Environmental Economics Report

On

The Dasgupta Review: The Economics of Biodiversity

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1 Summary

The article *Reflections on the Dasgupta Review on the Economics of Biodiversity*, authored by Ben Groom and Zachary Turk, was published in the journal *Environmental and Resource Economics* (Volume 79, Issue 1, 2021). The paper builds on the insights of the Dasgupta Review, highlighting the profound connection between biodiversity and economic systems. It emphasizes the need to integrate ecological limits into economic frameworks to ensure sustainability.

The authors outline the key problems driving biodiversity loss, including the unsustainable exploitation of natural resources, the failure of conventional economic indicators such as GDP to account for natural capital depletion, and misaligned incentives such as harmful subsidies. They introduce the concept of "Impact Inequality", which illustrates the imbalance between humanity's demand for ecosystem services and the planet's ability to regenerate them.

Through a formal model of the embedded economy, the article shows how natural capital stocks are depleted when economic activities exceed regenerative capacities. The authors advocate for shifting from GDP-centric measures of growth to the Inclusive Wealth Index (IWI), which accounts for produced, human, and natural capital.

The paper also addresses political sensitivities, such as resistance to the notion of limits to growth, and calls for structural and institutional changes to align economic policies with ecological realities. The authors emphasize the need for global cooperation, investment in ecosystem restoration, and the reform of harmful subsidies to mitigate biodiversity loss.

In conclusion, Groom and Turk highlight the critical role of biodiversity in sustaining economic and social well-being, urging immediate action to prevent irreversible ecological damage. This paper serves as a vital contribution to the discourse on sustainable economic practices and biodiversity preservation.

2 Introduction

The Dasgupta Review on the Economics of Biodiversity is a fundamental work that reveals the complex relationships between economic systems and biodiversity. It highlights the consequences of the unsustainable exploitation of natural resources and the necessity for a fundamental change in how biodiversity is integrated into economic decision-making. The report emphasizes that the economy is deeply embedded within the biosphere and that there are limits to economic growth as we know it today.

With alarming statistics—such as the loss of 20% of biodiversity over the past 500 years, including over 700 plant species and approximately 600 vertebrate species becoming extinct, and subsidies harmful to biodiversity valued at $4 to $6 trillion annually—the report calls for immediate action to reconcile economic progress with ecological limits. Global wildlife populations have also decreased by nearly 70% since 1970, and current extinction rates are 15 times faster than natural baseline rates. This document explores the problems identified by the report, the proposed solutions, and the global stakes of biodiversity conservation.

2.1 Exploration of Key Issues

1. **Major Identified Problems**
   - *Unsustainable Exploitation*: The excessive use of natural resources and ecosystem services stems from their undervaluation in economic systems.
   - *Inadequate Economic Indicators*: Tools such as GDP fail to account for the depreciation of natural capital, thus distorting the perception of economic prosperity.
   - *Inequitable Consequences*: Vulnerable regions, particularly in the Global South, suffer the most impacts despite contributing the least to biodiversity loss.
   - *Structural Imbalances*: Environmentally harmful subsidies, estimated at $4 to $6 trillion annually, exacerbate the situation.
2. **Economic and Societal Impact**
   - Biodiversity loss leads to profound economic consequences: reduced productivity, increased restoration costs, and heightened risks, particularly in relation to pandemics and climate change.
   - Critical sectors such as agriculture are becoming increasingly vulnerable.
3. **Proposed Solutions**
   - Revamping Economic Indicators: Adopt metrics like *Gross Ecosystem Product* or natural capital accounts to better reflect ecological realities.
   - Pigouvian Taxes and Elimination of Harmful Subsidies: Curb ecosystem-damaging activities by adjusting economic incentives.
   - Active and Passive Investments in Nature: Promote natural regeneration and restore habitats.
   - Changing Social Norms: Encourage more sustainable consumption and fertility balances through targeted public policies.

3 Economic Analysis and Findings

3.1 The Formal Model of the Embedded Economy

The paper builds on the *Formal Model of the Embedded Economy*, which integrates economic activities within the ecological constraints of the biosphere. This model emphasizes the interdependence of the economy and natural capital, showing how economic growth is constrained by the regenerative capacity of ecosystems. The core idea is that the economy does not operate in isolation but is embedded within the finite limits of the natural world.

3.1.1 Key Components of the Model

1. **Materials Balance Equation:**

$$\frac{dS}{dt} = G(S) - \left(\frac{Y}{\alpha_X}\right) - \left(\frac{Y}{\alpha_Z}\right)$$

   - S: Stock of natural capital (e.g., forests, fisheries, soil).
   - $G(S)$: Regeneration function of natural capital, which depends on the stock S.
   - Y: Economic output or GDP.
   - α_X: Efficiency of direct resource use in production.
   - α_Z: Efficiency of indirect resource use (e.g., supporting services provided by ecosystems).

   This equation demonstrates how economic activities can deplete natural capital beyond regenerative limits, that is, when demands exceed regeneration (dS/dt is negative), leading to the depletion of natural capital.

2. **Constraints on Technological Efficiency:** The model assumes that technological improvements (α_X and α_Z) can increase resource-use efficiency. However, these improvements are bounded, meaning that technology alone cannot disengage economic growth entirely from environmental degradation.

3. **Impact Inequality:** The Dasgupta Review puts forth the notion of "Impact Inequality," which illuminates the disparity between humanity's demand for the biosphere's maintenance and regulatory functions, and the biosphere's sustainable capacity to fulfill these demands. This inequality accentuates the excessive burden that human economic activities exert on natural ecosystems, stemming from factors such as growing population sizes, rising per capita consumption, and inefficient utilization of natural resources.

$$\frac{Ny}{\alpha} > G(S)$$

   - N: represents population size,
   - y: GDP per capita, and
   - α: the overall efficiency of resource use.

3.2 Key Findings and Economic Analysis

1. **Impact Inequality:** The article highlights the concept of Impact Inequality, which reflects the imbalance between humanity's demand for biosphere services and the capacity of the biosphere to regenerate. Global ecological footprints exceed the planet's regenerative capacity by approximately 70%, indicating that humanity is in ecological overshoot. The depletion of natural capital is unsustainable, particularly as these assets are largely nonsubstitutable, and their loss directly impacts long-term economic well being.

2. **Limits to Growth:** The economy is inherently embedded in the biosphere, which imposes limits on economic growth. Infinite growth, as envisioned by mainstream economic models, is not feasible when natural capital stocks are finite and bounded by planetary boundaries. The review emphasizes the need for a steady-state economy where growth is constrained within ecological limits.

3. **Market Failures:** Market failures, including the absence of proper pricing for biodiversity and ecosystem services, lead to the misallocation of resources. Negative externalities, such as environmental degradation, are not reflected in the costs of economic activities, resulting in overexploitation of natural resources. Corrective mechanisms, such as Pigouvian taxes and payments for ecosystem services, are proposed to internalize these externalities.

4. **Demography and Consumption:** The paper critiques the lack of attention to population dynamics and consumption patterns in global sustainability discussions. Rapid population growth in regions such as sub-Saharan Africa, combined with high consumption in affluent countries, exacerbates ecological pressures. Addressing these challenges requires investments in family planning, education, and the promotion of sustainable consumption practices.

3.3 Optimal Growth Paths in the Embedded Economy

The concept of optimal growth paths in the embedded economy integrates economic expansion with environmental constraints, ensuring sustainability. The article explores these dynamics using three key graphs that illustrate the interaction between GDP growth, biosphere constraints, population growth, technological progress, and savings rates.

3.3.1 GDP and Biosphere Paths (Fig. 1 and 2)

This figure consists of two sub-graphs that illustrate the relationship between GDP per capita and the biosphere's carrying capacity (planetary boundary L).

Top Graph: GDP per Capita vs. Planetary Boundary

Multiple curves represent different levels of the planetary boundary (L), where $L < 1$ means that natural capital stocks (S) are below sustainable limits. In all cases, economic demands on net primary production (NPP) eventually exceed supply, leading to impact inequality (demand surpasses nature's regenerative capacity).

Bottom Graph: Biosphere Mining (S) Over Time

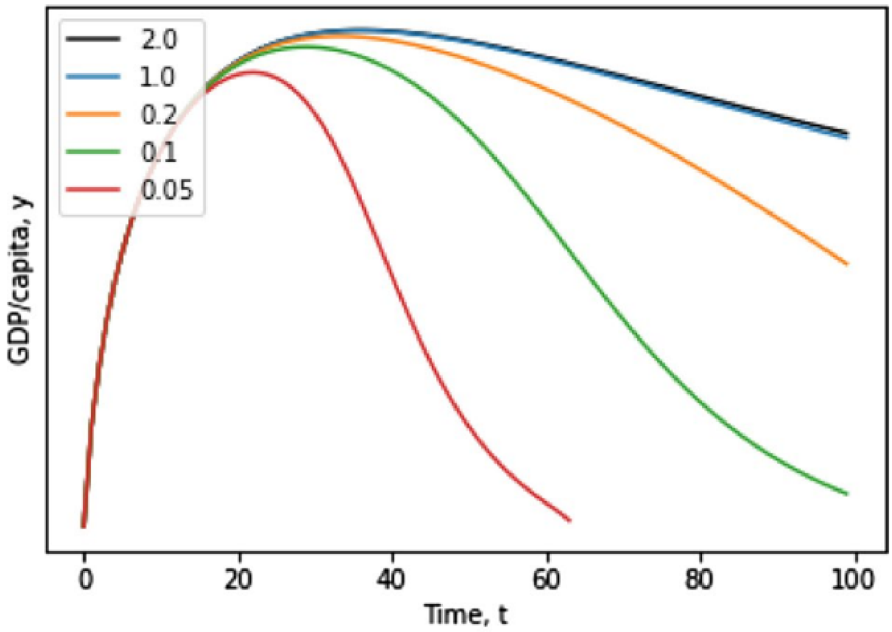

Figure 1: GDP per Capita vs. Planetary Boundary

Different growth paths show how biosphere depletion accelerates as economies grow, with different trajectories based on the planetary boundary level (L). The higher the GDP growth rate, the faster the depletion of biosphere resources, leading to a collapse scenario if unchecked.

Economic Analysis: The only sustainable path is one where economic activities remain within planetary boundaries. Reducing resource overconsumption and implementing circular economy models can mitigate biosphere degradation.

3.3.2 Growth Paths of the Embedded Economy (Fig. 3 and 4)

This figure examines optimal GDP paths under different levels of population growth and technological advancements.

Top Graph: GDP Growth with Population and Technology Variations

Multiple trajectories show how different assumptions about population growth and technological change (α_Z) influence GDP expansion. Higher population growth leads to faster resource depletion and a quicker GDP collapse. Higher technological efficiency (α_Z) can delay economic collapse but cannot prevent it indefinitely if natural capital declines.

Bottom Graph: Technological Growth and GDP Stability

Different lines show how technology grows logistically, with different starting values scaled

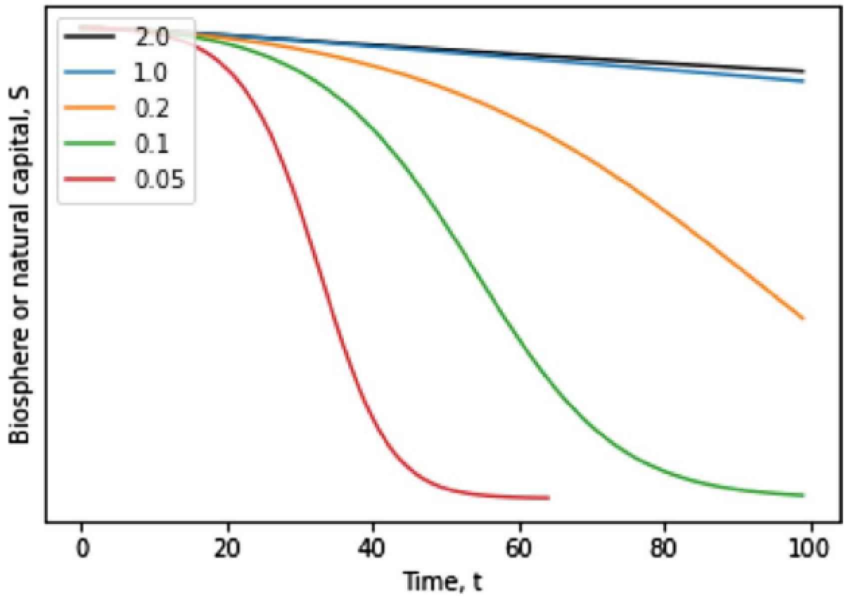

Figure 2: Biosphere Mining (S) Over Time

between 0.1x to 10x. Initial technological improvement helps sustain growth, but asymptotic limits prevent indefinite expansion. If α_Z stagnates before sustainability is achieved, economic collapse follows.

Economic Analysis: Balancing population growth and improving technology efficiently is essential to sustaining long-term economic stability. Investments in renewable energy, green innovation, and sustainable agriculture are necessary to enhance α_Z without degrading natural capital.

3.3.3 Savings Rate and Long-Term Growth (Fig. 5 and 6)

This figure investigates how savings rates influence GDP growth stability vs. collapse.

Top Graph: GDP Paths with Different Savings Rates

Different curves represent economies with varying savings rates. High savings rates lead to an earlier GDP collapse because increased capital accumulation accelerates resource depletion.

Bottom Graph: Long-Term Sustainable Growth

Lower savings rates allow for longer-term, low-level sustainable growth, reducing ecological stress. The economy stabilizes at a lower GDP per capita, but remains viable over time.

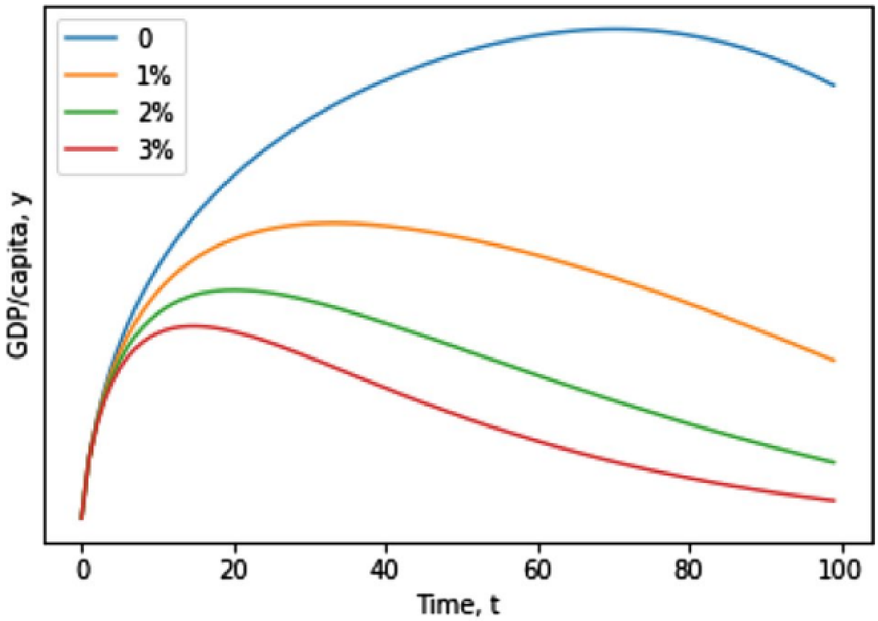

Figure 3: GDP Growth with Population and Technology Variations

3.4 Policy Implications of the Model

- **Reduce Impact Inequality:** Align global demand (Ny) with the Earth's regenerative capacity ($G(S)$) through sustainable consumption, population management, and efficiency improvements.
- **Shift to Inclusive Wealth:** Use the Inclusive Wealth Index (IWI) as a metric to guide policy, emphasizing natural capital preservation.
- **Encourage Global Cooperation:** Invest in ecosystem restoration, technological innovation, and equitable resource distribution to achieve long-term sustainability.

The *Formal Model of the Embedded Economy* provides a robust framework to understand the constraints of economic growth within planetary boundaries and offers actionable insights for sustainable development.

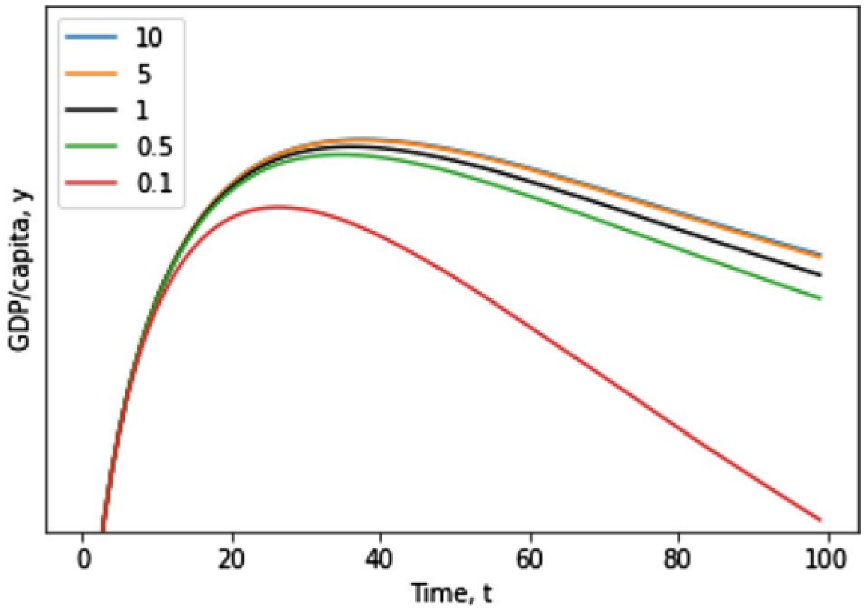

Figure 4: Technological Growth and GDP Stability

4 Political Sensitivities and the Emerging Consensus

The text addresses ideas that can spark controversy, notably the concept of limits to economic growth. This notion can be criticized by some economists who advocate for perpetual growth supported by technological transformation.

The report calls for structural, institutional, and political changes to achieve biodiversity objectives, emphasizing that consensus is necessary for the effective integration of biodiversity considerations in economic policy making.

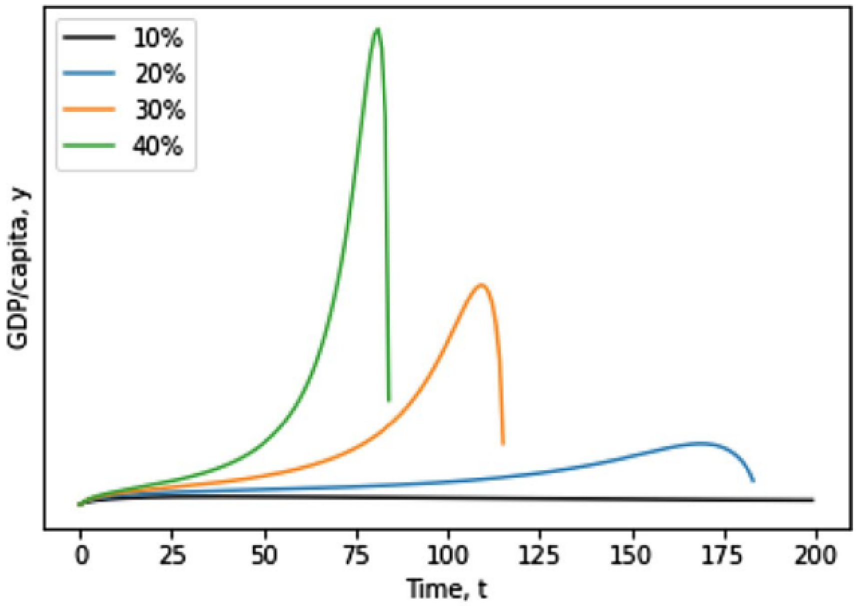

Figure 5: GDP Paths with Different Savings Rates

5 Conclusion

All our actions on Earth depend on the common good that is nature. However, our daily practices and behaviors are destroying this surrounding nature every day. In the capitalist world we live in, economic growth does not go hand in hand with environmental protection.

This report reflects on the economics of biodiversity. It highlights economic shortcomings that make the state of global biodiversity critical and proposes political solutions to reverse this trend. It establishes a link between the economy and the environment while emphasizing that economic growth has limits. The text calls for widespread awareness and urgent action to protect biodiversity, proposing a new approach that balances the economy and the environment.

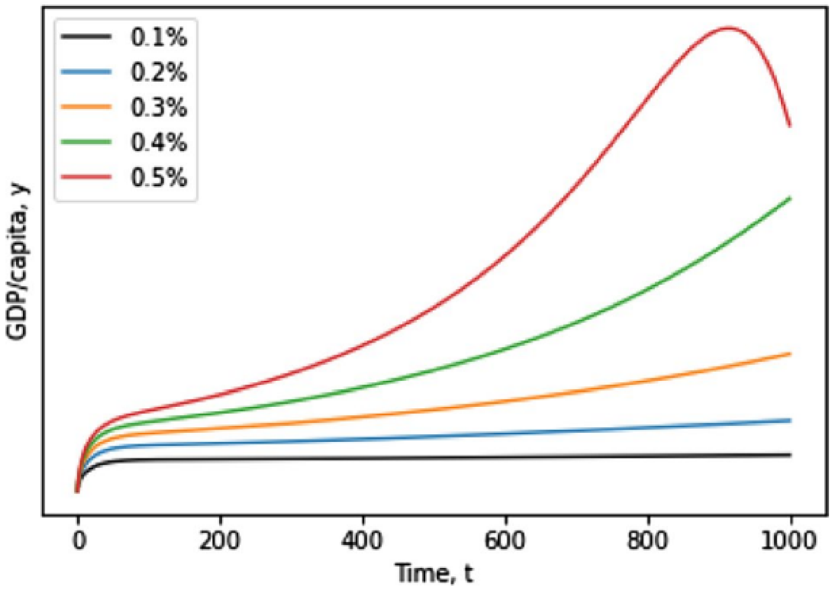

Figure 6: Long-Term Sustainable Growth

References

Groom, B., Turk, Z. (2021). Reflections on the Dasgupta Review on the Economics of Biodiversity. *Environmental and Resource Economics, 79*(1), 1–23. https://doi.org/10.1007/s10640-021-00560-2

Dasgupta, P. (2021). The Economics of Biodiversity: The Dasgupta Review. HM Treasury. Retrieved from https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S. J., Kubiszewski, I., Farber, S., Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change, 26*, 152–158. https://doi.org/10.1016/j.gloenvcha.2014.04.002

Wackernagel, M., Hanscom, L., Lin, D. (2019). Making sustainable development measurable: The Ecological Footprint framework. *Sustainability, 11*(7), 1891. https://doi.org/10.3390/su11071

OECD. (2019). Biodiversity: Finance and the Economic and Business Case for Action. OECD Publishing. https://doi.org/10.1787/a3147942-en

Managi, S., Kumar, P. (2018). *Inclusive Wealth Report 2018: Measuring Progress Towards Sustainability*. Routledge.

United Nations Environment Programme (UNEP). (2020). *Global Biodiversity Outlook 5*. Montreal: Secretariat of the Convention on Biological Diversity.