internalisation of externalities and proper definition of property rights (Panayotou, 1997). Anser et al. (2020) states that the U shape indicates that the ecological condition improves with economic growth upto a threshold indicating balanced growth (see Figure 6.2.2 panel b) followed by heavy industrialisation driven economic growth leading to worsening of the biodiversity.

***Figure 6.2.2**: Explanation behind flat U shape of Kuznets curve*

(a) (b)



Source: Panayotou (1997) *Source: Hassan et al. (2021)*

The growth spurt in industrialization of the Asian Tigers[19] and much of the countries in Asia-Pacific except for Japan and Australia in the late 20th century and the lagged effect of the same on growth might explain the U shaped relationship.

From the findings presented in Table 6.2.1, a noteworthy observation is the statistically significant negative impact of urbanisation on GDP. This aligns with the assertions made in the Living Planet Report 2022, indicating that biodiversity loss is exacerbated by non-sustainable urbanisation practices, which leads to the introduction of invasive species, ecosystem fragmentation, and increased unsustainable commercialisation of land. To mitigate these adverse effects, it is imperative to promote emerging concepts like green jobs and green infrastructure, coupled with effective regulations.

On the other hand, Foreign Direct Investment (FDI) appears to exert a negative impact on LPI, involving issues such as displacement and waste generation. However, it is interesting to note that the obtained result is not statistically significant. A notable and counterintuitive finding emerges regarding the existence of democracy, which is associated with a high level of statistical significance and a negative impact on the environment. Several reasons can be posited to explain this phenomenon. For instance, Gill, Hassan, and Viswanathan (2019) demonstrated how democratic systems can delay the turning point in the Kuznets relationship, ultimately leading to increased environmental costs for ASEAN nations. Importantly, it is suggested that the maturity and phase of democracy, rather than its absolute level measured by indices, determine its environmental effects. In the context of Asian countries, many are characterized by novel democracies with authoritarian influences in several republics, adding complexity to the relationship between democracy and environmental outcomes.

VII. Policy Recomendations

The primary consideration in formulating policy recommendations is to prioritise decentralised solutions. Policies and resolutions should be tailored to specific regions and sectors rather than adopting centralised approaches. Global-level goals and targets may not yield substantial impact, potentially favoring

19 The term "Asian Tigers" refers to the four countries of Hong Kong, Singapore, South Korea, and Taiwan.

already developed nations. Therefore, future discussions should focus on bloc-specific strategies. It is crucial to address the lack of a comprehensive nationwide database in many economies. Additionally, a paradigm shift is needed to treat climate change and biodiversity as interconnected issues rather than distinct challenges.

As the results suggest for the regression model, human capital formation can pave way for a green future. Integration of environment studies, cross curriculum and community projects would be a good direction. Sustainable urbanisation is challenging. But holistic (and not ornamental) green corridors[20] after comprehensive green mapping and zoning will fetch results. Integrating biodiversity impact assessments into the urban planning process to evaluate the potential effects of development on local flora and fauna, green infrastructure and transportation will make the pocess of urbanisation greener.

An issue with democratic systems is that democracies, constrained by short election cycles, often prioritize policies for immediate voter appeal, potentially sidelining long-term environmental considerations. Economic-growth pressures in democracies can lead to policies favoring industrial development and resource extraction, potentially compromising environmental conservation. This is where judicial intervention is needed so as to steer the policies towards environmental wellness.

Although many high income countries have achieved reduced environmental pressure while growing economically, alias eco-economic decoupling[21], which may be refelcted in the environmental indicators, it is to be noted that a comprehensive meta analysis of 180 studies showed that all the existing decoupling achieved are not sufficient for ecological sustainability (Vadén et al., 2020). Thus, rethinking green growth policies is essential for mitigating environmental pressures, with an emphasis on incorporating a sufficiency approach alongside increased efficiency.[22]

VIII. Limitations And Scope

The most common limitation of this paper is the limited period taken for study due to the unavailability of data. To derive unbiased robust long-term relationships, a wider period of study is to be taken. Ecological indicators like LPI are region specific. Hence, a country-level analysis is not possible. As far as the Biodiversity- Economic Growth Regression model is concerned, the study can be made more refined with cointegration tests and derivation of long-run and short-run causalities if the data supports cointegration. The current econometric result would be considered as a short-run causality or statistical relation. Also, the reduced form regression used for the Biodiversity Kuznets curve analysis has its limitations. Kijima, Nishide, and Ohyama (2010) give a comprehensive analysis on the limitations of reduced form regression models. "Reduced forms often reflect correlation rather than causality. The choice of functional forms affects the type and number of turning points." Another drawback of the most common quadratic EKC is that it is symmetric, that is, the rate at which environmental degradation changes concerning economic growth before and after the turning point is the same which is highly unlikely. Hence more efficient models like ARDL and GMM models can be employed. Tests for cointegration along with cumulative sum (CUSUM), and the CUSUMSQ (cumulative sum of squares) tests of stability on top of the ARDL estimation will give a better result.[23]

The Possibility Of Ssp- Biodiversity- Driven Growth

Long-term global scenarios have been a novel concept wherein different ecologic-economic scenarios are projected for mitigation purposes, the evolution of the same from IS92 scenarios to that of SSPs has been already discussed in Section 2 and Section 5. Otero et al. (2020) mentioned how the existing SSPs keep a target for economic growth first and then attempt to keep ecological wellness in check. Moving in the opposite direction, they introduced a separate SSP on the grounds of decoupling i.e. SSP0[24]- Beyond Economic Growth whereby high levels of biodiversity conservation can be achieved with low or negative economic growth.

Moving a step further the author would like to introduce the possibility of SSPα-Biodiversity driven growth. The scenario assumes a low cost of transition (with the help of an integrated world helping each other). Also, the scenario assumes regulations, government ownership and limits on external costs in the short run. Environmental protection can drive economic growth through three channels: better human productivity, the creation of green jobs, and increased efficiency of existing resources. This is not to be confused with SSP1-Sustainability where economic growth takes place with the environment kept in mind but with the two being relatively independent aspects. See Table 8.1.1 for more clarification on how these scenarios are similar and different at the same time.

20 An example is Stuggart Green corridors of Germany

21 In particular, it is relative decoupling where GDP grows faster than resource use and not absolute decoupling, where resource use declines in absolute terms with GDP growth. There is no empirical evidence for absolute decoupling.

22 An example of a scope for a detailed unique policy package is provided in the appendix of the paper

23 An alternate regression model (ARDL) is presented in the appendix (Table C.1)

24 Not to be confused with SSP0 in Section 5

***Table 8.1.1**: Difference between SSP1 and SSP*

Factor	SSP1 Sustainable development	SSP Biodiversity driven growth
Population Growth	Low to very low	Moderate to low
Economic Development	Low to moderate	Moderate to high
Resource Use	Shift toward renewable energy sources and efficient technologies	Diversification of eneregy sources with optimal allocation focused on low cost
Inequality	Reduced inequality with strong sense towards education and health care	Reduced inequality with strong sense towards education and health care
Environmental Sustainability	High priority on environmental conservation and protection	Environmental conservation is not seen as a trade-off but as a fundamental driver of sustainable and inclusive growth.

Source: Author

IX. Conclusion

The findings underscore the nuanced nature of biodiversity-economic growth nexus, revealing conventional outcomes in biodiversity scenarios across regions. South America's heightened biodiversity challenges and North America's relatively favorable conditions signal the need for region-specific conservation strategies. The non-conventional Biodiversity Kuznets relation for Asia calls for an in-depth analysis of the same. Moreover, the incorporation of the Shared Socioeconomic Pathways Index provides a novel dimension to the study, allowing for a more granular understanding of the diverse socioeconomic pathways and their impact on biodiversity. The categorisation based on the SSP Index further reinforces the empirical results, offering a comprehensive framework for policymakers to tailor conservation strategies according to distinct socioeconomic trajectories.

In conclusion, nurturing and preserving biodiversity not only safeguards the intricate web of life on our planet but also stands as a resilient foundation for sustained economic growth, illustrating the symbiotic relationship between a flourishing environment and a prospering economy.

Incorporation of the relative position of Shared Socioeconomic Pathways for fund devolution

A solution-oriented tool employed in the paper was the preparation of a Shared Socioeconomic Pathways Index (the concept has been used only for forecasting purposed before). Many a times ill-aimed target pool has been a fundamental issue in the implementation of fiscal consolidation schemes within a nation and fund sharing among multilateral organisations comprising of regions aimed at sustainability and regional co-operation. Crude and linear measures of sustainability for fund transfers aimed at sustainability have its own statistical limitations. The paper found out that Asia Pacific region is characterized under SSP0- The middle road scenario. Thus, incorporation of the shared Socio-Economic Pathways position of constituent parties within South Asian region as a determinant for financial consolidation gives a multidimensional view on where each region is standing hence more efficient usage of the limited fiscal space of the SAR.

South Asian Green Corridor

The panel data analysis of the study found significant association of urbanisation and biodiversity loss. Hence the paper proposed the idea of a green economic (and not ornamental) corridor. The South Asian Green Corridor Initiative aims to promote sustainability and environmental conservation through the establishment of green corridors inspired by the Stuttgart model in Germany. This policy seeks to foster regional cooperation among South Asian countries to create interconnected networks of green spaces, enhance biodiversity, mitigate climate change, and contribute to the overall well-being of communities. The interconnection can be made via land or sea considering the geographical standing of the region. However, taking the political situation of the region, the author opines and envisions that those corridors via water connecting the ports and coastline areas, the C-C-C chain (Cochin-Colombo-Chittagong) can be a moderate, firm and good start for the short run. This can foster both infrastructural development and sustainable urbanisation through regional integration.

Policies to endogenize sustainability

The paper also proposes to adopt policies that endogenizes sustainability rather than keeping a sustainability goal and moulding the economic performance according to the same (the plausibility of eco-economic decoupling is also disregarded in the paper). The paper envisions a policy model based on a new scenario SSPα- Biodiversity driven growth. This approach aligns with the Payment for Ecosystem Services (PES) concept.

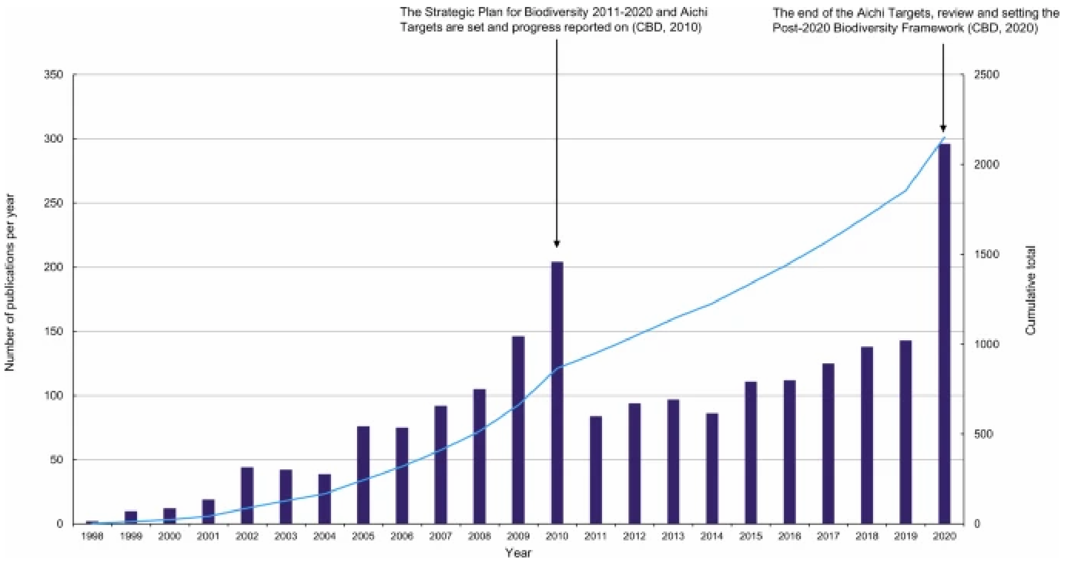
References

[1] Abdallh, A. A., And H. Abugamos. "A Semi-Parametric Panel Data Analysis On The Urbanisation- Carbon Emissions Nexus For The Mena Countries." Renewable & Sustainable Energy Reviews 78 (2017): 1350–1356. Https://Doi.Org/10.1016/J.Rser.2017.05.006.
[2] Anser, M. K., M. A. Khan, U. Awan, R. Batool, K. Zaman, M. Imran, Et Al. "The Role Of Technological Innovation In A Dynamic Model Of The Environmental Supply Chain Curve: Evidence From A Panel Of 102 Countries." Processes 8, No. 9 (2020): 1033. Https://Doi.Org/10.3390/Pr8091033.
[3] Aşıcı, A. A. "Economic Growth And Its Impact On Environment: A Panel Data Analysis." Ecological Indicators 24 (2013): 324–333. Https://Doi.Org/10.1016/J.Ecolind.2012.06.019.
[4] Cialani, C. "Economic Growth And Environmental Quality: An Econometric And A Decomposition Analysis." Management Of Environmental Quality: An International Journal 18, No. 5 (2007): 568–577. Https://Doi.Org/10.1108/14777830710778328.
[5] Gill, A. R., S. Hassan, And K. K. Viswanathan. "Is Democracy Enough To Get Early Turn Of The Environmental Kuznets Curve In Asean Countries?" Energy & Environment 30, No. 8 (2019): 1491–1505. Https://Doi.Org/10.1177/0958305x19851349.
[6] Hassan, M. S., M. Iqbal, And N. Arshed. "Distribution-Based Effects Of Disaggregated Gdp And Environmental Quality—A Case Of Quantile On Quantile Estimates." Environmental Science And Pollution Research 28, No. 22 (2021): 28081–28095. Https://Doi.Org/10.1007/S11356-021-12630-5.
[7] Hassan, S. T., M. A. Baloch, N. Mahmood, And J. Zhang. "Linking Economic Growth And Ecological Footprint Through Human Capital And Biocapacity." Sustainable Cities And Society 47 (2019): 101516. Https://Doi.Org/10.1016/J.Scs.2019.101516.
[8] Holtz Eakin, D., And T. M. Selden. "Stoking The Fires? Co2 Emissions And Economic Growth." Journal Of Public Economics 57, No. 1 (1995): 85–101. Https://Doi.Org/10.1016/0047-2727(94)01449-X.
[9] Kijima, M., K. Nishide, And A. Ohyama. "Economic Models For The Environmental Kuznets Curve: A Survey." Journal Of Economic Dynamics And Control 34, No. 7 (2010): 1187–1201. Https://Doi.Org/10.1016/J.Jedc.2010.03.010.
[10] Ledger, S., L. Mcrae, M. Böhm, R. Almond, M. Grooten, C. F. Clements, Et Al. "Past, Present, And Future Of The Living Planet Index." Biorxiv (Cold Spring Harbor Laboratory), 2022. Https://Doi.Org/10.1101/2022.06.20.496803.
[11] Li, R., T. Yang, And Q. Wang. "Does Income Inequality Reshape The Environmental Kuznets Curve (Ekc) Hypothesis? A Nonlinear Panel Data Analysis." Environmental Research 216 (2023): 114575. Https://Doi.Org/10.1016/J.Envres.2022.114575.
[12] Mahmood, H., M. Furqan, M. S. Hassan, And S. Rej. "The Environmental Kuznets Curve (Ekc) Hypothesis In China: A Review." Sustainability 15, No. 7 (2023): 6110. Https://Doi.Org/10.3390/Su15076110.
[13] Majumder, P., R. P. Berrens, And A. K. Bohara. "Is There An Environmental Kuznets Curve For The Risk Of Biodiversity Loss?" Journal Of Developing Areas 39, No. 2 (2006): 175–190. Https://Doi.Org/10.1353/Jda.2006.0008.
[14] Mitić, P., M. Kresoja, And J. Minović. "A Literature Survey Of The Environmental Kuznets Curve." Economic Analysis 52, No. 1 (2019): 109–127. Https://Doi.Org/10.28934/Ea.19.52.12.Pp109-127.
[15] Otero, I., K. N. Farrell, S. Pueyo, G. Kallis, L. Kehoe, H. Haberl, Et Al. "Biodiversity Policy Beyond Economic Growth." Conservation Letters 13, No. 4 (2020). Https://Doi.Org/10.1111/Conl.12713.
[16] Panayotou, T. "Demystifying The Environmental Kuznets Curve: Turning A Black Box Into A Policy Tool." Environment And Development Economics 2, No. 4 (1997): 465–484. Https://Doi.Org/10.1017/S1355770x97000259.
[17] Rydén, O., A. Zizka, S. C. Jagers, S. I. Lindberg, And A. Antonelli. "Linking Democracy And Biodiversity Conservation: Empirical Evidence And Research Gaps." Ambio: A Journal Of The Human Environment 49, No. 2 (2019): 419–433. Https://Doi.Org/10.1007/S13280-019-01210-0.
[18] Serpa, C., And J. Buescu. "A Fractal Analysis Of Biodiversity: The Living Planet Index." Available At Ssrn 4474491 (2023). Http://Dx.Doi.Org/10.2139/Ssrn.4474491.
[19] Ulucak, R., And F. Bilgili. "A Reinvestigation Of Ekc Model By Ecological Footprint Measurement For High, Middle And Low Income Countries." Journal Of Cleaner Production 188 (2018): 144–157. Https://Doi.Org/10.1016/J.Jclepro.2018.03.191.
[20] Vadén, T., Lähde, V., Majava, A., Järvensivu, P., Toivanen, T., Hakala, E., And Eronen, J. T. "Decoupling For Ecological Sustainability: A Categorisation And Review Of Research Literature." Environmental Science & Policy 112: 236–244. (2020) Doi:10.1016/J.Envsci.2020.06.016.
[21] World Wildlife Fund. 2022. Living Planet Report 2022 – Building A Nature-Positive Society, Edited By R.E.A. Almond, M. Grooten, And D. Juffe Bignoli. Retrieved From Https://Livingplanet.Panda.Org/En-In/.
[22] Zaman, K. "Biofuel Consumption, Biodiversity, And The Environmental Kuznets Curve: Trivariate Analysis In A Panel Of Biofuel Consuming Countries." Environmental Science And Pollution Research 24, No. 31: 24602–24610. (2017) Doi:10.1007/S11356-017-0087-Y

Appendix

Section A

Figure A.1: Number of Publications using LPI as ecological indicator



Source: Ledger et al. (2022)

Table A.1: *Summary of various scenarios used for projections*

SCENARIO	INITIATED BY	FOCUS
GLOBAL SCENARIO GROUP	Global Scenario Group	Sustainable development
IPCC-SRES	IPCC	Greenhouse gas emissions
IPCC-TAR/AR4	IPCC	Climate change, causes and impacts
UNEP GEO3/GEO4	UNEP	Global environmental change
OECD-ENVIRONMENTAL OUTLOOK	OECD	Global environmental problems
IEA-WEO	IEA	Energy
SSP	Integrated Assessment Modeling Consortium (IAMC)	Climate change and other global environmental issues.

Source: Author

Section B

Table B.1: *Hausmann Test- Biodiversity Economic Growth Regression*

: Random Effects Model would give consistent Results : Fixed Effects Model would give consistent Results			
Value	**P value**	**Result**	**Estimation Method preferred**
5.0795	0.6503	rejected	Fixed Effects

Source: Author's calculations

Table B.2*: Test for stationarity- Biodiversity Economic Growth Regression*

Source: Author's calculations

***Table B.3**: Breusch-Pagan test for heteroscedasticity- Biodiversity Economic Growth Regression*

Test statistic	*P value*	*Result*
18.065	0.0004264	*Evidence of heteroscedasticity*

Source: Author's calculations

Table B.4: Correction of heteroscedasticity- *Biodiversity Economic Growth Regression*

Variable	***Estimate***	***Robust Std Error***	***t-value***
Intercept ***	2.7707	2.53798830	6.742
log GDP ***	1.156281	0.01274207	15.4085
log HLO .	0.056678	0.41005341	0.8940
log CO *	-0.073066	0.04990075	-1.9901

Source: Author's calculations

***Table B.5**: Test for autocorrelation- Biodiversity Economic Growth Regression*

Durbin Watson Statistic	*d= 1.817* *(very near to 2, suggesting relatively little autocorrelation)*

Source: Author's calculations

***Table B.6**: Correlation Matrix for Multicollinearity- Biodiversity Economic Growth Regression*

	log LPI	**log HLO**	**log GDP**	**log CO**
log LPI	**1**			
log HLO	0.1176225	**1**		
log GDP	0.376341	-0.20949	**1**	
log CO	0.5431558	-0.02209	0.400898	**1**

Source: Author's calculations

***Table B.7**: Region-wise SSP Index Scores(2000-2017)*

Year	***Region***	***SSP Score***	***SSP category***
2000	South America and Caribbean	3.066	SSP0
2001	South America and Caribbean	3.031	SSP0
2002	South America and Caribbean	2.993	SSP0
2003	South America and Caribbean	2.962	SSP0

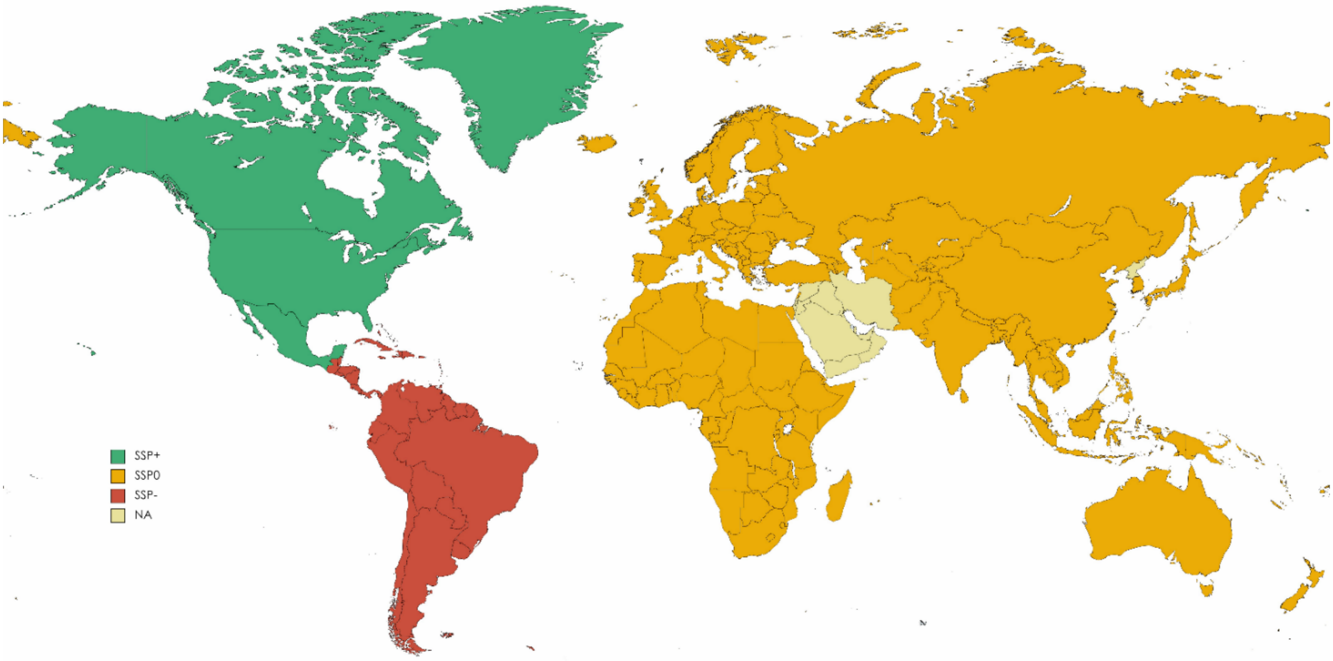
2004	South America and Caribbean	2.927	SSP0
2005	South America and Caribbean	2.913	SSP0
2006	South America and Caribbean	2.879	SSP0
2007	South America and Caribbean	2.859	SSP0
2008	South America and Caribbean	2.821	SSP0
2009	South America and Caribbean	2.755	SSP0
2010	South America and Caribbean	2.683	SSP-
2011	South America and Caribbean	2.612	SSP-
2012	South America and Caribbean	2.558	SSP-
2013	South America and Caribbean	2.519	SSP-
2014	South America and Caribbean	2.511	SSP-
2015	South America and Caribbean	2.507	SSP-
2016	South America and Caribbean	2.48	SSP-
2017	South America and Caribbean	2.441	SSP-
2000	North America	6.402	SSP+
2001	North America	6.379	SSP+
2002	North America	6.379	SSP+
2003	North America	6.372	SSP+
2004	North America	6.394	SSP+
2005	North America	6.386	SSP+
2006	North America	6.394	SSP+
2007	North America	6.397	SSP+
2008	North America	6.391	SSP+
2009	North America	6.345	SSP+
2010	North America	6.343	SSP+
2011	North America	6.317	SSP+
2012	North America	6.301	SSP+
2013	North America	6.295	SSP+
2014	North America	6.306	SSP+
2015	North America	6.314	SSP+
2016	North America	6.329	SSP+
2017	North America	6.337	SSP+
2000	Asia and Pacific	3.902	SSP0
2001	Asia and Pacific	3.892	SSP0
2002	Asia and Pacific	3.891	SSP0
2003	Asia and Pacific	3.889	SSP0
2004	Asia and Pacific	3.889	SSP0
2005	Asia and Pacific	3.874	SSP0

2006	Asia and Pacific	3.873	SSP0
2007	Asia and Pacific	3.848	SSP0
2008	Asia and Pacific	3.814	SSP0
2009	Asia and Pacific	3.759	SSP0
2010	Asia and Pacific	3.716	SSP0
2011	Asia and Pacific	3.677	SSP0
2012	Asia and Pacific	3.657	SSP0
2013	Asia and Pacific	3.643	SSP0
2014	Asia and Pacific	3.645	SSP0
2015	Asia and Pacific	3.643	SSP0
2016	Asia and Pacific	3.614	SSP0
2017	Asia and Pacific	3.59	SSP0
2000	Europe and Central Asia	3.552	SSP0
2001	Europe and Central Asia	3.551	SSP0
2002	Europe and Central Asia	3.565	SSP0
2003	Europe and Central Asia	3.6	SSP0
2004	Europe and Central Asia	3.593	SSP0
2005	Europe and Central Asia	3.592	SSP0
2006	Europe and Central Asia	3.576	SSP0
2007	Europe and Central Asia	3.57	SSP0
2008	Europe and Central Asia	3.559	SSP0
2009	Europe and Central Asia	3.541	SSP0
2010	Europe and Central Asia	3.543	SSP0
2011	Europe and Central Asia	3.472	SSP0
2012	Europe and Central Asia	3.503	SSP0
2013	Europe and Central Asia	3.481	SSP0
2014	Europe and Central Asia	3.487	SSP0
2015	Europe and Central Asia	3.465	SSP0
2016	Europe and Central Asia	3.433	SSP0
2017	Europe and Central Asia	3.402	SSP0
2000	Africa	3.498	SSP0
2001	Africa	3.482	SSP0
2002	Africa	3.456	SSP0
2003	Africa	3.446	SSP0
2004	Africa	3.436	SSP0
2005	Africa	3.421	SSP0
2006	Africa	3.41	SSP0
2007	Africa	3.407	SSP0
2008	Africa	3.41	SSP0
2009	Africa	3.408	SSP0
2010	Africa	3.392	SSP0
2011	Africa	3.367	SSP0
2012	Africa	3.341	SSP0
2013	Africa	3.314	SSP0
2014	Africa	3.29	SSP0

2015	Africa	3.282	SSP0
2016	Africa	3.29	SSP0
2017	Africa	3.32	SSP0

Source: Author's calculations

Figure B.1: *Region wise categorisation of SSPs(Average of last 5 years)*



Source: Author's calculations

Table B.8: *Various Test results- Biodiversity Kuznets Curve for Asia - Pacific*

Multi-Collinearity		Variable	log GDP	log	log URB	log FDI	log DEM
		VIF	2771.79423	2748.01966	47.12366	13.84353	27.23212
		Result	High degree of multicollinearity.				
Heteroscedasticity	Test statistic	P value	Result				
	7.2149	0.2051	No Evidence of heteroscedasticity				
Autocorrelation	Test statistic	P value	Result				
	0.53584	4.21e-11	Evidence of autocorrelation				

Source: Author's calculations

Section C

Alternate dynamic model of estimation: Biodiversity Kuznets relation of Asia-Pacific

Table C.1*: Regression results- Alternate dynamic model of estimation*

Variable	***Estimate***	***Std Error***	***t Value***
Intercept	-14.101**	4.370	-3.226
	4.421***	0.815	5.425
	-0.276***	0.051	-5.407
	-0.116	0.326	-0.355
	-0.119**	0.040	-2.979
	-0.823***	0.272	-4.892
	-0.174	0.334	-0.522
	-2.463	1.802	-1.367
	0.147	0.116	1.266
	12.952 *	5.683	2.279
	0.133**	0.045	2.951
	0.143	0.272	0.526

*'***':Significance level less than 0.001*
*'**': Significance level between 0.001 and 0.01*
'': Significance level between 0.01 and 0.05*
'.': Significance level between 0.05 and 0.1

Source: Author's calculations

Residual standard error: 0.03804 on 26 dof	
R-Squared: 0.987	*Adj. R-Squared:* 0.982
F-statistic: 179.2	*p-value: 0.00000*